Uniform guidelines for postmortem work in India

Article *in* Journal of Forensic Medicine and Toxicology · January 2013

CITATION
1

READS
139,766

1 author:

Om P Murty
All India Institute of Medical Sciences, New Delhi 110029,India
213 PUBLICATIONS **1,166** CITATIONS

SEE PROFILE

SPECIALARTICLE

UNIFORM GUIDELINES FOR POSTMORTEM WORK IN INDIA: FACULTY DEVELOPMENT ON STANDARD OPERATIVE PROCEDURES (SOP) IN FORENSIC MEDICINE AND TOXICOLOGY

O.P. Murty[1], Anil Kohli[2], Tabin Millo[3], Mukta Rani[4] SK Verma[5], Asit K Sikary[6], Shalini Girdhar[7], SK Sharma[8] KK Banerjee[9], P Sampath Kumar[10]

ABSTRACT

Skill-based forensic training has become necessity of the world to increase the practice of evidence based forensic practice. Unfortunately, many criminals are let off due to improper reporting of findings and defective workout of cases at their first contact in the hospitals and autopsy centers. In India, there are about 358 medical colleges and their training standards are different from college to college. This varied standards have created a serious gap in the forensic knowledge and practice and reasons are conflicting resource material, teaching methods, faculty development and their proper training , unplanned training of faculty, arbitrariness in the subject coverage, pattern of assessment of trainees and trainees ,inadequate human resource, poorly equipped working stations and infrastructure available.

To combat this deficiency a step is being taken by us to train forensic professionals and organize skill-based training of faculty. This program has been termed as "Faculty Development Training Workshops on Standard Operative Procedures (SOP) for Medico-Legal Work and Modular Teaching in Forensic Medicine and Toxicology". This will help forensic practitioners in recording objective findings and observations in more transparent and authentic manner. Thus, this practice will indirectly help administrative and judicial outcomes in criminal cases where forensic evidence matters.

We started this training in May, 2012 in phase wise manner. This training and Forensic faculty development is aimed to add more skills among professionals to meet expectations of society and law. To meet these challenges, team of trained professionals are being created through these training workshops. This faculty development programme covers professional, technical, personal and social aspects of faculty growth. Such programs are likely to produce quality forensic services. This training will help them to provide quality services and teaching.

This goal will be achieved through multiple training workshops on modular teaching and Standard Operative Procedures with the help of National resource faculty pooled from different medical colleges. These workshops have Leading presentations, key-demonstrations, group discussion, hands-on exercises and sharing of experiences.

There is overall shortage of trained professionals in this region, so opportunities to obtain training at low cost in home country are created through these training workshops, conferences and sharing experiences. We intend to make these modules available to different institutions on non-commercial basis. In this document on SOP , we have tried to give brief account of all common situations faced by a general forensic practitioner in day to day practice in a simplified way. We will make efforts to make these SOP available to all practitioners in the field through all other possible means through national bodies.

Keywords: *SOP; Minimum guidelines for postmortem work; Autopsy Standards; Standard Operative Procedures for Postmortem Work; Postmortem Protocols; Autopsy Protocols; Indian forensic medicine.*

1,3,6. Additional Professor , Additional Professor, Senior Demonstrator, Department of Forensic Medicine and Toxicology, All India Institute of Medical Sciences, New Delhi 110029.

2,5,9. Reader, Professor, Professor, Department of Forensic Medicine and Toxicology, University College of Medical Sciences, Delhi 110095

4,7. Associate Professor, Assistant Professor, Department of Forensic Medicine and Toxicology, Lady Harding Medical College, New Delhi 110001.

8. Assistant Professor, Department of Forensic Medicine and Toxicology, Army College of Medical Sciences, Delhi Cantt, New Delhi

10. Professor and Head, Department of Forensic Medicine and Toxicology, Sri Ram Chandra Institute of Medical Sciences, Porur Chennai Tamil Naidu.

Correspondence:

Dr. O P Murty, Additional Professor
Department of Forensic Medicine and Toxicology
All India Institute of Medical Sciences, New Delhi 110029
Email : dropmurty@yahoo.co.in
Phone 0091 9868397155 / 91 11 26593274

INTRODUCTION

This document is based on professional experience of the team members, common knowledge literature and resources available on the subject in public domain on

internet as well as in the printed literature. All possible resources have been acknowledged as a part of fair dealing with subject, but if there is any inadvertent overlook then it may be brought to the notice of Chief Coordinator for rectification. Same material which is given/available at multiple sources is not referenced as it becomes common knowledge material.

This document is aimed to encourage development of quality services and teaching in the field of Forensic Medicine and allied branches. It has futuristic outlook and application; this is not suitable for retrospective comparison or review. This document should not be applied blindly to all centers and more so it is advisory in nature. It is not a replacement to textbooks on the subject but these suggestions are 'trigger points' to initiate working in that particular direction so that case can be worked out in best possible way.

This material is mainly meant for teaching and developing uniform guidelines, protocols for betterment of society. There is no conflict of any nature and it has no financial support and grant from any source. It is an out come of self motivation and honorary work of group members for social and scientific cause. Central or State Government of India are authorized to make any appropriate use of this in original or modified form.

This is honorary work produced by like -minded professionals and we held three workshops on quality services and teaching at AllMS for this purpose in 2012-2013 to have minimum format. These workshops were held in collaboration with faculty for LHMC, UCMS and ACMS, New Delhi. This is first version for field use and it will be reviewed periodically. All are welcome to give inputs as we are open to positive inputs and determined to improve it further.

Almost maximum possible events seen in Indian forensic medicine working have been covered. To facilitate concept of quality services, we have given photographic points so that evidence-based practice is imbibed in daily practice. We feel, our infrastructure requires overhauling and every mortuary should get minimum infrastructure and facilities. It will take few years to make these really practical. We have 358 medical colleges and most are having mortuaries as forensic is an essential subject in second phase of MBBS course. In addition we have more than 671 districts and all districts have mortuaries. In total, we will be having around 1500 mortuaries in the country. Approximately, more than 1000 mortuaries are having heavy work load. In Delhi there are nine districts and all are having mortuaries and 5 of these are attached to medical colleges. We are planning to integrate and interlink all mortuaries in future for faster communication. In this venture, we require help of all professionals who believes in doing something for the country.

In this manual, we have discussed whole forensic subject in 92 topics and every topic has bare minimum introductory information, expected external and internal findings, investigation required, common cause of death, audit sheet mentioning important check points, and in the end of topic we have mentioned 'Social Forensic Message' as a part of our social responsibility.

We admit that there may be some short coming as there is vast literature, SOP, journals and books available on the subject which may be missed by us. We request readers to fill this gap as it belongs to all of us and we have bounden moral duty to uplift our specialty. We will make all efforts to spread this information among Indian Forensic Experts through all other means so it can be brought into practice. Now, we discuss each topic in chronological order as mentioned in the index.

POSTMORTEM EXAMINATION [14,45,25,26,27]

Medico-Legal Postmortem

Autopsy is being requested by Investigative Agencies -Police under Section 174 Cr PC and /or Magistrate under section 176 Cr P C with following objectives :

1. To find out cause of death
2. To find factual, objective, medical information for law enforcing agencies and court.
3. To allow proper recovery and preservation evidence
4. To document injuries and disease
5. To determine manner of death
6. To know time of death
7. To reconstruct Crime Scene
8. To provide correlation of facts and circumstances related to the death
9. To help in identification of victim, etc.

The post mortem report is required by people of different levels like police, public, court, lawyer. All have different level of understanding. It should be concise, simple and relevant to points raised during interrogation of the particular case. The main unavoidable reason for ordering PM remains cause of death.

Postmortem is a serious exercise and has serious medical, social and legal repercussions. The result of autopsy has potential of affecting life, limb and liberty of people so utmost care should be taken to avoid injustice to any one. One should be cautious in medico-legal practice that very genesis of this work is **doubt, litigation, review and re-examination at various stages** till conclusion by court.

Waiving off Postmortem

Medico-Legal Postmortem is done on request of Police/

Magistrate/ Court. Medical Officer has no power to waive off postmortem examination. He can play a role of an advisor in such cases but final decision lies with Investigative Agency**.**

Complete or Incomplete Postmortem Procedure

As on today in India, full postmortem is carried out in medico-legal cases i.e.

1. Examination of clothing /items over the body.
2. External examination of body from head to toe front, back and sides.
3. Internal examination with opening of all the three cavities i. e Head, chest and abdomen.

There is no practice or provision of incomplete or partial or limited postmortem in medico-legal cases. Partial postmortem is practiced in clinical autopsies(Non-MLC cases).

Exchange of dead bodies

In large number of public mortuaries in India, possibility of exchange of bodies is always there. This is mainly due to disinterest of relatives to touch the bodies due to their personal beliefs and practices; bodies of similar appearance, height, sex, and look, illiteracy among handlers and relatives. More possibilities do exist in circumstances :

- Visual identification can be wrong in mutilated, burnt and decomposed bodies.
- There is strong repulsion in public in viewing decomposed and distorted faces.
- Circumstances are shocking and disturbing to next of kin so they avoid to see it.

Steps to be taken when body exchange has taken

1. Set up teams to handle specific tasks as body recovery, public handling, media handling, counseling and legal handling of case.
2. Try to recover the right bodies and handover to relatives with sympathy and apology.
3. If body has been taken to different state then help of local police is must to recover body or ashes.
4. Enquiry should be carried out to fix responsibility.
5. Steps should be taken to prevent future happening.

Suggestions

- Positive identification when requested, should be carried by DNA profiling and other records .
- Slough skin has finger prints so it should be preserved.
- Dismembered or mutilated remains may have finger prints / foot prints intact, try to preserve these.

Crime Scene Visit

Medical Officer can visit Crime Scene on request of Investigator or can put his advice to IO for visiting scene if it is going to clarify some issues in question. It should be in writing on either side. A report to this effect should be made part of inquest. Important points in each scenario are given in each type of death inside in this document.

Working Hours

Normal Working hours should be declared by every center. Usually these timings can be anywhere from sunrise to sunset in peripheral or district centers. In cities, these can be made round the clock also by intuitional/ local administration policies. There is no restriction from law side about doing postmortem beyond routine hours but it is dependent on Government Orders and other technical or human resource reasons.

Display of information

1. There should be proper display of policies, timings, contact numbers of officers/PRO for any clarification, telephone numbers of different morgues in the city, public utility numbers and information, transport policy, dressing and clothing, information about nearest cremation and burial grounds.
2. Public Information about certificates to be obtained from mortuary before taking possession of dead body by relatives.

Retention of tissues/organs

In medico-legal cases, tissues can be retained without consent and after completion of investigation these should be disposed off by proper methods of disposal as per hospital practice. The most common method of disposing in incineration of tissues and biological waste.

If tissues are retained for any purpose other than medico-legal investigation or working out of a case then proper written consent of relatives should be obtained. All organs retained for museum should be anonymised. A piece retained for purpose of future use in medical education, progress in medicine and future research for human benefit does not require consent but retention of body and full organs should not be without consent. Make the specimens non-identifiable. Such usages have inherent power to use for teaching and public benefit from the very inception of sanction of medical school. There is no limit for retention.

In borderline case, world wide principle is "Human welfare takes over individual rights" provided anonymity and protocol is maintained. Histology and histopathology microphotograph does not require consent. Name of the individual and face should not be displayed in public without consent. Consent is not required for anonymised images. Display of specimen, photographs and organs in museum for educating medical, paramedical, science and investigative students is not a public display.

Research in the mortuary

For any planned research on corpse following guidelines are recommended**:**

1. It should have approval of Ethics Committee of main Institution where research is planned (place of Principal Investigator/ PhD registration centre).
2. Approval / NOC of Ethics Committee of Local Institution where dead bodies are used.
3. Request to Mortuary for use of tissues with copies of proposal, ethics committee approval, consent form and name of researcher.
4. Proper acknowledgement of the department wherever public display/publication is there
5. Declaration that tissues will not be used for any other purpose and are meant only for research purposes.

Advisory to Police Personnel

All police personnel who bring cases for postmortem, please ensure that :

1. Request for PM is made (Form filled up)
2. Police Form 25/35 A B C, are filled up as per the requirement of case.
3. Crime Scene Assessment/CSI is attached with inquest, if feasible photographs either as prints/ on CD / in Pen drive should be submitted at the time of postmortem.
4. Death Summary, if it is hospital death should be attached.
5. IO should bring police photographer/ videographer if there is legal requirement in the case.
6. Crime Scene visit should be arranged, if desired by IO or advised by doctors in consultation and under supervision of Consultant on Duty / CMO or senior most doctor available.
7. Our working is as follows (Medical College)
   - Work In -charge for the day – Consultant on Duty / Chief Medical officer
   - Duty Officer (Immediate First responder) – Senior Resident/ Senior Medical Officer on Duty
   - Junior Resident / Junior Medical Officer on duty (Second Responder)
   - Our working recommends team approach (example- JR+SR+ Consultant)

Non-teaching centers have different set up of Sr Medical Officer, Chief Medical Officer& Specialist. Medico-legal postmortem work is a team work and it cannot be carried out as a solo act in isolation. All evidences and working steps should be managed with utmost care as this may be the last opportunity to preserve important items from the body of a victim of crime.

MINIMUM FACILITIES AT PM CENTERS

Mortuary complex is very important area in the hospital premises and all classes of society visit this area that too in groups. This area is another face of hospital so care should be taken that public or visitors carry good impression about it. This are should have general ambient surrounding, office, enquiry counter, doctors room, staff room, store, cold storage, specimen storage, clothing drying room, public viewing of deceased, dissection area for normal autopsy , dissection room for infectious and decomposed bodies, organ retrieval / evidence preservation, photographer room, observation area for students.

Audit sheet for minimum facilities required at post mortem centre

Items to be checked	**Yes**	**No**
Building infrastructure		
Autopsy room • One room at primary level • Two rooms at district level • Minimum three rooms at tertiary 1 Normal room for routine cases 2 Separate room for decomposed cases 3 One clean room for organ retrieval		
Autopsy tables Primary level (1), district level (2), medical college (4) .		
One table can be made **evidence collection table** (putting white cotton or plastic sheet) on dried and clean table		
Evidence collection Table (Clean Table without running water and may have a fixed camera) • Put a white plastic sheet over the table • Transfer the body to this table over the sheet • Collect evidence • Sampling • Swabs • Smears • Photography of original condition, with clothing and without clothing • Taking off clothing, description and examination • Examination • Personal effects collection Fold the sheet and seal it for further evaluation at Forensic Laboratory **Working Table** • Transfer the body to working		

autopsy table having running water for complete PM • Take full photography without or with cleaning and then proceed to perform • External examination in detail • Internal Examination in detail • Sampling as indicated further (SOS)		
Doctors room Office room		
Staff room		
Public cum Counselor – organ donation Room		
Police room –where they can prepare inquest papers With table, chairs		
Cold storage (30-50 spaces for bodies at college level)30 working ; 10 for unknown cases; 10 for disaster		
Water		
Electricity		
Waiting place for relatives		
Instrument sets – Two sets for every table		
Weighing Machines (Electronic -2 ; 5 kg -1 ; 10kg-1 ; 20kg -1; Body weight weighing machine 100kg		
Protective garments and masks		
Gloves (sterile , non-sterile, general)		
Gum boots (different sizes)		
Plastic bags for body		
Containers for toxicology samples/ viscera preservation		
Fridges: 4^0 C – One(Normal utility)-20^0 C– One(samples requiring deep freezing)-70^0 C– One(DNA Profiling tissue samples)		
Bath rooms for staff, doctors and toilet for public		
Changing room for doctors and staff, must in higher centers (district and college room)		
Store rooms at centers		
Clothing Drying Room In cases, where clothing are soiled with stains, these require drying before sealing so one separate place is required for this purpose. It may be open/ shaded area / or close room with minimum facilities		
• Hangers • Hanging Rods • Moveable fans • Hot blowers **Strong Room /Exhibit Room / separate Almirah** For keeping weapon / other items under custody		
Cameras digital (ordinary-two; heavy duty- one) One vehicle on demand for crime scene visit One photostat and scanning machine in higher centers		
Independent X-ray machine at college level with one borrowed radiographer from radiology department on need. X-ray facilities at district level.		
Conference room at secondary and tertiary level Mortuaries (25-50-100 people)		
Observation Room for students (25-50-100 people)		
Working arrangement policies		
Waste disposal universal policies		
Body handling policy		
SOPs for normal cases and working pattern at college and district level		

Every Postmortem Center should be provided with digital camera, videographer facilities, computers for computerized reports and all above mentioned items are helpful in providing quality services and efficient work. Facilities can be categorized on work load of the centre. At all medico-legal centers viscera preservation materials and five meter white clothing or plastic for covering body before handing over should be a part of mortuary budget. Asking material from relatives should be discouraged.

BODY HANDLING POLICY

1. All bodies should bear **identification tags** over plastic or cloth covering of the dead body; over chest, wrist or ankle areas in hospitalized or brought dead persons.
2. Body should be identified by accompanying police personnel and relatives of deceased.
3. All bodies shall be refrigerated immediately in cold storage (4^0C) with proper tag and identification number by morgue attendant/staff.
4. **Do not clean** the body or clothing after death till postmortem examination is conducted.
5. All clothing of the deceased should remain with the body and their examination should be documented in the postmortem report.
6. Clothing should not be disposed off in any case without permission of Police. All clothing should be handed over to police in cases of murder, suicide, custody, encounter and jail deaths, in sealed packet (after air drying the clothing if stained with blood or any other stains).

7. Body should not be disturbed in any way till original condition photography and after that start evidence collection, finger printing. All steps should be with permission of IO (Investigating Officer) at scene; and in the morgue autopsy surgeon when submission of inquest papers is there till then IO is custodian of body on behalf of state. Only authorized person (IO and Autopsy Surgeon) has authority to take decision in this regard.
8. In hospital admitted cases all therapeutic needles, bandages, drainage tubes etc should not be disturbed from the body if medical negligence is suspected till these findings are documented and photographed. This is also important in cases where there was surgical intervention in firearms, stab or injury or like cases.
9. X-ray should be done upon arrival in the hospital in firearm and suspected skeleton trauma cases or as mentioned earlier. These should be taken in presence of emergency personnel and IO with proper documentation. Introduction of digital X-ray has made things easier and cost effective. X-ray documentation is of great help and is very economical and should be encouraged in the interest of justice.
10. Body is handed over to Autopsy Surgeon by IO at the time of postmortem and then he receives back it from him after autopsy. Role of relatives is in identification of person, they receive body from IO.
11. Body can be preserved for a reasonable period with mutual agreement depending upon nature of case. A limit of 72 hours as mentioned in various police manual is for primitive autopsy centers where there is no electricity and storage facilities or body is highly decomposed and is not suitable for further preservation. India is a vast country and everyone cannot afford air travel to reach morgue as majority belong to low income group. It should be minimum one week to few months if refrigeration facilities are available at the centre.

Futuristic view would be to afford 24 hours evidence preservation services. Currently, it is difficult due to shortage of human resource at all centres.

DOCUMENT POLICIES

The common form of documentation in postmortem services remains written reports, diagrams, sketches, photographs and videography. Postmortem reports are usually handwritten but due to court requirement, electronic advancement and for clarity, nowadays computer typed reports are required. All doctors must get orientated to this development and should type their own reports. A general points about these reports are given below.

1. Report completion time - Immediate to 3 days in normal cases; 3 weeks when histopathology is carried out; 3 months when viscera analysis or special examination is required.
2. Handwritten or Typed reports – Typed reports should be given now within reasonable time- 2 weeks if handwritten report of death certificate has been issued immediately.
3. Printed Forms / typed reports for different type of death as mentioned in next page should be made available for clear and fast work.
4. Photocopy and scanning facilities so that soft copies of document can be retained.
5. Internal Audit policies /cross-checking – daily/weekly/ monthly.
6. External Audit Policies – periodical 5 years (Currently not practiced in India).
7. Maintenance of files, documents, photographs, etc should be clearly documented.
8. Custody of documents, procedure for keeping and releasing documents.
9. Accreditation of centre.

Postmortem reports are maintained for indefinite period. Local guidelines and policies should be drafted in consistency with recommendation of government. If storage space is a problem then these can be maintained electronic form (pdf) after a cut off point like 30 years. Postmortem center must develop common formats , some of these are mentioned in next page.

COMPUTERIZED / PRINTED FORMATS IN POSTMORTEM WORK SHOULD BE MADE AVAILABLE

1. Adult/ Geriatric Male Postmortem Format
2. Adult / Geriatric Female Postmortem Format
3. Fetus / Conception Products
4. New Born Postmortem Format
5. Children Postmortem Format
6. Adolescent Girls Postmortem Format
7. Adolescent Boys Postmortem Format
8. Dismembered Human Remains Postmortem Format
9. Charred Human Remains Postmortem Format
10. Exhumation case Postmortem Format
11. Skeleton Remains Inventory
12. Skeleton Remains Format with Sketches
13. Custody Deaths (NHRC case)
14. Body Sketch Format

15. Organ Sketches
16. Coronary and cerebral vascular sketches
17. Important Body Parts Sketches
18. Subsequent opinion format
19. Weapon examination format
20. Custody of document transfer sheet

Currently, one printed format is available and it is modified according to the nature of case. Most of the Indian states have their own format in dual language, one is local language and other is in English language. Use of different types of format will avoid inadvertent errors creped in or overlooked in typing when reports are prepared in hurry and not cross-checked. A cross-check mechanism among team members is advocated to avoid embarrassment at later stage due to inadvertent serious errors may occur during cut - paste or modification.

INQUEST PAPERS REQUIRED FOR CONDUCTING PM

1. Request for Postmortem – **Must**
2. Medico Legal Certificate if any- desirable
3. Police Form 25/35A , B or C as per need of case- **Must**
4. Seizure memo(items seized at scene)- Desirable
5. Crime Scene assessment by CSI team / Photographs – Desirable (overall scene can be provided in CD/ Pen drive). Overall scenario information is very helpful otherwise precious time of medical man and investigator is lost in speculations and confabulations.
6. Statements of public/panch/ relatives – desirable
7. Death Summary in hospital death /treatment summary – most desirable if hospitalization was there.

In fact, above mentioned documents are essentially desired but in cases when it is a holiday, document is not ready, interstate-transfer of patient, it may not be feasible to bring these in reasonable period. Autopsy should not be delayed unnecessarily.

With scanning facilities a copy of inquest papers can be retained in Pdf form with the department.

MINIMUM TRAINING OF MEDICAL PERSONNEL

1. General Medical Officer -MBBS with three months orientation course for PHC (Minimum 25 cases independently and 50 under supervision with report writing and digital photography)
2. Senior/Chief Medical Officer/Specialist - MBBS and MD in Forensic Medicine or persons having MBBS with six months to one year orientation course (100 independent PM and 200 under supervision) for District centre
3. For Tertiary centers, more experienced professional should carry out or supervise the postmortem work.

Basic Skills expected in Medical man handling Forensic cases

- Professional Skills
- Communication skills
- Workable English language skills
- Description of wounds/lesions
- X-ray interpretation of findings in forensic situations
- Handling, preservation and transportation of evidence
- Different types of format used for writing PM findings
- Sketching skills
- Photography skills (digital recording and interpretation)
- Making diagnosis (Know as how to differentiate from other probable diagnosis)

Type of Center	Postmortem Services	Clinical Forensic Services	Referral
Primary Health Centre (PHC)	Natural Death, Accidents, Asphyxia (Hanging, strangulation, smothering, drowning), fall from height, Poisoning, Murders (stab, blunt objects)	Injury, Poisoning , Sampling of any case in emergency First aid in any case	Can refer cases asphyxia, factory accidents , female/ maid servant deaths and Sexual assault if not competent with his skills.
District Health centre (DHC)	All above mentioned cases plus dowry death , custody death, encounter death, board cases, maternal deaths, firearm , murders and other deaths	Dealing with all types of MLC cases X-ray and when Histopathology services are expected	Can refer where they find it difficult to work on case due to facilities and expertise
Tertiary Centre - Medical college level and super specialty centers. **(TC)**	All above cases plus medical negligence, encounters, skeleton remains, custody deaths, maternal deaths, Second autopsy ; must have capability to handle Crime branch and CBI cases, Expert opinion	Dealing with all above cases and all referred cases with advance facilities of smear examination, X-ray, Skeleton examination etc . It must all facilities and services including subspecialties like sexual cytology ,Subsequent opinion, scene reconstruction, age estimation, DNA Profiling, Toxicology	Must have capacity to handle all types of Medico-legal work. It should organize orientation courses for Primary, District and tertiary center workers. It must develop subspecialties of forensic like forensic histopathology, skeleton examination, radiology etc.

Note- The doctor referring the case to higher center must accompany the case to gain knowledge, expertise and confidence so that in future he can independently handle such cases in his own center.

- Rendering opinion on basis of findings (deduction from findings)
- Limitations (Do's and Don'ts)

POSTMORTEM CASES DISTRIBUTION AT PRIMARY, DISTRICT AND TERTIARY CENTERS

PHOTOGRAPHY [28,76]

All mortuaries should have minimum two digital cameras. In every case following photographs are highly recommended as a routine practice in every mortuary. It is very economical and easy to take photographs. These will be part of official record of mortuary under safe custody. Postmortem documentation consists of PM report, inquest papers, photographs, sketch, diagrams and investigation reports.

Photography should be carried out in a systematic and clock-wise manner and **overall** view, **midrange** and **close-up** should be taken in every case.

Overall view – for seeing relationship of body or injury with other objects.

Mid range- relationship photograph with other immediate body part.

Close-up – for detail of injury or item in view

All photographs should be taken with and without of reference number and scale. Photographs without reference and scale are good for viewing in totality and academic purpose as these scale and number markers may hide some part.

Minimum photographs in routine cases are

1. Scene photographs if scene is visited by Medical Officer or given by Investigative Officer (print/cd/ pendrive).
2. Photograph indicating condition of body with clothing when brought.
3. Total body photographs – Front, back and both sides
4. Routine – Face, Face and trunk, groin and thigh, lower limbs from front and back of body.
5. Specific – Injury/lesion in relation to body; close-up shots.
6. Cause of death findings.

Where photographic facilities are not available then sketches are recommended for recording of injuries/lesions as these are best shown in sketches. Photographs/Sketches can be easily done by Medical officer. In addition to above, police/IO should bring his police photographers/ Videographer in murder, custody and board cases. All labels should be typed and should show case number and year like PM999/13AIIMS.

All photographs taken at the center by anyone (either doctor/ Morgue Attendant/ Photographer) will be transferred to master computer for safe custody in the designated folder with case number and year like A22/2012 or 2012- A 22 .

The doctor conducting autopsy can have one copy of photographs for academic or research or court use with understanding that these will not be used for any other purpose. These photographs should be made available to police or court only on written request as any other document in medico-legal practice. If photographs are required to be used for research purposes then a copy of project and ethical clearance should be asked from the researchers with written undertaking about proper use and not disclosing the identity of victim. Photographer can also work as record keeper for photographic documentation of the unit under supervision.

Full front view of body of with Clothing as case brought to centre	Full Back View of body with clothing	Right side of body	Left side of body	Face front view and both sides (3)	Full Front of body without clothing	Full Back of Body without clothing	Any special feature of interest
P1	P2	P3	P4	P5 P6 P7	P8	P9	P10

Simplified plan for Photography after receiving body at Post mortem Centre Minimum 27 Digital Photographs

P11	Head and Neck
P12	From shoulders , chest and abdomen with upper limbs on sides
P13	From pelvis to upper part of thighs
P14	From lower part of thighs, legs and feet dorsum
P15	Soles close-up

Stage 0 - Face photographs of victim front , right side view

P16	Head and Neck
P17	From shoulders , chest and abdomen with upper arms of sides
P18	From lower back , buttocks to upper part of thighs
P19	From lower part of thighs , legs and feet
P20	Soles close-up

of face, left side view of face by morgue attendant on duty ————————————Identity Photograph in morgue

Right hand front and back with open webs	Left hand front and back with open webs

attendant file with entry number of register in medico-legal cases.

Stage 1- Minimum 10 photographs

Stage 2- 10 Photographs

Segmental standard Photography front of body

Segmental standard photography back of body

Stage 3- Four Photographs

Close up view of hands

Stage 4- as required

Rest of the photographs should be taken as per need of the case as each is unique in nature and presentation.

1. Injuries in detail with and without scale with midrange and close-up shots as per the need of case.
2. Special /remarkable observation as per the case

Photographs required by court /police from Forensic Department

Example of certificate to be given by doctor, if photographs taken at the time of PM are required by Police / Court

Certificate

This is to certify that photographs no 1-20 recorded on CD were taken by me (or name of photographer in my presence) in the mortuary on 4/5/2013 in relation to post-mortem no A 22/2013.

Name and Designation

Photographs are required by Forensic Practitioners in:

Clinical Forensic Medicine cases

Post-mortem Cases

Histopathology

Professional Examination photographs

Academic photographs for books and journals

Scene visit or scene reconstruction

Postmortem photography –**minimum shots** – Face, front of body, back of body and both sides with and without clothing (total 10 photographs).

Digital Photographs are equally good for academic as well as legal purposes. If we examine metafile of photograph file, it gives fairly good information about background. If resources are limited and there is no availability of rolls then digital photographs are must and should not be missed.

FORMAT FOR CRIME SCENE

(Modifiable-keep it simple and handy, it can be plain paper also)

Ref. Letter……Telephonically called ……

PM…… No……
Date…….....……..Time…….....…….

Time of arrival to scene…….

Location……

Weather condition at scene ……

Temperature……Humidity level……..

Outside weather at Morgue…….

Accompanied by ……..

Investigating Officer of case ……..

Initial Information/ PCR Record…….....

Observation of surrounding

Observation of victim

- Position
- Clothing
- Wounds

Time Since Death

- Rigor Mortis

- Postmortem Staining
- Decomposition
- Core Body Temp
- Injuries visible
- Insects
- Any other important finding

Blood/stains spatter

Items found in vicinity

Sketches

Impression

Female Clothing Chart (Also take photograph)

Clothing	condition	observation	Photograph	Sketch	peculiarity	tears	Stains	Trace evidence
Neck – Duppata/ Mufflar/ Neck collar etc.								
Upper part – Kameej/, T shirt/, Kurta / Kurti / blouse/ gown etc.								
Lower part – Salwar/ Pant /half pant/ Jean/Pyjamietc.								
Undergarment – panty/ underwear/ etc.								
Winter clothing – Woolen half or full pullover/ coat / Firan/ Kurta etc.								
Full naked body								
Half naked body								

Male Clothing (Also take photograph)

Clothing	condition	observation	Photograph	Sketch	Peculiarity	tears	Stains	Trace
Neck – Mufflar/ Neck collar/ tie etc.								
Upper part – Kameej/ T shirt/, Kurta / coat etc.								
Lower part – Pant / half pant/ Jean/ Pyjami/Lungietc.								
Undergarment – underwear/ Kachha etc.								
Winter clothing – Woolen half or full pullover/ coat / Kurta etc.								
Full naked body								
Half naked body								

Any advisory to IO and his team

Camera used

Signature

Crime Scene should be visited along with Consultant / CMO on Duty

This is modifiable crime scene visit plan and details noting can be developed according to need of the case as example given below for clothing description.

Female Clothing – condition, Clothing examination, chart, Condition

Observation, Photograph, Sketch. Special mention of peculiarity, Tears/ defects

Stains, Trace material

The basic processing of any evidence is identification of evidence, immediate position of other objects, way of lifting it/ preserving it, labeling, tagging, making ready for transportation and maintaining chain of custody.

Near by items – example

Bedsheet / Bed cover/ Quilt/ Shawl/ Blanket/saree / Duppata/Belt/ String/ Rope/towel etc.....

Example - Crime scene evaluation when a person is found dead on the spot

Check Points	Yes	No	Indeterminate
Who is the person?			
When he died ?			
How he died			
Any one else involved ?			
Who located ?			
Single death or group involved			
What time incident happened?			
When last seen alive			
Is it home / road /indoor / outdoor/ guest/ farm house etc?			
Scene Photographs			
Weather –clear/ cloudy/ foggy/hot/humid/ rainy/cold			
Raining-hard/ moderate/ light/drizzling			
Vegetation			
Rigor Mortis absent/ mild/strong / well established			
Is Rigor Mortis consistent with original position?			
Postmortem Staining- absent/ anterior/ posterior/ sides/ limbs			
Is PM staining balalchable on pressure?			
Is PM staining consistent with position?			
What is colour of			
PM staining			
Natural Orifices Mouth – foam/food/saliva/ Mucus/Blood/ cloth/ other Nose – Mucus/food/ foam/ blood / others			
Ears- Bleeding/			
Anus – soiled with blood/ faeces/foreign body/ lubricant – if found naked			
Genital organs, if found naked			
Describe injuries over exposed parts			
Items and their relation with body			
Resuscitation by family/ friends/ Attendant- Pinching/ Slapping/ Shaking/ holding arms/ push on chest/ mouth to mouth breathing / chest pumping			
Medical support Team- Mouth to mouth breathing/ Face mask breathing / Intubation/ Oxygen/ Chest compression/ IV line			
Hospital – IV line / Face mask breathing/ Ambu bag pressure breathing / Intubation/ Chest cardiac message			
Clothing – clean/ soiled Blood/vomitus/ mud/grit/Cut/ hole/ tear/ wrinkling/ fresh de-stitching Buttons-loose/ detached Appropriate to weather and location any Natural disease record			
Medication, if taken, details			

Visible wounds

Blood - Location, colour, direction, size, thickness, dry/ wet, spatter, shape.

Digital Camera has replaced sketches. By chance camera is not available then sketches are best and simple way of recording findings.

Photographs of genitalia of victim should be reserved for medical viewing only. Ordinarily these should not be given to police or court until unless particularly asked. For genital areas, sketches are best form of communication.

CRIME RECONSTRUCTION

In forensic practice, there are cases of hanging, strangulation, firearms, bodies over railway tracks, fall from height, vehicular death where suspicion of homicide is there. To make things clear, investigative team ask for reconstruction of events. It is basically a team work and comprises of investigative team, forensic scientists, forensic medicine expert and computer programmer to create graphics. Team is not fixed and it can be expanded or reduced as per the case.

Reconstruction is based on the ability to make observations at the scene, the scientific ability to examine physical evidence, and the use of logical approaches to theory formulations.[161]

These request may be immediate or late depending on complexity of crime. One msut be clear of terminology of reconstruction, re-enactment, re-creation, and criminal profiling.

Reconstruction is based on the ability to make observations at the scene, the scientific ability to examine physical evidence, and the use of logical approaches to theory formulations.

Re-enactment Refers to having victim, suspect , witness or other individuals to re-enact the event that produced the crime or the physical evidence based on their knowledge of the crime.

Re-creation is to replace the necessary items or actions of the crime scene through original scene documentation.

Criminal Profiling is a process based upon the psychological and statistical analysis of the crime scene, which is used to determine the general characteristics of the most likely suspect of the crime.

Basic Training for reconstruction

This training is imparted to forensic medicine experts during their training. This is how to make reach to conclusions in such complex situations. In any case, necessary steps of reconstruction are scientific training, scientific principles, logical methodology, common sense Observation capacity, experience, interpretation, analysis and theory projection.

Sources of Information and physical facts

Sources of Information remain crime scene, physical evidence, records ,statements, witness account known data, previous events of similar nature, crime Scene photographs, sketches, postmortem report, chemical analysis report, FSL report on physical evidence – fibers, slides, DNA, bullets etc, Notes, crime scene reports, visiting of scene, orientation, any experimentation, previous reconstruction, photographs, videotapes of scene, postmortem,, measurements analysis and reconfirming hypothesis.

Limitations

Limitations of reconstruction remains limited knowledge, poor training, untrained staff, reasoning flaws, limited resources, circumstantial information is poorly collected, design of reconstruction is on wrong lines, hypothesis error, pre-determined goal, wrong comparison ,lack of personnel.

Format of reconstruction report must have request for reconstruction, need for reconstruction, team constitution , reviewed material on record, views about previously expressed view/reports, study sketches, photographs, labeling of observation in photographs, doubts or further enquiring points, missing link, tabulation of facts, observation, linking, hypothesis, re-evaluation, peer discussion with presentation. There could be more points depending on nature of case, it is absolutely flexible.

All events should be put in chronological order and important observations should be noted. A reasoned answer is appreciated more by the courts and dogmatic opinions are rated poor. It should not have subjective bias.

Opinion expression can be a comparative statement, disagreement and could be expressed as consistent, inconsistent, most probable, most likely, inconclusive, could be, cannot be determined on available material.

Medical investigation is based on:

- Observation (open eyes, attentive ears, alert mind, control tongue)
- Collection of facts (medical , circumstantial, personal body habits)
- Noting all external and internal findings in the case systematically
- Investigation as required (biochemical/ toxicology/ ballistic/DNA etc)
- Time sequencing of available facts – chronology of events
- Marshalling of facts, identify the problem and their possible answers
- Identify the main reason for –immediate cause of death and event responsible for it i.e. multiple injuries as a result of road traffic accident or like
- What are logical alternatives? could something else also lead to this
- Precedents in scientific literature, papers, case series on similar probelm

- Probabilities – weighing other important findings and ruling out others
- Record evidence – making detailed report of material of relevance
- Main findings – summary (clinco-pathological-medico-legal relationship)
- Shifting facts to drive some opinion on basis of your training and knowledge
- Conclusion/opinion to the best of your knowledge and belief

X-RAY USE IN FORENSIC PRACTICE

X-ray is advised in following conditions:

1. Firearm cases
2. Burnt remains.
3. Age estimation.
4. Foreign body within body.
5. Drug smuggling through sealed packets in body cavities, gut and genitalia.
6. Air Embolism.
7. Bony Peculiarities helpful in identification.
8. Any other condition as per need of the case and circumstances like child abuse, poly trauma, documentation of pattern of fractures, decomposed, skeletonized remains etc.
9. Sudden Death of young or middle-aged person mainly foreigner at airport or during air travel.
10. Medical negligence cases where air embolism, wrong placement of endo-tracheal tube, leaving of surgical instruments is suspected.
11. Road Traffic Accident to understand and record pattern of skeleton injuries.

Henceforth, we can consider taking minimum set of x-rays when a traumatized person (MLC) is brought to hospital in following order Head and Neck (AP and Lateral view), chest, abdomen with upper limbs on sides, pelvis and thighs, knee, lower limbs and feet. These will work as good evidences and will be helpful in locating skeleton trauma in suspicious cases or cases mentioned above. This will helpful in giving quality services and is very cost effective. As forensic cases are usually of serious nature so this much of cost can be afforded easily by state/ hospital providing these services.

BASIC RULES FOR SAMPLING/EVIDENCE COLLECTION[14,45,47]

All samples and evidences over the body should be collected legally and should be properly documented. Whenever, it is suspected that victim had contact with assailant. The following samples are must:

- Blood.
- Blood in Gauze piece (dried and preserved).
- Body hair of involved /injured part.
- Scalp hair if scuffling /injury (Hair Standard sample(20-30 hair) from different parts of scalp or injured part after plucking).
- Nail Scrapping /clipping.
- Photographs / Sketches of important findings and injuries.
- Clothing as worn by deceased (must in all cases except natural deaths).

For rest different situations, please read individual section and sample collection.

PLAN FOR POSTMORTEM EXAMINATION

Planning to do a case, depends on your preparation to face the challenge.

Every case is unique as particular individual has died first and last time. It is like a planning for good operation which has to be carried out by autopsy surgeon. We feel more comfortable and can expect good results if a case is handled in systematic manner and following suggested way for working out cases in more efficient way. In postmortem examination, we can visualize a case with following essential workouts stages.

Stage A

- Inquest papers findings
- Crime Scene Scenario assessment
- Pre- autopsy workout
- With Clothing examination
- With clothing photography

Stage B

- Examination of body after taking off clothing
- Photography after taking off clothing
- Evidence collection continues
- Cleaning of body
- Examination of injuries with dimensions
- Photography of important injuries and findings
- Sketch preparation of injuries
- Photography with orientation in relation to body and close up shots

Stage C

- Internal Examination.
- Important findings noting and photography.

Stage D

- Cause of Death
- Opinion framing in relation to queries raised by IO.

Essential documentation after above steps:

Certification

- Postmortem Certificate
- Cause of death certificate
- Postmortem report

*All possible evidences as per requirement of the case and request of IO should be collected from the body as it may be **last opportunity** to retrievet.*

SURGICAL INCISIONS FOR OPENING BODY[14,39,45]

These methods are mentioned for convenience , any deviation or modification can be done according to need by autopsy surgeon.

Head: Incision from one mastoid tip to another mastoid tip – coronal section.

Neck Opening:

A. Front of neck

a. I shaped incision from chin to suprasternal notch (most common in all except asphyxia deaths).

b. Y shaped incision – from mastoid tips to suprasternal notch (most common in asphyxia deaths).

c. T shaped incision – an incision at nipple level extended towards neck (can be carried out in asphyxia more so in traumatic asphyxia).

B. Back of neck (when indicated)

a. 'I' shaped – occipital protuberance to prominent spine process (method of choice).

b. Y shaped.

Back of trunk (when indicated)

a. Flaps method 'H' shaped by giving one incision at shoulder level from acronium to acronium and then going downwards till sacral area and then giving horizontal incision at iliac crest level.

b. 'I' shaped Incision

Incision to see buttocks (when indicated)

Incision along with gluteal folds

Incision to calf (when indicated in DVT)

Over back of leg I shaped or T shaped

Soles (when indicated)

I, T, H shaped incision

Finger or toes (when indicated)

I , T or H shaped incision

Internal organs can be dissected cavity wise or as en-bloc or organ by organ or in-situ as per the need of the case. Basic rule is that all organs should be examined as we do not practice partial autopsy in medico-legal cases. In cases of fulminant TB or HIV, dissection and exposure should be minimum so in-situ is acceptable but not in other types of cases. Flexibility in adopting evisceration technique is permissible.

PERSONAL PROTECTION AND CARE IN AUTOPSY ROOM[1,2,14,39,45]

There should be special structural design as well as special operational procedures to safe guard the health of all personnel working in the autopsy room.

The autopsy room must be properly ventilated, illuminated and clean. There should be ample running water. Air supply should be from ceiling to the floor with exhaust at the floor level to avoid turbulence. The room must be separated so that no infected material is sent out without proper disinfection. Daily cleaning and disinfection must be done., Odor control , use of ultra-violet lamps after the end of the working hours and weekly fumigation is must. It is advisable to have a separate area for high risk cases with minimal exposure and with facilities for exhaust air supply to the workers. Unauthorized entry to the autopsy room must be prevented.

Those working in autopsy room must be educated regarding the infectious hazards and preventive measures, personal safety and the safety of the others, first aid measures etc before taking up the job. They must be immunized for tetanus, tuberculosis, hepatitis B, etc. They must be subjected to periodical medical checkup including X-Rays if necessary.

Whenever working in the autopsy room caps, masks, autopsy room suit, gowns, aprons, gum boots, double gloves must be worn. Use of goggles or visors is also advisable.

While doing autopsies care must be taken to prevent unnecessary soiling of floor, walls and instruments and splashing of blood, body fluids and water. Due care must be taken to prevent injuries to self and others.

First aid facilities must be available in case any accidental injury happens. In case of accidental cuts and pricks, contamination must be avoided and bleeding must be encouraged with washing under running water. Splashing to eyes must be dealt by washing with cold running water immediately. Any accident happened in the

autopsy room must be reported to the infection control section and the victim must be follow up. Special screening of the victim must be done periodically.

The instruments must be kept clean and in good working condition. All instruments must be washed with disinfectant after use. Flakes of dried blood must be removed with brushes.

Ideally the instruments must be autoclaved. But instruments kept in Lysol (1:40) for 2 hours can be considered safe to use. Biological and other materials must be disinfected and disposed in a proper way to prevent them from being a public health hazard.

Routine Cleaning Agents in Mortuary

Phenolic substances 2% solution	Active against most bacteria including tuberculosis Not effective against viruses	Floor , drains, walls , instruments, boots , clothing , tables
Hypochlorites 1-10% solutions depending on infective material	Effective against viruses Also effective against HIV and Hepatitis	Blood spillage Infective cases HIV and hepatitis Corrosive to instruments
Savlon Solution	Clean instruments with liquid soap and wash in running water and keep in savlon solution	Instruments All other used material for dissection
Gluteraldehye 2%	Highly infective cases	HIV , Hepatitis , flues etc.
Fumigation	It can done on weekly basis	Helps in controls insect , mosquitoes , flies
Mosquitoes repellant spray	Once in week	Helps in controlling mosquitoes and flies

Infection can be acquired in mortuary by inhalation, cuts, percutaneous inoculation, contamination of mucus surfaces of orifices, ingestions and infective material over skin surface**.** There are four varieties of pathogens divided on basis of their virulence, transmission power, preventive and curative response. For details any textbook or site of Royal College of Pathologist may be consulted. Good hygiene, follow up of universal guidelines, had washing, using face masks, gloves, disposable gowns can avoid infection in majority cases. In India tuberculosis, hepatitis and meningitis remain a threat.

Where possible pre-autopsy screening of HBV, HCV and HIV can be done in postmortem blood and results are quite reliable.

Steps for cleaning autopsy instruments

1. Keep all instrument in a steel perforated tray with the help of forcep.
2. Wash under running water and remove all biological material.
3. Put in soap solution and clean with ordinary brush with touching.
4. Wash in running water again.
5. Put instruments in cidex solution tray.

AUDIT SHEET

FACILITY/PROCEDURE	YES	NO
Ventilation, lighting, running water adequate?		
Workers aware of risks?		
Immunization of workers complete?		
Personal Protection Devices available?		
First aid facilities available?		
Accident reporting and follow up planned?		
Proper disposal of biological material arranged?		
Weekly Mortuary cleaning		

Basic **minimum** requirements – Plastic apron , head cap , gum boots, gloves and face mask, liquid soap, running water are must item in any autopsy room.

Social Forensic Message

Tuberculosis is common disease among pathologists and if you are careless then HIV and hepatitis can be in bonus.

SAMPLING AND SPECIMEN PRESERVATION[1,2,3,14,39,45]

SPECIMEN FOR TOXICOLOGY

Total body **weight** and **length** of the body should be considered before interpretation of the concentration of

substances. Therefore weight and height have to be recorded. Personal details (age, sex, occupation, brief history of illness & symptoms), postmortem interval, date and time of sampling, nature of any preservative used, condition of storage, poisons suspected have to be provided.

In cases of suspected foul play, strict chain of custody must be maintained to avoid any challenge in court room by defense lawyers in the form of proper labeling, proper sealing, safe storage, proper handing over and receiving. Mortuary office contact number should be provided to the laboratory for any further clarification on request form.

Any risk such as HIV, Hepatitis must be conveyed to all those handling samples. For toxicology analysis fresh samples are best wherever facilities are available. In case, there is expected delay of more than one day after collection and immediate refrigeration then Sodium Fluoride and Potassium Oxalate should be added to blood to retard putrefaction changes.

It is a good practice to preserve **two set** of liquid samples, one with preservative and another plain without any additive (in cold storage). There is no harm to preserve little extra quantity in sensitive cases (murder, dowry death, death in custody, foreigner, sex- murder, negligence, public dignitary etc)

Blood

Peripheral Vein blood (Femoral, Jugular, Sub-clavian) is preferred. Blood can be syringed out or can be taken after opening the veins. Keep the sample in a screw cap bottle containing NaF (Sodium Fluoride) and Potassium Oxalate. Vacutainers can also be used as these are already sealed.

100mg of NaF and 30 mg of Potassium Oxalate to 10ml of blood should be added. Roughly it is one pinch of these salts.

For toxicology, basically serum is utilized for toxicological screening and cellular sediments are discarded. It is always better that collect 50/100ml in one tube, centrifuge it and preserve upper part and discard bottom part. This can save large amount of fluid for wider screening.

This is suitable for Ethanol, Methanol, Cocaine, other abusive drugs, CN, CO and other Poisons. In the case of Cocaine, plastic bottles should be avoided. In cases of CN and CO airtight cap should be used. In cases of volatile poisons a thin layer of liquid paraffin is advised over the top of collected fluid to avoid evaporation.

For insulin and Cortisol levels- Serum should be separated immediately.

For Glycosylated Hemoglobin- Heparinisation of the sample to be done.

Urine

Catheter samples or Supra pubic puncture samples can be collected from urinary bladder.

100mg sodium fluoride for every 10 ml of urine is recommended. 30 ml in NaF or thymol is desirable quantity.

A pinch of Phenyl curate and little Thymol should also be added in urine samples as a preservative.

Bile

It is suitable for Morphine and other Opioids, Drugs like Chlorpromazine. It can be obtained after opening of gall bladder or full gall bladder with adjoining tissues can be kept for analysis. Bile may be extracted in 20 ml wide mouth bottle as it is thick fluid and normal preservative NaF can be added if there is delay in chemical analysis.

Vitreous

It should be aspirated into a syringe with a wide bore needle especially when blood is not available due to decomposition.

This is mainly used for sugar, electrolytes, urea and creatinine estimation. But it can also be used for toxicological analysis also. Aspiration can be done with syringe of 5ml with needle size of gauze 15/16/17. A portion of the vitreous should be preserved with NaF on similar way as for blood samples. After taking sample , fill equal amount of water or saline so that eye can retain its original shape and contour.

Cerebrospinal Fluid

This is mainly used for microbiology and virology.

Lumbar puncture, cisternal puncture before dissecting the body or from the space in front of Pons after the opening of skull but before removing the brain or from the lateral ventricles can be performed to collect CSF.

NaF should be added for toxicological analysis. Aseptic procedure should be followed in bacteriological studies. (See below).

Stomach Contents

Open via greater curvature and collected in to wide mouth jar without contamination. Container with screw cap lid is used.

Preservative is added, if there is delay before sending to Laboratory.

This is used when ingestion of poisons or drug over dose is suspected.

Loops of small bowel

Both ends of small intestine of about 10- 30cms is tied and put into large containers. It is routinely preserved in poisoning cases. Intestine contents and intestine walls should be examined in obstruction typhoid, tuberculosis or as indicated in the case.

Loops of large bowel

These are not taken routinely. Chemical analysis is indicated when heavy metal poisoning is suspected. (Arsenic,

Antimony, etc).

Other tissues

Usually these are taken when there is no way to collect fluids due to decomposition, charring or advanced mutilation.

Liver-50-100g away from portal tract with total weight of liver.

Brain, Spleen 50-100g

Muscle -50-100g

Muscle, Skin tissue, Puncture Marks in injection cases (Insulin, Morphine, Heroine, Cocaine, other drugs or toxins) without preservatives is preferred if it is to be examined immediately. Otherwise preservatives should be added. Normal preservative in majority of cases remain saturated solution of common salt (Sodium Chloride).

In cases of insect or snake bites, fang marks should be preserved for histopathology and immunology studies. FSL does not do these tests, hence local arrangements with microbiology department has to be made. One control sample of skin one cm^2 size should be kept . In cases of heavy metal poisoning scalp or pubic hair and bone piece can be subjected for analysis.

Commonly saturated solution of NaCl, alcohol, thymol remains the common preservative. These tissues are usually preserved when body is brought in advanced stage of decomposition until unless specifically required.

Specimens For Biochemistry

If Postmortem blood is unsuitable

Vitreous humour should be taken with wide bore needle in to a syringe. Eye should be filled with water thereafter for cosmetic reasons.

Potassium and other electrolytes, sugar (Glucose), urea and creatinine can be done using vitreous.

Cerebrospinal fluid can also be used for this purpose.

Specimen For Microbiology

Smears

Smears can be prepared using pus collections/mucus/ other tissues and body fluids. After fixation in alcohol, Gram Staining, Ziehl Neelsen, special fungal staining can be done as indicated to identify organisms.

Blood Cultures

Blood Samples can be taken from large veins after cleaning the Skin with antiseptics, with gloved hands using a sterile needle and a syringe. As a double precaution, needle is heated in flame of spirit lamp (to destroy the germs derived from the nearby areas), blood sample is introduced into Culture Bottles. Sent immediately to laboratory or stored at 4°C.

Alternatively blood can be taken from heart after searing the surface with a hot Iron Blade with sterile syringe and needle. But contamination is high with gut flora.

This sometime will not give positive cultures due to high antibiotic levels prior to death.

Swabs from valve vegetations can be collected under sterile condition.

Spleen Culture

Sear the surface with hot blade, make a hole with a sterile blade and plunge a sterile swab into the organ and put into culture bottle. It is indicated in cases of transfusion death, infections. There is no need in routine cases.

Cerebrospinal Fluid

By Lumber puncture, cisternal puncture, from ventricles (after opening the skull) under sterile conditions and introducing into culture bottles.

Swabs

From nose, pharynx, trachea, bronchi, or deep air ways can be collected under sterile conditions in to Viral or Bacterial culture bottles as in suspected Avian Flu cases.

Specimen For Histology

Routine tissues

Liver, Spleen, Kidney, Heart, Lung, Thyroid, Adrenals, Pancreas, Muscle, Brain or any other tissue as indicated. In some cases more than one sample is taken as indicated. 2 cm size sample is best as formalin can penetrate to this level so causes effective preservation. Standard Size is 20mm x 12mm x 5mm in to a container with 10% buffered formalin. Ideally, tissue: formalin volume should be 1:6 or at least level of formalin should be well above tissue piece.

The buffered formalin is preferred for better preservation, reduce formalin pigmentation, reduce antigenic determinants and to reduce degradation of DNA / RNA material. Tissue fixation is done to prevent autolysis, retard degradation of tissues and to maintain original appearance of tissue.

Formalin pigment may appear as black birefringent shiny deposits in tissue sections. These black deposits are prominent in blood rich areas. These can be avoided by buffered formalin. This pigment is acid formalin hematin pigment, and it is formed by reaction of formic acid in unbuffered formalin with heam part of haemoglobin.

To describe any lesion should include **shape, capsule, size, colour, consistency, relationship with near by structures, extent of lesion**. If multiple lesions are there then overall description and important findings.

Description of shape: Circular, convex, concave, cuboidal, cylindrical, ellipitical, fusiform, fimbriated, leaf like , flowery, angulated, rectangular, oval etc.

Margins of tissue: Bulging, circumscribed, cystic, tooth like (dentate), encapsulated, fragmented, septated, smooth,wavry, wrinkled, angulated tortuous etc.

Colour of tissue: White, pale, black, bluish, brown, dark-brown, light yellow, yellow, green, grey, greyish,orange, purple, red, tan coloured, etc.

Consistency of tissue: Firm , friable, soft, fleshy, caseous, cystic, bony-hard, mucoid, rubbery, gritty, pliable, soft, spongy, thin, thick etc.

Appearance: Gelatinous, glistening, shiny, slimy, moist, granular, honeycombed, broken-up. Macerated, multinodular, multicystic, transparent, opaque, velvet etc.

Decalcification of hard tissues/ vessels

Reason - Hard tissues damage microtome

1. First preserve tissue in formalin for 2 days
2. Decalcification is done in Nitric Acid - few hours under monitoring

Staining in routine and specific situations in forensic practice:

Routine stain in histopathology and cytology – Haematoxlin and Eosin

Aminiotic fluid: Alcian green – phloxine tartrazine ; keratin stains redwith Phloxine tartrazine while mucin is stained green with Alcian green.

Amyloid: Congo –red for larger areas and Crystal violet for small amyloid globules

Calcium: Alizarin red S

Collagen tissues: Van Gieson (red) and Masson Trichrome (green)

Elastic fibres in **blood vessels**: Elastic Van Gieson (EVG) – Black

Fat or lipids: Oil-red (red) and Sudan Black (black)

Fibrin: Martius scarlet blue (red)

Glycogen/glycoprotein/mucin- Periodic-acid Schiff (PAS) : red

Hemosiderin – Perl's stain – blue

Muscles- Masson Trichrome (red)

For immediate results Frozen Sections can be taken using Liquid Nitrogen and Microtome and stained with H&E.

If such facilities are not available, smears can be prepared on slides and stained with Leishman or Giemsa.

BONE MARROW: Smears should be taken into albumin and glycerin media and fixed with methanol and stained with Giemsa.

Chromosomal Studies

Facia lata sample is grounded and suspended in serum containing antibiotics. Then growth is inhibited with Colchicine and chromosomal studies done.

For DNA Profiling

1. Blood 10ml in EDTA bottle (purple bottle)
2. Blood on bloating paper, dried and preserved
3. Blood stains on gauze piece after rubbing on them over organ / muscles/ fetal skin. Dry the gauze piece and preserve it in paper envelope.
4. Tissue samples (ideally liver, heart, kidney, muscles or fresh soft tissue of any solid organ) in plastic tubes/ packets frozen at (-20 degree centigrade). Solid organ 50-100 grams are sufficient for DNA profiling.
5. Dental Pulp, Hair root in decomposed bodies
6. Skin
7. Bones – usually sternum, clavicle or long bones. Preserve these bones without any additive if there is no delay in examination. Otherwise, remove wetness from extracted bones and preserve these in paper and keep in fridge. If these are to be preserved for longer time then absolute alcohol or 70% alcohol or saturated saline remains ideal preservative. Never preserve tissues and bones in formaldehyde as it denatures protein and make DNA extraction very difficult.

Blood is the best sample for DNA profiling. In decomposed cases when blood is not an option then teeth are next best samples. For safer practice long bones, ribs, vertebrae may be cut and frozen. For cutting bone, always use **fresh or properly cleaned blade**. Blades may cleaned with Sodium hypochlorite or commonly used with bleach or soap solution at the centre. Bone cutter used for skull opening on routine basis should be avoided if there is alternative otherwise follow above suggestion of cleaning blasé and base of saw.

Never Use Formalin to Preserve if DNA Profiling is Requested

Sample in sexual offences

For semen stains preservation either in gauze piece or plain cotton - wool swabs must be used. Samples should be **dried** before packing, otherwise, these will get decomposed.

Swabbing from following sites is done to obtain stains, focus remains on DNA profiling and semen traces.

- Around the vaginal orifice and the interior of vulval labia
- Mid vagina
- The upper vagina, posterior fornix, cervix and the using a speculum if permitted
- If more fluid is seen in high vagina pipette can be used to collect these

- From margin and interior of anus as indicated
- If dried semen is suspected on clothing, body or pubic hair cotton swabs moistened with saline can be used.
- Slides should be prepared for examination of spermatozoa (wet smear examination at spot).
- Swabs can be used for examination of prostatic acid phosphates and Prostate Specific Antigen.
- Swabs can be preserved in deep freezer for DNA studies
- Pubic hair combing samples can be retained for comparison with suspected hair found with suspects
- Any matted pubic hair with semen for sperms, semen and DNA profiling
- Nail clippings or scraping can be preserved for comparison and analysis.(DNA, Traces)
- Bite mark swab for DNA profiling
- Bite marks photographs with scale for identification of accused
- Teeth photographs of victim for comparison if accused has some bites
- Swabs should also be preserved for oil/lubricant present over condoms (to establish penetration)
- Any visible lubricant or cream used (for penetration)

Sample selection and direction to laboratory about expectation from sample

Sample	Expectation	Care during sampling	Duration
Vaginal swabs – Four **FSL** samples 1.Outer part labia majora 2. Opening 3. Poster part of vaigna 4. Cervix ---------- **Hospital** Samples 1.Culture swab	Semen, saliva, blood, infective material Ask for DNA profiling of accused P30 Prostatic Antigen Acid Phosphatases ---------- Culture for infective material	Always dry the swab before preserving	One week
Vaginal smears -4 smears From Outer part From inside ---------- One wet smear …… Vaginal wash with normal saline(after above sampling only)	Presence of spermatozoa Blood if injury Vaginal cells …….. For hanging drop preparation Hanging drop preparation	Air dry smear Fix in 70% or absolute alcohol It is examined by examining doctor for motile spermatozoa and % of motile sperms	
Forensic ……	**Samples Continues……..**		
Oral swabs	Saliva ABO Grouping DNA Profiling	Air dry sample	Three days
Blood in Gauze piece	For reference standard blood of female	Dry the blood soaked gauze	Any time
Breast swab	Saliva DNA profiling	Dry the swab	72 hours
Bite mark swab	Saliva DNA Profiling	Dry sample	72 hours
Bite mark preservation	Cast making for comparison Photography with scale on sides of bite injury	Always take multiple shots of overall , mid range and close-up	Any time till it is visible
Matted Pubic hair	1.Cut the bunch with scissor 2. Prepare smear	Dry and keep in paper envelope Sperms	In not bathed , any time
Pubic hair combing	For foreign hair(assailant) Hair for standard comparison if female hair is found in male	Keep in white paper or can be kept in small glass bottle, Seal for FSL	72 hours
Injuries over body	Proper description of all injuries and take multiple shots of overall, mid range and close-up	Photographs should be with and without scale. Genital injuries should be represented by sketch for court and police purpose.	Any time till these can be recognized visually or artificial UV light
Nail scrubbing or clipping	For foreign skin, blood, hair and fibres	Keep from both hands separately	One week
Urine	For date rape drugs	GHB, Benzodiazepine or like	One week

Always dry samples before preserving for Forensic Science Laboratory

Red tube (plain tube)	
• *Serology – Hepatitis, HIV, Dengue Full Blood Count*	• Bone Marrow • *DNA studies*
• *Endocrine-Cortisol*	• *Glycosylated Hemoglobin*
• *Liver functions*	• Hemoglobincontent, Hemoglobinopathies
• *Renal function*	
• *Electrolytes*	
Yellow Tube (SST II Bottle)	**Gray Tubes (Fluoride)**
• Blood Urea	• Common drugs (opiod, heroin, cocaine, amphetamines etc)
• Serum creatinine	
• Serum Electrolytes	• Blood sugar • Blood Alcohol

Quantity Requirement with modern techniques

Blood- 10-50ml

Urine- 25-50ml or as available

Vomitus - 100 grams or as avialable

Liver, Kidney, Spleen- 100g each

Vitreous- 2.5-5 ml or as available

Bile –as available

Muscle- 100g

Solid organs- 100 grams

Old practice is in place to preserve maximum quantity, please consult requirement of laboratories where samples are going to be analyzed in your area. Ask laboratory for any clarification. Number of FSL laboratory should be available.

Old practice in place is, one jar contains liver 500g, spleen half and kidney half from both; another jar contain stomach, stomach contents and small intestine first 30 cm ; all are preserved in saturated solution of Sodium Chloride/ common salt. One bottle 100ml blood with added half little spoon of Sodium fluoride and Potassium oxalate. Discuss with your laboratory for guidelines on the issue.

There are limited laboratories and their workload is very high so only in genuine cases where it is mandatory or specific request to get the toxicology results, one should send samples. It should not be a time buying tactic. Good preservation of samples may yield good result not casually packed material without preservative.

List of sampling which should be performed by autopsy surgeon are:

1. Femoral blood collection
2. Vitreous humor aspiration
3. CSF aspiration
4. Synovial fluid collection from knee, elbow and ankle
5. Stomach content collection
6. Blood collection from heart
7. Collection of material for culture blood, pus, cavity fluids
8. Blood soaked dried gauze piece
9. Smear preparation
10. Swabs from different parts in sexual assault, bite marks, foreign material etc
11. Material for DNA profiling - Blood, bone, muscles, teeth
12. Tooth extraction, preservation
13. Long bones cutting and preservation
14. Skin rubbing from fetal skin
15. Nail scrapping
16. Nail clipping
17. Pubic hair combing
18. Pubic hair collection (pulling and cutting)
19. Head hair combing
20. Head hair collection (pulling and cutting)
21. Botanical material from body surface and clothing
22. Soot and inflammable material from scalp hair, clothing, ear and nostril
23. Blood smear preparation
24. Sphenoid sinus fluid aspiration
25. Swabs from body surfaces
26. Histology sampling from different organs
27. Sampling for diatoms in drowning cases
28. Swabs in firearm cases for gunpowder residue, paraffin cast preparation
29. Tissue collection, blood collection, stain collection at site/ from vehicle etc.
30. Faulty procedures and their consequences - full exposure, lab visit and demonstrations

A full orientation course should be given to doctors before they start forensic autopsy work. A list of some samples is given for convenience of users.

Some common samples collection in Forensic Practice

Method of collection	Spot identification and collection photograph	Precaution
1. Femoral Blood Collection steps 1. Keep 10-50 ml syringe with wide bore needle ready for withdrawing blood from femoral vessels 2. Expose inguinal region 3. Clean area with salvon or spirit, wait till evaporation 4. Locate femoral artery -it is located midway between superior anterior iliac spine and pubic tubercle 5. Artery is approached perpendicularly, almost at 90^0, it gives little resistance before puncture 6. If femoral is approached, it 1 cm medial to femoral artery 7. Aspirate blood 10ml to 50 ml as per requirement 8. Transfer to container 9. Put Sodium Fluoride and Potassium Oxalate (one pinch per 10ml or 1% of total weight like 1 gram in 100 ml blood) 10. Seal bottle with identification and case information 11. Prepare for transportation and handing over to IO		
2.Vitreous Collection 1. Take 5m syringe with needle 15/17 gauze 2. Retract eyelid 3. Puncture eye ball on lateral part at oblique angle (60^0) 4. Aspirate vitreous (1.5 to 3ml) 5. Transfer to bottle/ yellow top tube 6. Add Sodium Fluoride 7. Seal 8. Label 9. Take plain tape water and inject into eyeball to restore shape 10. Prepare / transport sample to laboratory		
3. CSF Collection (cisternal puncture from back of neck) 1. Take a long needle with wide bore 2. Attach with 10-20 ml syringe 3. Put a wooden platform under upper chest 4. Flex neck 5. Palpate atlanto- occipital memebrane in the middle 6. Pierce the skin at this point with needle pointing towards nasal bridge 7. Go about 2 cm deep and feel resistance 8. Aspirate CSF 9. Transfer to tubes 10. Add Sodium Fluoride 11. Seal, label and make ready for transfer	 	
4. CSF (after neck evisceration) 1. Keep syringe and needle ready 2. Eviscerate neck structures 3. Clean area 4. Identify first and second cervical vertebrae 5. Pierce theca membrane between these via spinal foramen 6. Aspirate CSF		

7. Follow other steps as mentioned above		
5. CSF after opening cranial cavity 1. Open Skull 2. Dura is exposed 3. Can pierce dura after making nick 4. Aspirate CSF from sides and base 5. Other steps are similar		
6. Bile Collection 1. Keep ready one small wide mouth bottle ready 2. Open abdomen 3. Expose gall bladder 4. Take wide bore needle 5. Pierce GB and aspirate bile or (give a small cut and directly put bottle under it) 6. Transfer bile into needle 7. Add NaF 8. Seal, label. make it ready for transfer		
7. Bile collect after removing liver 1. After dissection when liver is taken out 2. Dissect whole gall bladder with contents 3. Transfer to bottle 4. Put preservative 5. Seal, label and transfer to laboratory		
8. Collection of Gastric Contents 1. Open Abdomen 2. Identify stomach 3. Ligate oesophageal end of stomach 4. Ligate pyloric end of stomach 5. Remove stomach 6. Open stomach and take out contents into a bottle (100 grams or as avialble) 7. Keep contents over glass slide and try to identify contents 8. Examine stomach and preserve it for chemical analysis 9. Take 30 cm of SI and its contents		
9. Synovial fluid 1. Take a wide bore long needle 2. Identify joint knee, ankle 3. Flex a little 4. Pierce at weakest point 5. Synovial fluid 6. It is thick fluid, oily fluid 7. Transfer it bottle	 	
10. Urine Collection 1. Give incision till supra pubic area 2. Expose bladder 3. Clean area 4. Punture with wide bore needle and aspirate 5. Or give a small cut and aspirate by syringe without needle 6. Transfer it to 50/100 ml bottle 7. Put thymol 8. Seal and label it		

Investigation Face Sheet of Postmortem No…… Dated ……..

Example

Investigation	Samples	Purpose
Histopathology	Heart, lungs, Kidney…..	Hyper Tension changes
Haematology	Blood smear	Anaemia
Biochemical	Blood Vitreous	Lipid profile Electrolytes, Sugar, Urea
Microbiology	Culture from Brain	Meningitis
Forensic samples	Viscera	Toxicology
	Vaginal swabs	Semen
	Blood	DNA Profiling

Audit Sheet

Check points	Yes	No	Remarks
Guidelines for preservation of different samples available?			
Preservative containers/ tubes available?			
NaF, Saturated Saline, Alcohol thymol available?			
Procedure adopted for collection of samples?			
Sample taken from correct place?			
Sample taken to correct container?			
Correct preservative added?			
Proper Labeling?			
Proper Storage?			
Specific request for testing a substance/differential diagnosis?			
Complete Details of case findings are given?			
Integrity of material?			
Chain of custody maintained?			
Probable Diagnosis?			
Any other query like poisoning /drugs etc			

Basic Rules for sampling/evidence collection[14,45,47]

All samples and evidences over the body should be collected legally and should be properly documented. Whenever, it is suspected that victim had contact with assailant. The following samples are must:

- Blood
- Blood in Gauze piece (dried and preserved)
- Body hair of involved /injured part
- Scalp hair if scuffling /injury (Hair Standard sample (20-30 hair) from different parts of scalp or injured part after plucking)
- Nail Scrapping /clipping
- Photographs / Sketches of important findings and injuries
- Clothing as worn by deceased (must in all cases except natural deaths)

For rest different situations, please read individual section and sample collection.

Good practice is an important step to deliver justice to case.

SUDDEN ADULT NATURAL DEATHS[1,2,4,5,6,7,10, 11,14,39,45,61,80]

Preliminaries

1. History

Name of the Deceased, Age and Sex

Time, Place and Date of Examination

Introductory Comments- Scene and Brief History of Incident.

Personal History- Occupation, Marital status and also history of sudden death in family.

Medical History- Previous and current illness and treatments.

Social History- Alcohol and Drug consumption, Smoking and Other habits.

2. External Examination

- Description of clothing.
- Height, Weight.
- General Description (Obesity, Emaciation, Dehydration, Hygiene etc).
- Identification features including Scars, Tattoos, Hair and Teeth.
- Signs of Medical intervention.
- Description of External Injuries.
- Postmortem Changes Lividity, Rigidity, Changes of Decomposition.

3. Internal Examination

i. Cardiovascular system

Pericardium and pericardial cavity description (thickening, adhesions) and contents, amount, volume and nature.

Heart- Description of

- Pericardium (Hemorrhages, Adhesions, Rupture).
- Myocardium (Thickness, Fibrosis, Fresh Infarcts).
- Endocardial (Hemorrhage, Fibrosis).
- Valves (diameter, Thickening, Vegetations, Adhesions as indicated).
- Wall thickness(Right and Left Ventricles) near valves.
- Weight of the heart after removing clots (Total Weight and Right and Left Ventricular Weights separately where desired and indicated).

Coronary arteries description, distribution of Right and Left (Anterior descending and Circumflex) coronary arteries, atheroma, thrombi and severity of narrowing and Bridging

Major arteries- Carotid, aorta, internal thoracic renal arteries as indicated

ii. Respiratory system

Pleural cavity: *A*dhesions, contents and its nature and volume should be described

Larynx, pharynx: Position, integrity, and contents like blood , froth, fungus, water , mud should be described.

Trachea, Bronchial tree: Mucosa and contents (pus, blood and froth) should be described

Lungs: Description of external surface, cut surface and consolidation. Weights of Right and Left lungs

Pulmonary vessels: Description of atheroma and thrombi

Mediastinal nodes: Description as indicated

iii. Gastro-Intestinal system

Oesophagus: Description of mucosa, erosions as indicated

Stomach: Description of mucosa (erosions, ulceration, growths) and wall, contents- peculiar odour, volume and nature

Small and Large bowels: Description of mucosa, contents and wall as indicated

Liver: Weight, Description of external and cut surfaces and texture,

Gall bladder: Description of the nature and contents , size, amount etc. as indicated

Pancreas: Weight, description of nature of surface and cut surface as indicated

Spleen: Weight and description of the nature and texture,

Peritoneal cavity: Description of contents nature amount, any adhesions

iv. Genito-Urinary system

Kidneys Weight, Description of the surface, cut section cortex and medulla.

Ureters and bladder Description and contents.

Prostate Assessment of the size, Description of the cut surface and the texture.

Penis and Testicles description as indicated, morphology, testicular size, abscess etc.

Cervix and Uterus – appearance, morphology, contents description as indicated.

Ovaries –size, weight ,external morphology , cut surface or as description as indicated.

v. Central Nervous system

Meninges: Description of surface (bleeding, pus, thickening, adhesions).

Major arteries in neck and Circle of Wills: Description, distribution of atheromas, aneurysms

Brain: Weight, Description of Surface and cut surface and ventricular system, Description of CSF

SPECIMENS (This is mainly case dependent)

Histology: ***Organs should be targeted according to the case*** [1,2,4]

Heart: One section from each chamber and interventricular septum. More sections form affected part. Sections from Sinus and AV node sites. Sections from Coronaries as indicated.

Lungs: One section from each lobe and more sections from affected site.

Liver-one section from left and right lobe.

Brain- Sections from Cortex, Cerebellum and Brain Stem.

Adrenals: For hypertrophy, haemorrhage, phaeochromocytom

Toxicology: As indicated

Microbiology: As indicated

Radiology: As indicated

Summary of Major anatomical and investigation findings.

Cause of Death (according to International Classification of Diseases)

In "CAUSE OF DEATH" FORM

Medical certificate of cause of death:

Part a: particulars of deceased

Part b: cause of death

II: Incidental Finding / associated non-fatal findings

Comments

Death due to Natural Diseases or not

Brief explanation of the disease

Relevant Medico-Legal Issues Addressed

Postmortem Certificate

Filling of Postmortem Certificate should be carried in each case where PM report is not issued on same day. This is helpful document for burial / cremation / transport of body. In majority cases, cause of death is clearly determined at time of postmortem, so clearly mentioning it in certificate will be a great relief to the relatives and it solves their concerns.. A sample of post mortem certificate is given here as well as in death certification.

Post mortem Certificate

To whom it may concern

This is to certify that Post Mortem Examination was conducted on the body of ..... Son/ Wife/Daughter of .....On..... ....at.....Body was brought for PM by Police Station.....Through PC .....

The deceased died due to .....

Signature

Name

Department

Audit Sheet [5,7]

Procedure	Yes	No
Identification of the person done?		
Risk factor identified in history?		
Specific external features noted?		
System-wise dissection done?		
Major Pathology identified?		
Other pathological findings noted?		
Cause of Death ascertained?		
Medico-legal issues addressed?		
Histology samples retained?		
Blood and other fluids retained as indicated?		
Proper documentation done?		
Further action taken as indicated?		

Common Causes

- Ischemic Heart Diseases
- Coronary Artery Disease
- Intracranial Hemorrhages
- Pneumonia
- Bronchial Asthma
- T B
- Epilepsy
- Diabetes Mellitus

Photographic evidence

- Photographs as per practice in each case
- Cause of death

EXAMINATION OF HEART [14,16-21, 61,80]

Heart should be routinely examined as it is one of the vital organs of the body and frequently is the site of fatal lesions and diseases. It should be examined more meticulously in cases of sudden death, or with the history of hypertension or other cardiac diseases

History

- Hypertension
- Any heart disease: previous or current
- Family history of heart disease, hypertension or sudden death

Examination of precordium

If there is any lesion or injury suggestive of involvement of heart like large contusion, stab wound or fractured ribs, start examination after opening the sternum.

Pericardium

- Examine the pericardium while the heart is still in-situ.
- Determine if it is free from the underlying heart or adherent, keep in mind that adhesion may be focal.
- Whether the appearance is normal or dull.
- Any injury to the pericardium: old or fresh.
- Open the pericardium with inverted T-shaped incision: determine the content of the sac, the thickness of the wall, appearance of the visceral surface.

Heart

- Examine if the heart is attached to the great vessels with normal anatomical continuity or lying freely detached from other structures.
- Remove the heart with great vessels attached at least 1 cm beyond the pericardial fold.

If any congenital heart disease is suspected, it is better to eviscerate heart and lungs en block to retain the

connections of both the organ, especially in infant and child death cases.

External Examination

- Measurement of width at the level or just below of valvular region ; for the length highest point when heart is kept in normal anatomical position. Any concentric hypertrophy should be measured at that point.
- Measurements: for exact circumference (1cm below the AV sulcus) weight should be taken after dissection.
- Examination the external surface, any focally adherent pericardium, any visible fibrosis or recent infarcts, determine the age of fresh / recent or healing infarcts.
- Document any contusion, laceration or any wound to the heart (contusion over base of the heart should be differentiated from Lividity).

Internal Examination

- Dissect the heart: along the blood flow (usual way), along the short axis of heart to examine the AV valves in detail and by creating window if only focal lesions are present.
- Examine each chamber for: any visible fibrosis or recent infarcts, cavity dilatation, thickness of the wall.
- Examine inter-atrial septum: patency of foramen ovale
- Examine inter-ventricular septum: septal defect, membranous or muscular.
- Examine AV valve: circumference, any incompetence or stenosis, cusps: fibrosis, any growth or nodules, examine both the surface, atrial and ventricular.
- If artificial valves are there, look for its functioning, any blockage, any missing part.
- Examine cordae tendinae: shortened, adherent to each other or ruptured.
- Examine papillary muscles: infarction, adherent to each other or ruptured.
- Semi lunar valves: circumference, any incompetence or stenosis, cusps: fibrosis, any growth or nodules, examine both the surface, ventricular and arterial.
- Take the weight of the heart after the dissection of the heart.

Coronary arteries

- Right and Left: main trunk, anterior descending and circumflex, it's better to examine the coronaries before dissection of heart.
- Ostia of the coronaries should be examined for patency of lumen, any thrombus, plaque, concentric or eccentric narrowing. Coronary lumen narrowing is expressed in percentage and it is measured as cross-sectional area of lumen. It can be expressed as 20% to 90 % narrowing , narrowing more than 70 % has demonstrable effect of myocardium. It can also be expressed in simplified way as 25 %, 50% , 75 % or 100% . If WHO criteria for measuring narrowing are followed then uniformity can be maintained otherwise subjectivity creeps in.
- Look for the anatomical normalcy of the arteries: their origin, path, bifurcation, their branches
- Better way to examine the coronary lumen is to make transverse incision along the artery 3-5 mm apart. Keep all sections serially and take photographs to demonstrate condition.
- Decalcify if the lesion is calcified otherwise crushing force applied to the vessel may dislodge thrombus or clot fragmented or make these hard walls cracked.
- Keep in mind, lesion over left coronary artery is mostly confined to proximal 3cms, while the lesion over right coronary is diffusely present along the artery
- Look for any embolism present within the coronaries: air embolism, fat embolism or thrombo-embolism

Parameters

- Weight of heart.
- Circumference of heart at highest level, usually near valves.
- Weight of right and left ventricle seperately where indicated.
- Left ventricle is measured along with septum, right is measured without septum.
- In adults ventricular thickness of heart is measured perpendicular to epiradium and excluding trabeculated subendocardial muscle. Left ventricle thickness (at site 1 cm below the mitral valve is <15mm. Right ventricle thickness at site 1 cm proximal to pulmonary valve ring is <5mm.
- Thickness of all walls of four chambers.

How to measure separate ventricular weights

1. Transect heart at atrio-ventricular groove and exclude mitral and tricuspid valves.
2. Transect at the base of aorta and pulmonary trunk
3. Remove epicardial fat.
4. Seperate right ventricle from left ventricle (septa remains with left ventricle).
5. Weigh right ventricle and left ventricle plus septa separately.

Weighing of heart[160]

Combined weight of both ventricles should be less than 250 grams.

Right ventricle is usually less than 65 grams.

Left ventricle plus septa is usually below 190 grams.

Ratio (LV+S)/ RV = 2.3 to 3.3.

Right ventricular hypertrophy : RV >80g or LV+S / RV is less than 2.

Left ventricular hypertrophy : LV + S is more than 225 grams.

Routine Sampling

- Routine sampling: one section from anterior wall of right ventricle, one section from lateral wall of left ventricle, one section from right atrium, one section from left atrium, one from the ventricular septum, and sections from the lesions/suspected site.
- Sampling of the pericardial fluid for microbiological analysis if indicated.

Tissues for proper cardiac histopathology screening in sudden cardiac deaths / cardiac pathology cases as per need of the case

- Left ventricle – anterior , lateral and posterior wall
- Septum – minimum one piece or as indicated by morphology.
- Right ventricle – One or two sections.
- Right and left atrium – one piece.
- Conduction system – SA area, AV area, fibres area.
- One full coronal section 1-2 cm below valves or 4-5 cm above apex of heart.
- In addition to above any abnormal looking area on naked eye examination.

Staining methods for cardiac tissues on histopathology:

H&E: for normal screening, MI, Myopathies, IHD, myocarditis.

Connective tissue stain – Elastic Van Gieson or Masso's Trichome in old healed myocardium.

Amyloid changes – Congo red.

Iron deposits- Perl's Persian Blue.

PAS – Storage disorders.

Myocarditis- Immunochemistry for CD3, CD 20 and CD68 and H& E screening.

Toxicology – Alcohol, amphetamine, cocaine, Opiates in blood, urine and GIT contents. Toxicology screening may be required in some cases but not in all and depends on age and circumstances.

Special dye staining gross methods:[16,17]

- Special dye used for identification of recent infarct areas is Tetrazolium dye: Nitro-Blue Tetrazolium and Triphenyl Tetrazolium Chloride.
- These dyes change colour of normal myocardium to purple-blue but infracted area of myocardium remain unstained.
- These dye methods are not much useful beyond 12 hours.

Common Cardiac Conditions [Davies, RCPath] and steps by autopsy surgeon

Appearance / disease	Macroscopic Findings	Expected outcome	Tissue / sample
Coronary vessels atheroma with blockage from thrombus[r]	Atheroma narrowing the coronary vessels and thrombus lodged in the lumen	Sudden death with necrosis of affected myocardium	Ventricles walls anterior , lateral and posterior , septum , affected lesion with adjoing normal appearing tissues . Coronaries with affected lesions with epicardial fat and myocardium below. See other arteries and aorta Take blood for cardiac Troponin T
Coronaries with atheroma with one or more vessel having < 1mm diameter with healed myocardium[r]	Whitish patches in myocardium of scarring. Narrowed coronaries with atheroma and one showing narrowing more than 75 % narrowing	High probability of sudden death	Narrowed part of vessels Myocardium showing scarring and macroscopic changes. Take blood for cardiac Troponin T
Coronaries with atheroma and one vessel showing narrowing of diameter < 1 mm but no evidence of healed infarction.[r]	Narrowed coronaries , one showing narr owing and having diameter less than 1 mm . Myocardium appearance normal	Possibility of sudden death exists and depends on circumstances	Take blood for cardiac Troponin T
Coronaries near normal No evidence of IHD Ischaemic Heart Disease but dilation/hypertrophy/	Hypertrophy of either of ventricular wall, congestive heart failure signs, dilation of heart	There is moderate possibility of sudden death	Vetricular myocardium Take blood for cardiac Troponin T
No significant coronary and cardiac pathology	Normal coronaries Normal myocardium	Less chances of sudden cardiac death	Full cardiac HP Conduction System Toxicology Take blood for cardiac Troponin T
Cardiac Myopathies	Thickened myocardium, enlarged heart . Fibers variability and disarray appearance on microscopic examination	Probable chances sudden death in stressed conditions like strained jogging, sports events and conditioning training of forces.	Full cardiac HP Vitreous for electrolytes and Sugar Take blood for cardiac Tropon in T and Cholestrol
Myocarditis	Inflamed or more reddish heart Near normal appearance	Possibility of sudden death is there but depends on severity and circumstances. More than 5 cells per microscopic field	Full HP coverage from both ventricles and septum Virus screening from nasal washing , sphenoid sinus aspirate , tracheal /lung aspirate

Ref :Davies MJ. The Investigations of Sudden Cardiac Death. Histopathology 1999;34:93-98. And The Royal College of Pathologist ,2005.

For better understanding heart failures, following information is of great help[160] :

Acute heart Failure – Blood Investigation, ECG if avaialable, C9 Immunichemistry, Cardiac Tropnin, full macroscopic and histopathological screening of heart are quite helpful in making diagnosis

Chronic heart failure – Pulmonary hypertension, intraveolar haemosiderin deposition and hepatic venous congestion. Histopathology evaluation of liver, lungs and heart is must in these cases.

Failure of heart supported with artificial devices- although rare but battery failure, short-circuiting, dislodgement, fractures, insulation breaks, mainly lead related problems can result in failure of already a diseased/ unhealthy heart.[160]

EXAMINATION OF THE CONDUCTION SYSTEM[7, 11, 17-22]

When history is suggestive of involvement of conduction system or routine examination of coronary vasculature reveals occlusion of right coronary artery.

History

- Congenital heart disease, previous dysrhythmia
- Family history of dysrhythmia, sudden death

Location

- **SA node:** in the sulcus terminalis, at the summit of superior vena cava and right auricle
- **AV node:** lies in the right atrium between the coronary sinus ostium and medial leaflet of tricuspid valve within the triangle of Koch
- **Bundle of His:** traversing through the central fibrous body, entering the membranous ventricular septum up to the top of muscular septum
- **Bundle Branches:** lies in the ventricular septum over the respective side of the septum

Sampling

- **SA node:** a section taken involving the lower part of superior vena cava, anterior wall of the right atrium, sulcus terminalis and right auricle
- **AV node:** a section from the lower part of right atrium from the region bound medially upto the septal leaflet, laterally the coronary sinus ostium, above the tendon of Todaro and below the posterior leaflet of tricuspid valve
- **Bundle of His:** a section from the upper part of the muscular part of the ventricular septum involving the lower part of the membranous part of 4cm width keeping in mind that the bundle runs from posterior to the anterior part of septum obliquely

Sectioning

- Make multiple sections each 3 mm thick

Staining

- Trichrome
- Verhoff-van Gieson
- H& E staining

Microscopic findings

- Age related changes: fibro-fatty infiltration, senile calcification, atrophy, hypertrophy, senile amyloidosis.
- Blocked vessels to the conduction system.
- Fibrosis, inflammation, infarction, amyloid deposition.
- Irregular arrangement of the myocardial fibres.

Audit Sheet

Procedure (Examination of Heart)	Yes	No
Identification of structures		
Location of SA Node		
Location of AV Node		
Location of area of AV Bifurcation		
Purkinje Fibres area		
Tissue Selection and sampling		
Method of putting labels and tagging		
Awareness of importance		

Common lesions which may be found are cyst, calcification, fat infiltration, fibrosis. It requires patience and hard work to screen conduction system. It is not recommended routinely and should be referred to higher centers where trained personnel are there.

Photographic evidence:

- Heart photography
- Heart measurement
- Calcification
- Cyst
- Myocardial fibrosis
- Gross findings of interest
- Histopathology photography of lesions

SUDDEN DEATHS IN EPILEPSY

Sudden death in epilepsy poses a great problem to

medical investigator in clearly deciding the case. Epilepsy is a clinical syndrome characterized by recurrent episodes of convulsive seizures due to abnormal discharge of nerve cells in gray matter of brain. It may be generalized , focal , structural or functional. Focal epilepsy with seizures is usually associated with focal lesions in a specific area. Temporal lobe epilepsy causing psychomotor seizures is usually produced by a lesion in or near the medial temporal cortex.[124] In epilepsy patients, tachycardia developed during fits produce ischemic changes in myocardium. It puts heart into stress and uncontrolled dysarrythmias result in fatality.

Sudden unexpected death in epilepsy is also responsible for sudden deaths. It can can be defined as sudden, unexpected, witnessed or unwitnessed, nontruamatic, and nondrowning deaths in patients with epilepsy and post-mortem examination and toxicological examination does not reveal any thing[126]. There are definite correlation that altered autonomiccardiac nerve discharge, interictal epileptogenic activity and cardiac arrythymias, which contribute to sudden death in epileptic patients.

Contributory causes of such deaths remain automnomic neurohumoral dysfunction, autonomic cardiac neural dysfunction, cardiac changes of sunendocardial perivascular and interstitial fibrosis, atherosclerosis of coronaries, anti-epileptic drugs[126]. During the winter, there is increase in haemocontration (erythrocyte count, plasma cholesterol, and plasma fibrinogen levels) which may cause arterial thrombosis[125].

Postmortem findings

- Bodily Injuries occurred during fit
- Oral structures injuries – tooth injury, fresh and old bites over sides of tongue
- Aspiration of vomitus
- Aspiration of fluids –gutter / drain / rainy / tub
- Gums for hypertrophy
- Previous injuries

Previous injuries relevant to issue

- RTA
- Fall from height
- Frequent falls during fits
- Head Injury
- Healed injuries

Previous relevant diseases

- Tuberculosis
- Sarcoidosis
- Calcification
- Worm infestation
- Cysticercosis

Investigation

- Epileptic drugs screening for overdose in blood, urine, gastric contents, plasma and vitreous humor.
- Toxicology screening as routine.
- Hair also helpful in screening cases.

Histopathology

- Fresh and old tongue bites indicating tonic-clonic convulsiosn.
- Myocardium for fibrosis. Heart requires special examination, take a full mid coronal section of heart about 4-5 cm from apex for further examination; beside this coronal section and make 8- 10 cardiac tissue sampling block from left ventricle(3), septum(1) and right ventricle(2) and rest as per gross findings of fibrosis. Fibrosis may be graded according to severity and may be shown in sketch as shaded, crossed, gray and dark gray areas. Subendocardial part of heart is very informative.
- Lungs: aspiration, oedema
- Any other organ as indicated but brain examination is must
- Scarring in brain tissue and other findings as microscopic findings of decreased myelin, gliosis, cystic gliotic lesions, neuronal clusters, increased perivascular oligodendroglia, cerebellar gliosis.
- Plan for sections from brain should include : Full coronal sections just front and behind mid brain, mammalary bodies may act as reference. Beside this brain histology should have hippocampus gyrus, cingulated gyrus,superior and middle temporal gyrus, middle frontal gyrus, caudate nucleus, putamen, globus pallidus, cerebellar vermis, dentate nucleus, and sections from cerebellar hemisphere. In addition to these any gross tumor, calcified area, cyst, thinned out or enlarged area should be included in screening.

Epileptic case also require documentation of all morbid anatomical, toxicological and histopathological findings.

Audit Sheet

Check Points	Yes	No
History, previous attacks		
Medical history		
Scene Assessment		
Examination of oral cavity		
Complete body examination		
Complete internal examination		
Brain examination in detail		
Drugs screening - antiepileptic etc.		
Exclusion of other cause of death		
Cause of death		

Common findings which may be observed in a epileptic case are external evidences of fits, bites over tongue sides, gum thickening if on medication, injuries sustained during fall or accident during seizures, brain oedema, focal findings in brain, atrophy in mesial temporal area(Ammon's horn), cerebellar atrophy, cardiac abnormality or pathology, pulmonary oedema, aspiration of gastric contents. Previous trauma may also be correlated.

Photographic points: Overall scene **circumstances of death, position of body, evidence of incontinence of urine and feces, objects which could be correlated with injuries, medicines.**

Photography during postmortem: Fully body photography as in any other case, incontinence of urine and feces, injuries over the body, face, teeth, gums, tongue, trachea, lungs, heart and brain.

Death may be due to as a result of status epilepticus, accidental trauma during seizures, aspiration during seizures, overdose of medicines, and could be a case of sudden and unexpected death associated with epilepsy(SUDEP) where toxicological and anatomical cause is not detected. Status SUDEP [RCPath] is defined as "sudden, unexpected, unwitnessed or witnessed, non-traumatic and non-drowning deaths in patient with epilepsy, with or without evidence for a seizure, and excluding documented status epilepticus, where autopsy examination doesnot reveal a toxicological or anatomical cause of death."

(Ref:153.Love S. Review. Postmortem sampling of the brain and other tissues in neurodegenerative disease. *Histopathology* 2004;44:309-317.

154. Black M, Graham DI. Sudden Death in epilepsy. *Current Diagnostic Pathology* 2002;8:365-372.)

ANAPHYLACTIC DEATHS[156-158]

Systemic anaphylaxis is presented with vascular shock, wide spread oedema, and severe difficulty in breathing[158]. Some people may develop an acute fatal allergic anaphylaxis to foreign materials like medicinal products, antisera, vaccines, edible proteins, stings and bites. In such cases time ranges from 5 minutes to a few hours. Often there are non-specific findings in most cases but still meticulous examination can yield satisfactory results to make a diagnosis. It becomes a herculean task to autopsy surgeon when a person with anaphylaxis is admitted in intensive care, many additional findings creep in so diagnosis becomes more difficult. Discuss with laboratories before starting the case and make a proper plan to preserve proper samples in right containers.

History: History of injection, consumption, previous history of allergy, test dose, urticaria, severe itching.

Presentation: Itching, swelling, urticaria, rashes, collapse, restlessness, tight chest with constricting chest.

Gross findings

Skin: Injection mark and inflammation skin around it. Urticaria, wheals

Laryngo-pharaynx: Laryngeal oedema, vulva, fauces and lingual are watery and oedematous almost choking the passage. Small patechial haemorrhages with red tinge are noticed. It may have copious sticky mucous and secretions. Vocal cord.

Tracheo-bronchial tree: filled with blood tinged froth with copious secretions.

Lungs: oedematous, bronchial asthma like appearance but chronic findings of asthma are missing. Bronchioles filled with fluid, mucous, eosinophils. Patechial haemorrhages are seen in sub pleural surfaces and inter lobar fissures.

Heart: coronary artery and may contribute to ischaemic changes in anaphylactic shock.

Kidneys : Findings of shock

Brain: oedematous, watery surface, easily flattens on cutting, differentiation between white and gray matter. White matter extraordinarily shining and watery.

Other Investigation required in the case.

Biochemical – vitreous chemistry for electrolytes.

Immunological - Ig E levels, blood mast cell tryptase, specific drug antibodies if available.

HP recommended - Heart, coronary artery, lungs with airways, vocal cords, injection site

Microscopy - It depends as on what stage, case was brought for autopsy. If it is immediate death without hospitalization then findings are having a different presentation. After hospitalization and resuscitative measures presentation is slightly different as therapeutic and resuscitative measures do produce their impact.

Findings of shock, hypoxia are very dominant in such cases.

Audit Sheet

Common Cause of death - Anaphylactic Shock and asphyxia.

Common presentation - cardiac arrest.

CAUSE OF DEATH UNASCERTAINED AT AUTOPSY (NON-DECOMPOSED BODIES)[1,2,4,5,6,7,10, 11,14,45,88]

Following guidelines in addition to those described under Sudden Adult Natural Deaths.

Internal Examination

Cardio-Vascular system.

Heart- Measure left and right ventricular thickness at the level of papillary muscles.

Respiratory system

Lungs- Specific comment on the contents in the airway, mucus and foreign bodies and Disorders

Anaphylaxis signs

Mucus consistency and microscopy of bronchial secretions

Central Nervous system

Brain -Description of ventricular system and examination for Colloid Cyst

Spinal cord-Special dissection and description as indicated

Others

Adrenal glands- Description of gland as indicated

Lymph nodes- Description of Cervical, Mediastinal, Para-aortic, and Pelvic group of nodes as indicated

Pituitary- Description of the gland

Specimens

Histology [6]

Heart- At least one section from anterior, lateral, posterior and septum of left ventricle.

One section from right ventricle

Sections from SA node, AV node and conducting system.

Lungs- One section from each lobe

Adrenal glands- One section from each gland

Pancreas- One section

Spleen- One section

Lymph nodes- One section from each group of nodes

Bone marrow- One section and smear

Brain- Sections from Cerebral cortex, Midbrain, Pons, Cerebellum and Hippocampus and corpus callosum.

Skeletal muscle- One section including Quadriceps and the Deltoid.

Pituitary-One section

Kidneys- One section from each kidney

Toxicology and Biochemistry

Blood- For full toxicological examination and Ethanol and Methanol

Vitreous- For Potassium, Sodium, Urea, Glucose, Acetone and Toxicology

Bile for Opioids and other drugs

Stomach contents for Toxicology

Urine for Ketone Bodies

Serology

Consider serum Cortisol

Microbiological cultures

As indicated

Radiology

As indicated

Audit Sheet [5,7,11]

Check Points	Yes	No
History		
Treatment record		
Substance known		
Past history		
Photography		
External appearance		
Findings in oropharynx, larynx, glottis		
Internal findings		
Samples for Immunochemistry		
Histopathology		
Bio-chemistry		
Opinion		

Common Causes

- Metabolic Disorders (Hyperkalemia,)
- Endocrine Disorders (Hypoglycemia)
- Cardiac dysarrythmia
- Conduction System Disorders
- Epilepsy
- Asthma
- Poisoning
- Snake Bites
- Vaso-vagal shock

Important photographic evidence

Place where he was found dead

- Overall view
- Sleeping position
- Items in vicinity
- Any medication / bottles/ food etc

At the time of postmortem

- Clothing search
- Face
- Full photography

- Important external and internal findings

Social Forensic Message

It is a time for postmortem centre to review its working if rate of undetected causes cross 5% of total autopsy cases.

NEGATIVE AUTOPSY [77,14,45]

In forensic practice, there are instances when autopsy even after meticulous examination is unable to determine the cause of death. Before declaring any case as negative autopsy/obscure autopsy, one should screen for proper medical history, histopathology of vital organs, toxicological screening, crime scene evaluation, drug interaction, envenomation, hypersensitive reaction due to new protein material, vaso-vagal inhibition, concealed injection and air embolism. The important reasons which also contribute to undetermined cause of death are inadequate training , inadequate and improper external and internal examination, incomplete medical examination, not attempting histopathology and toxicology screening. Medical history is very important in these cases. If negative autopsy is more then 5 %, then centre requires audit and introspection of method of working out such cases. The following guidelines are recommended in such cases.

1. Evalute scene and take proper medical history- palpitation, syncope, dizziness, snoring, 2.position when recovered dead, room ventilation, sexual asphyxia, mental illness, addicting substance use etc.
2. Examine clothing and search pockets for any abuse substance / medicine, suicide note.
3. Full photography of body with close-up.
4. Examine body in systematic way to screen for any hidden injury/ injection.
5. Sampling for vitreous, blood, urine before starting autopsy for toxicology screening and prepare blood smear for haematological abnormality like anaemia, leukemia, pancytopenia etc.
6. Swabbing palms and finger tips for toxic substance.
7. Examine oral cavity and its swabbing for toxic substance.
8. Examine oro-pharynx- larynx and respiratory track for any bolus or aspiration
9. Examine for air embolism
10. Open head first and look for head trauma
11. Take culture from brain surfaces for meningitis
12. Examine for thrombosis in coronaries in heart and brain vascular tree
13. Examine heart in detail and take sampling from coronaries,myocardium and conduction system
14. Examine GIT in detail and subject contents for toxicology screening
15. Examine for seizure effects
16. Genitalia for recent sexual activity, swabbing for saliva for vagino-oral sex in sexual active females for air embolism. Look for teeth bite in clitoris area for vaso-vagal and over stimulation.

A simplified approach to understand importance of sampling in such cases is given in tabulated form to highlight their importance.

What are you looking for?	Sample of choice	Time of sampling	Important thing to remember
Electrolyte Imbalance	Vitreous humor(eyefluid)	At earliest point when brought to hospital	More informative in first 72 hours
Drug Interaction	1. Blood 2. Urine 3. GIT contents	1 and 2 at earliest opportunity	Serum portion is u sed for analysis so cellular component is not very important for toxicology screening
Air embolism	Examine heart and brain for embolism	At autopsy	One must follow the procedure as how to look for embolus
Thrombosis	In coronaries and cerebral vascular tree	At autopsy	One must be able to differentiate between thrombus and agonal thrombus
Myocarditis	Take sample from both myocardium (one from each chamber), both ventricles should have more representation in sampling	At autopsy	It is usually not v isible to naked eye so any history viral infection in immediate recent past (few weeks to 2 months)
Fatty Liver	Liver HP screening Lipid profile	Blood for Lipid profile Liver -4 pieces –right lobe, left lobe, near GB, dome of liver	Lipid profile can be trusted up to one week after death
Anaphylaxis	Larynx, voc al cords, lungs , skin, visceral surfaces	Section from larynx , lungs, skin, stomach for mushroom, sea food or new protein material or seeds	Angio-oedema is quite common after consumption of betel nut, new protein
Electrocution	Wet soles , hands or any body part; current leakage at scene or any electric item in hands or immediate vicinity	Examine soles and hands carefully. Take close up of suspected contact areas and then exami ne photographs after magnification	In rainy season , wet surface , person working on machine in shops, restaurant and work place etc
Infection	Blood culture, brain surface/ culture	Examine brain lungs properly	Early infections where thick pus is no t formed are missed on naked eye examination
Decomposition beyond three days in summer and one week in winter	At least try Toxicology and HP every such case. Send maggots also for toxicology	Blood chemistry is not very helpful but vitreous can still be tried	It poses real problem in human corpse in more than two weeks

Minimum requirement for such cases is overall assessment of scene, clothing, body, complete post-mortem, histopathology of organs and toxicology screening. After these workout, if nothing is found then it can be declared as negative autopsy and cause be assigned as functional natural death – exact cause of death could not be ascertained.

Audit Sheet

CHECK POINTS	Yes	No
Overall Scene Assessment		
Medical History		
Full Photography		
Complete external examination		
Complete Internal examination		
Proper sampling		
Samples for HP		
Toxicology Screening		

Minimum workout before declaring it negative / functional death

Essential work out	yes	No
Complete Autopsy		
Histopathology		
Toxicology Screening		

MECHANICAL ASPHYXIAL DEATHS (COMPRESSION OF THE NECK)[1,2,4,5,6,7,10, 11,55,14,45]

The following procedure is in addition to what described under Sudden Natural Death

Scene visit

- Scene visit should be carried out as indicated or at least assessment should be done on basis of Crime team reports and photographs provided by IO.
- All scenes should be visited on written request on either side (for all forensic cases).
- In the cases of hanging measurements from ground to the hanging point (Suspension Point), height of the support to reach the suspension point, must be documented.
- Scene must be examined for signs of violence and circumstantial evidences.
- Scene visit/assessment is always educative to give clear opinion which saves precious time of medical and investigative personnel.
- Finger prints over skin may be attempted with superglue fumigation in a transparent chamber. One specific transparent chamber should be made available in the mortuary where superglue fumigation can be done. Lifting of finger prints can be carried either by trained medical team or finger experts as available. Photography is must before lifting the prints.

External Examination

- Ligature must be described with special reference to width, length, presence of cut ends and description of the knots.
- The ligature mark is very important evidence, as it reproduces the pattern and dimensions of the ligature itself.
- Height, length between finger tips to toes when the upper limb is raised should be measured (to assess the accessibility to the hanging point)
- Distribution of Hypostasis must be described and interpreted in relation to the posture.
- Comment on the presence of petecheal hemorrhages, congestion of head and neck, Subconjunctival hemorrhages of eyes.
- Description of ligature mark (Abraded Contusion) with reference to width, length, direction and presence of gaps must be made.
- Comparison of Abraded injury and the ligature must be done.
- External Genitalia and anus must be examined for injuries and sexual penetration.

Internal Examination [6]

- Detail neck dissection in a bloodless field to note soft tissue injury (after removing the brain and thoracic contents, after draining of blood neck should be dissected in situ layer by layer).
- The thyroid cartilage, hyoid bone and other laryngeal cartilages must be examined for fractures and periosteal and peri-cartilaginous haematoma.
- Special comment must be made on the integrity of the cervical spine.

Specimens

1 Toxicology as indicated (mainly sedative , intoxicants, psychotropic)

2 Radiology- Neck before the dissection to see fracture, if required and X-ray facilities are there

3 Histology of soft tissues , muscles, glands, cartilages for hemorrhages is optional in doubtful cases

4 Anal and Genital swabs as indicated.

5 If indicated, clothing fibres stuck to skin of neck area(all around the neck in ligature mark area) should be visualized with the help of hand lens and should by removed with gloved finger on plain white paper. Paper

should be folded and should be sent for further analysis as per the need of case. Another simple method of using sticky cello-tape , lecukoplaster can be used to pick up fibers in neck area. This is put on plain and transparent sheet or OHP sheet. It should be put in paper envelope for further analysis. This is not done routinely but in sensitive cases where is allegation of third part involvement, it is must.

6. In some cases, if latent finger prints are attempted then neck area should be fumigated with finger print dusting powder with the help of finger print / forensic technician.

Audit Sheet[5,7,11]

Procedure	Yes	No
Scene visit		
Measurement of ligature mark/s and material in detail Ligature material examined and preserved		
Attempts to recover DNA material from ligature Ligature mark examined and documented		
Neck dissection of anterior and posterior segments Photography of face, ligature material and mark, teeth, tongue, inner cheeks, thyro-hyoid complex and tracheal rings		
Radiography if required		
Toxicology screening as indicated		
Documentation		
Relevant medico-legal issues addressed		

Common Circumstances

- Suicidal Hanging(fixed noose inverted V shaped; running noose-horizontal ligature mark; lower suspension/partial suspension oblique/horizontal mark)
- Throttling(Manual strangulation)
- Ligature Strangulation
- Smothering
- Gagging
- Judicial hanging
- Accidental Compression of neck (fall)
- Sexual asphyxia (Scene assessment is must)

Common Mechanisms

- Vagal inhibition of heart
- Cerebral ischemia
- Cerebral Congestion
- Anoxia
- Cervical cord injury

Weight pressure for occluding neck vessels:

- Jugular vessles-2kg;
- Cardotid-4-5kg;
- Vertebral arteries-30kg;
- Trachea-15kg.

Time of producing unconsciousness varies from 10 seconds to one minute if both side vessels are compressed. This is the reason even if person is brought down , cerebral hypoxia makes person brain dead.

How to say?

Whether it is hanging?: Signs of asphyxia, oblique and incomplete ligature in upper part of neck, dribbling saliva, eyes findings, shining/pale subcutaneous tissue, carotid tears, hemorrhages in lumbo-sacral region, absence of any other cause of death are sufficient to declare it as ante-mortem hanging.

Note – There may be concomitant poisoning or other type of suicidal attempt.

Post mortem suspension of body will not show above mentioned findings. Most common allegation in hanging cases, remains it was 'strangulation' not hanging and if hanging there was involvement of third party. If precaution is taken then these issues can be settled fairly.

Whether it is strangulation?

If one finds complete ligature mark around neck , marked asphyxia findings above ligature, blood from oral and nasal cavity, subconjuctival haemorrhages, haematomas and inuries to neck structures, struggle injuries, multiple nail injuries are sufficient to declare it as ligature strangulation.

Whether it is manual strangulation?

In cases of manual strangulation disc shaped bruises from finger digits associated with curved /crecentric nail abrasions; haematomas, bruising and injuries to neck structures; asphyxial findings as above in ligature strangulation; associated smothering attempt.

Whether it is compression by object?

Strangulation by neck compression by objects or pressure over neck from back against object. These situation will have impression of object, neck trauma is prominent and is slightly of different type from ligature and

manual strangulation. Close photography and comparison with object shape and pattern is helpful in differentiating. Skin tags over object may present. Shaving of back scalp hair can help in finding bruise over upper neck. Dissection of front and back is recommended.

Photographic Points in different asphyxia deaths

Hanging

At scene where hanging is being carried out-

- Photograph overall view,
- Body view and then closer views of
- Hanging point /Suspension point – roof, ceiling fan, window railing etc.
- Type of knot
- Manner of application of knot to neck
- Knot around the neck
- Facial features – cyanosis , condition of tongue , saliva dribbling, condition of eyes
- Relation of feet to ground – touching , if above how far
- Floor just underneath feet
- Stepping point
- Signs of struggle
- Place from which ligature was taken or cut

At the time of Postmortem examination

- Ligature
- Knot
- Ligature mark complete coverage with and without scale
- Open Eyes with bulbar and palpebral conjunctivae for hemorrhage and state of cornea
- Lips
- Dribbling of saliva over face , neck and clothing
- Hands with nail
- Feet with nails
- Face –front, both sides and back
- Layer-wise dissection and important findings of front and back of neck
- Oro-pharynx – larynx
- Haemorrhagic points at dorso-lumbar spine
- Tears in carotid

Strangulation

- Ligature
- Ligature mark over neck
- Finger and finger nail marks
- Nostrils and its contents
- Lips for contusions and teeth indentation marks
- Eyes as in hanging
- Hands and nails
- Ankles for ligature
- Struggle marks
- Important neck findings on layer by layer dissection
- Thyro-hyoid complex
- Sub pleural blebs
- Inter lobar fissure haemorrhages in lungs
- Oro-pharynx for congestion , haemorrhages
- Tongue sides for bites
- Any other important findings

Smothering important views of at postmortem examination

- Nose flattening
- Around mouth nail abrasions and finger shaped bruises
- Lips for injuries
- Inner lips for teeth indentation tears , bruising and abrasions
- Marks of resistance

Gagging important views at postmortem examination

- Gagging piece of cloth/ material in place
- Position of hands and legs (tied or not)
- Cloth inside oral cavity and abrasions by it , cloth fibers
- Abraded palatal surfaces and inner cheeks
- Secretions in trachea and near vocal cord
- Rest as deemed important

Traumatic Asphyxia photographic views of

- Discolored part of upper trunk and face
- Remains of material causing compression
- Inhalation of finer particles of gravel/ mud / sand etc

Social Forensic Message

Man has only fifteen minutes of life if asphyxia takes charge

DEATHS IN DROWNING (WATER IMMERSION)[1,2,4,5,6,7,10, 11,14]

The following procedure is in addition to what described under Sudden Natural Deaths.

(For the bodies recovered from wells, ponds, lakes, swimming pools, rivers and sea without any apparatus used for

swimming and diving)

History

Details about the water body where the body found have to be documented

Well- Used or unused; protected or unprotected; depth; presence or absence of projection like stones.

Ponds and lakes: Measurements, human activities, nature of water, presence of animals such as crocodiles, fish etc.

Swimming pools: Commercial or private, well maintained or ill- maintained, measurements (Width, length, Depth), presence of life guards and other people, Chlorination, Lighting, etc.

Rivers: Nature of water, presence of stones, human activities, animals, etc.

Other water bodies can be lake, sea, canal, tank,pond and bath-tubs etc.

Scene visit should be done if indicated and desired some points.

Details about the person

Can or cannot swim?

Instruction received from coach, owner in the case of Swimming pool deaths.

Alcohol and drug habits of the person.

Details about the body at the time of recover

In cloths, swimming kit?

With or without shoes?

Presence or absence of bondage or ligatures.

Fresh or decomposed state at the time of recovery

External Examination

- Body must be examined with clothes, shoes and contents must be documented.
- Careful examination to document effects of immersion is important. (Washer Woman hands and feet, Cutis anserina)
- Presence of cadaveric spasm must be documented
- Presence or absence of tenacious foam must be documented and photographed is recommended
- Any injury found on the body must be documented.

Internal Examination

Central Nervous system

- It is recommended that the brain is examined at the beginning of the postmortem examination.
- The cervical spine is examined carefully.

Respiratory system

A formal dissection of the neck is mandatory and larynx, trachea and major airways and contents must be described. Special mention must be made regarding froth in the airways.

Pleural cavity must be examined for effusion.

Specimens

Validity of Diatom test is debated widely and it should be accepted that there is no ONE diagnostic test for drawing opinion[6].

Examination of Blood samples from right and left heart for difference in electrolytes is obsolete.[1]

Blood for toxicological screening including alcohol and drug abuse has to be done.

Histology of major organs should be done.

Procedure for deaths associated with Self Containing Under-water Breathing Apparatus (SCUBA) (In addition procedure described above)[6]

Scene Visit

This should be done whenever appropriate.

The SCUBA equipment must be examined by a competent technical person and a verbal or written report must be provided to the pathologist by Investigating Officer.Identifiable defects in equipment must be recorded, photographed and documented by technical person for future reference.

Radiological Investigation

It is highly recommended.[6]

External Examination

Examination of the ear drums must be done ideally with an auriscope for ruptured tympanic membrane.

Internal Examination

Respiratory System

It must be checked for pneumo-thorax.

Evidence of interstitial emphysema must be looked for.

Cardiovascular System

- The pathologist must check for evidence of air embolism.
- Epicardial arteries and great veins must be examined for air bubbles. Epicardial sac must be filled water and right atrium and ventricle must be opened under water to demonstrate escaping air bubbles.
- Presence or absence of foramen ovale must be documented.

Central Nervous System

The brain and spinal cord must be referred for formal

neuropathological examination.

Musculoskeletal System

Head, neck, and shaft of humerus and femur must be examined for changes due to dysbarism. Musculature of chest and upper limbs may show bleeding.

Specimens

1. Histology

   Samples from major organs must be retained for subsequent histological examination.

2. Radiology

   Once the equipment is removed, the body must be subjected to full X-Ray examination including limbs, lateral chest, where possible upright 45 degree angle chest X-Ray. These must be done immediately after receiving the body.

3. Toxicological Analysis

Audit Sheet for Bodies Recovered with out any Apparatus[5,7,11]

Check Points	YES	NO
Details about type of water body documented		
Depth of water in feet or meter		
Photography at scene and at the time of PM		
Body position on surface / deep / bottom / face down or up/limbs tied or free		
Mouth and nostrils – covered or open		
Clothing and shoes examined		
Body intact/dismembered/ damaged by aquatic creatures		
Cadaveric spasm		
Ocular signs		
Skin changes - Signs of immersion documented		
Signs of decomposition documented- purging, bloating, skin discoloration, skin slippage, marbling, adipocere		
Insect position		
Formal neck dissection done		
Respiratory tract examined for foreign bodies		
Toxicological screening done		
Samples for diatom test taken Water sample preserved		

Audit Sheet For Scuba Deaths

In addition to above procedure[5]

PROCEDURE	YES	NO
Radiology of the body		
Examination of the apparatus with a qualified technician		
Histological examination of bones and other tissue for necrosis		
Blood gas analysis if death is on arrival in the hospital		

Special Note on -

Swimming pool drowning , the following information may be asked

Check Points	Yes	No
Use of intoxicant like alcohol and drugs		
Ability to swim		
Trauma		
Diving		
Seizure		
Epilepsy		
Coronary Artery Disease		
Tiredness		
Exhaustion		
Electrolyte Imbalance		
Full stomach and aspiration		
Chlorination level of water		
Bacterial level		
Presence of trained coach		

Common Circumstances

- Accidental Drowning
- Suicidal Drowning
- Homicidal drowning

Common Mechanisms

- Laryngeal Spasm
- Vagal Inhibition of heart
- Liquid (water) aspiration in to air passage and Anoxia
- Electrolytes imbalance
- Pneumonia in delayed deaths

Immersion artefacts

- Light red, pink postmortem staining
- Maceration of skin or washer-woman's skin
- Epidermis of hands and feet peels off like gloves

- Chromogenic bacteria(bacillus prodigiosus and bacillus violaceum) invade skin and give tattoo appearance-1-2 weeks.
- Aquatic Injuries

Photographic points

At Scene

- Overall scene
- Position of body
- Clothing
- Foot wear
- Face - foam from nose and mouth , cyanosis
- Hands- cadaveric spasm
- Whether tied or open limbs
- Body – any visible injury
- Insect activity
- Artefacts
- Type of algae
- bites of sea creatures
- Water sample for diatoms

At the of post-mortem

- Overall body
- Mouth and nostril
- Froth at nostrils and upper respiratory tract
- Lips and contents of mouth
- Head & Neck
- Clothing
- Limbs
- Trachea
- Lungs
- Stomach
- Any other important findings

On autopsy features to decide fairly **in favour of drowning** are foam over nostrils and upper respiratory tract, aquatic debris in bronchioles, pulmonary odema fluids sinuses, petrous ridge haemorrhages, emphysema acqusom, same fluid in small intestine, cadavric spasm, no other fatal injury. Decomposed bodies recovered from water pose a difficulty but meticulous workout of case can result in positive diagnosis.

Social Forensic Message

Swimming is a good exercise if you know it

Toxic Gases induced suffocation

Lack of oxygen either due to mechanical , chemical and concentration of oxygen in ambient air result in asphyxia deaths. Common examples remain carbon monoxide, carbon dioxide, hydrogen sulphide, phopsphine, hydrogen sulphide, nitrous oxide, chlorine, methane, methyl isocynate, cyanide, ammonia. A brief description of important gases is given here.

Carbon Monoxide

It is an odourless, colourless, and non- irritating gas and can accumulate in confined places, covered external air passages, underwater swimming, incomplete combustion of organic materials. If, it is associated with smoke from fire then soot deposition may be seen over skin and in respiratory tract.

Postmortem findings: Cherry red and bright pink postmortem staining and appearance of organs and muscles due to presence of carboxyhemoglobin. This pinkish discoloration is also noticed over inner surface of lips, inner of cheeks, nail bed in fingers and toes and surfaces of organs.

CO levels more than 10 % in blood is confirmatory of it's role in death. If it is absent then other causes of suffocation should be evaluated/ considered. Inhalation of heated smoke and steam result in rapid swelling and increased secretions in respiratory tract.

Cyanide

Cyanide is a very strong and fatal asphyxiant when present in gaseous form. The reaction cyanide salt with Hcl in stomach liberate HCN or KCN gas.

Postmortem findings: Cherry red or pinkish bright discoloration of skin and other structures.

Strong odour of bitter almond emanating from body cavities and fluids. Stomach contents, blood and urine are ideal samples to detect it chemically.

Methane: It is a product of decay of organic matter. It replaces oxygen in confined places and sewages. This may cause rapid loss of consciousness. Postmortem findings are non-specific and are those of suffocation. Low oxygen level in air of place may be noted by Oxymeter.

Nitrous Oxide: recreational use may result in accidental death.

Tunnel Entrapment: Metro tunnels in modern India have posed problems of entrapment in closed railway compartment due to electric failure, fire, explosion and collision. In busy hours, one compartment has more than 100 people commuting at one time. One compartment has 52 sitting and more than 100 people can be accommodated in standing. In peak hours, mainly in the morning and evening hours, festival times, one bogie has more than 200 people riding it. In cases of electricity failure in summer and

humid environment , it is very suffocating inside and quality of air has dominance of carbon dioxide . As the duration of entrapment increases beyond 20-30 minutes , CO_2 toxicity takes over, outcome and severity depend on number of commuters and air quality.

Outcome of entrapment depends on type of incident and time taken in evacuation of passengers. India is highly populated country and all public transport are overloaded and overstressed. There have been more than 10 incidents with fatal outcomes. Fatality results from suffocation due to lack of oxygen, inhalation of smoke arising from fire, stampede due to panic situation; multiple injuries from jumping, concrete and iron structures over track; injuries from another train on parallel or opposite lines.

SEWER GAS SUFFOCATION FATALITY [14,40,41,48,85]

Hydrogen sulphide in combination with methane, nitrogen, hydrocarbons, ammonia and carbon dioxide is formed in sewers, is known as sewer gas. This is a work related suffocation among cleaners of sewages. At times, these workers enter into sewage without protective devices which lead to suffocation. The main gas which is responsible of such deaths is Hydrogen Sulphide in higher concentration. It is present in wells, sewage , septic tanks , close premises, coal mines, dung gas or any organic garbage dumps.

H_2S is colourless, toxic, flammable and water soluble gas. It is generated as by product of organic decomposition. It is heavier than air so it get accumulated in low lying areas and close spaces. It is easily recognized due to peculiar smell of '**rotten eggs'**. Normal tolerable limit is 20ppm and levels more than 100 ppm is dangerous to life. [40] It produces irritation of respiratory track . At levels more than 300 ppm it is neurotoxic and cause collapse and paralysis. Hydrogen sulphide in higher concentration 1000-3000ppm produce effect on CNS leading to sudden deaths.[85]

Sampling, 10 ml blood in red top tube for blood thiosulphate (normal 0.3 microgram/ml , range beyond 8 are dangerous)[41]. Blood samples should be collected at earliest for blood sulphide levels. Among tissues lungs and brain are very useful for thio-sulphate levels. Urine samples for thioslphate are very helpful in slow deaths.

Post mortem findings: It produces cyanosis, bronchial secretions, pulmonary oedema, haemoptysis, visceral congestion, petechial haemorrhages, greenish colour of brain , typical greenish blue to chocolate colour post-mortem staining. There are generalized asphyxia findings. There may aspiration of sewage contents in lungs.

Photo documentation in sewage gas poisoning

Scene

- Overall of scene
- Drain depth and gas
- Safety measures and equipments
- Sludge over body
- Face and nostrils
- Condition of clothing

At the time of postmortem examination

Overall appearance, postmortem staining appearance, trachea, lungs, brain, stomach

Audit sheet in sewer gas fatality

Overall scene	Yes	No
History		
Clothing		
Photography		
Sampling		
External findings		
Internal findings		
Viscera preservation		
Opinion		

Social Forensic Message

Wear safety devices while going deep into sewer for cleaning.

Exhaust fans are put over main holes of gutter before entering.

DEATH ASSOCIATED WITH FIREARM INJURIES [1,2,4,5,6,7,10, 11,14,53,67]

The following procedure is in addition to the procedure described for Sudden Natural Deaths

History*:* Date and time of the incident, nature of the weapon involved, distance between the weapon and the victim, number of shots, etc.

Psychiatric History of the victim (suicidal attempts)

Scene must be visited when appropriate. Spatter of blood and tissues must be documented

Radiography of the relevant part body should be done to locate missiles and locate fractures and lesions like pneumothorax, pneumoperitonium. [(6)] If x-rays are taken on arrival of the body to casualty then these are very helpful in deciding future course of case. First radiograph should be with clothing and then subsequent can be done on naked body.

Photography of clothing, body and injuries is highly recommended**.** Photography should include body with clothing, wounds, photographs of after cleaning, tracks formed by missiles. Details in the end.

External Examination

Never Disturb clothing

Clothing must be examined in situ and in relation to the

injuries in the body. Presence or absence of Burning, Blackening, Tattooing, direction of the blood stains and direction of fibers must be noted. Photography of clothing must be done. Residue must be taken from palms, fingers and web space by swabs moisten with saline by the pathologist or forensic science expert and should be sent for comparison and analysis whenever it is thought appropriate. Clothing must be preserved and chain of custody must be maintained.

Examination of the body

Description of the Entry wounds and Exit wounds (**Entry wounds and Exit wounds should be described separately)**

1. Presence or absence or Burning, Blackening and Tattooing
2. Measurements of Skin defects
3. Comments on the abrasion color around the skin defect
4. Comment on Muzzle Imprint, Foresight imprint and description.
5. Direction of wound and travel of missile
6. Color changes of tissue due to Gases (CO)
7. Exact location in reference to fixed anatomical land marks and in relation to midline and heel level (Distance in centimeters)
8. Description of Residue and collection for analysis

Measurements from acromio-clavicular joint to olecranon and the distance from the olecranon to the tip of middle finger [6] should be taken in suicidal cases.

Internal Examination

- Documentation of the injuries to the organs, amount of blood in cavities and reconstruction of the tract in relation to entry and exit wounds. Location of bullet/ foreign Bodies, recovery and preservation for analysis.

Specimens

- Blood for alcohol, drugs and toxicological analysis as indicated
- Histology of Skin when appropriate for powder effect and inflammatory reaction
- Residue and projectiles for analysis by Ballistics experts.
- All bullets/discharged ammunition should be put in a glass bottle having cotton padding. All bullets should be photographed with scale, one sketch should be made. Electronic weight of bullet should be recorded. These small measures of electronic weight, X-ray, sketch and photographs can avoid any possible tampering of evidence at the later stage.

Comments

- Opinion on the nature of weapon like shot gun or rifled(pellet or bullet weapon) further part depends on confidence and training of the person
- Possible range of fire (with muzzle mark/wad and fire (close contact) within fire/powder range (close range) or beyond it without powder and residue effect (distant range)
- Number of shots
- Number of weapons (different types of ammunition used).
- Nature of Projectiles (Jacketed, Unjacketed, Measurements).
- Opinion of Ballistic Division (Firearm expert for physical properties) must be sought
- Medical man should confine to Wound ballistics and general properties
- Reconstruction or animated reconstruction by using advance computer software and dummy experimentation is very informative
- Common problems in interpretation of wounds are due to surgical intervention, removing of clothing or clothing not subjected to examination, presence of multi layers of clothing and decomposition of body.
- Ammunition(bullets and pellets) are identified on basis of identification number, manufacturer, weight, diameter, cartridge type, base design, length ,colour, shape. location of cannelure.
- Test fire indicated relationship with tested weapon, unrelated to weapon, fired with same weapon having primary and secondary markings.
- Evaluation of original positions may give answers to bullet trajectory and atypical wounds while reconstructing scene.
- Interpretation of firearm wounds should be avoided when blood is masking their appearance.
- Stop running water on autopsy table when examining for retrieval of bullets. Use of filtering sieves in water sink prevents slippage of bullets into drain.
- Among body tissues, fat is notorious for providing a soft cushion to embedded bullets and makes retrieval a difficult task. The body areas like abdomen , buttocks, thighs , spine and para-spinal muscles pose a difficulty in retrieval. All bullets should be retrieved in murder, encounter, gang fight and multiple assailants are involved.

Scene Evaluation in consultation with IO and Crime Scene Investigation team (CSI)

Check points	Yes	No
Incidence date and timing		
Position of body		
Relative positions of parties		
Blood spatter		
Casing of bullets		
Discharged bullets from through and through wounds		
Disturbance of area		
Items present around		
Entry /Exit to premises if closed premises		
Types of weapon used		
Photography from all angles in relation to body and premises		

Evidence list in Firearm cases

Check points	Yes	No
Blood in gauze piece		
Hair of wounded area		
Finger Nail scrapping		
Gunpowder residue from entrance		
Clothing showing gunpowder deposition / defect in clothing		
Presence or absence of flame, singeing, powder, soot deposition muzzle imprint, stippling Photography of entry /exit wounds in relation to body and close shots	Encircle if present	
Swabs from hands if suspected / evident that victim handled weapon		
Track length and direction		

Planning of firearm case should be carried out in four stages:

A. At Crime Scene (overall view , blood , bullets, cases, weapon, finger and foot prints , vehicle tyre marks, entry and exit points

B. At Casualty (Important are clothing, original wound, surgical intervention, x-ray)

C. Postmortem Room (Complete work out of case)

D. After postmortem reconstruction of scene in relation to firearm injuries on postmortem examination (putting things in logical order)

Firearm cases should be dealt in a well planned way as done in any surgery case

- X-ray with clothing
- Photography with clothing and original shape (Six shots).
- Photography without clothing in original shape , orientation and close-up shots
- Evidence Preservation (Blood , gauze , swabs etc)
- Cleaning of body
- Proper description of wounds with orientation and close-up shots
- Preparation of sketch of each track and its photography
- Permanent cavity dimensions formed by missiles
- Handling of recovered missiles and bullets
- Embedded bullet should be retrieved with gloved fingers
- Body wounds – number, location, size, appearance, track, surgical intervention, clothing finding in relation,
- Hands –powder, gas, blood, tissue
- Gases- Nitro-cellulose, nitro-glycerine, nitrites, graphite, H, CO, N, Co2

Role Division in firearm cases

Forensic Medicine Expert	Forensic Scientist
Examine clothing for firearm effects – powder, holes, tears, burns, blood in systematic manner and document these with sketches, photographs and diagrams Seal clothing for further examination in FSL.	Examine clothing for gun powder and tears in the clothing Examine bullets as per their protocol for finer details Weapon examination
Examine and record all injuries inside and outside of the body. Make proper sketches and take appropriate photographs Preserve all discharged ammunition bullets, pellets without cleaning/ washing. Take photograph, prepare sketch and electronic weight of bullets. Seal it for further examination for primary and secondary markings and other tests as required.	Crime reconstruction with the help of forensic medicine expert and investigator
Do not comment on microscopic part until unless, you are trained in this	This part belongs to forensic Ballistic Division
If recovered bullets are brought then advise – first send these for DNA and Ballistic examination	This part belongs to Forensic Laboraorty

Crime Scene Reconstruction: It is a joint exercise carried out by forensic scientist (Ballistic), forensic medicine, investigator and computer programmer for animation.

Clothing examination is must for corroboration of injuries over the body and is integral part of forensic medical

examination.

Commenting on nature of fibers , finer parts of gun powder and their chemical testing , heat effects etc belongs to forensic scientist.

Swabs from hands/ entry wounds – these should to be collected by medical man during postmortem or forensic scientist if facilities are provided to morgue. These may be taken on plain swab or may be taken by moistened swab with 5% nitric acid.

Audit Sheet[5,7,11]

PROCEDURE	YES	NO
Scene visit		
Radiography		
Photography original condition, clothing, defects in clothing, body wounds, tracks		
Clothing examined for effects and gun powder residue		
Injuries examined for effects of gun powder residue without cleaning		
Firearm and other Injuries after cleaning described with size, shape and powder effect		
Reconstruction of large wound for clear view		
Internal tracts described and sketch prepared for each wound		
Recovery of missiles		
Missile's weight, sketch, photograph identification sign		
Preservation of bullets in cotton padded bottle		
Residue and missiles handed over to police properly		
Relevant medico-legal issues addressed		
Toxicology done as indicated		
Documentation		

Common Circumstances

1. Homicidal Shooting
2. Suicidal Shooting
3. Accidental Injuries

Common Causes of death

- Injuries to Brain
- Injuries to Chest organs (heart, lungs)
- Hemorrhagic Shock
- Hemo-pneumothorax
- Injuries to neck structures

PHOTOGRAPHIC POINTS IN FIREARM CASES

Firearm - all perforations, penetrations, grazing injuries

- Overall view
- Close of body with items around
- Clothing defects in mid and close range
- Hand position with close-up of discolored areas
- Entrance wound of firearm
- Exit wound of firearm
- Powder effects -burns, deposition, stippling
- Firearm's presence / absence in vicinity
- Possible trajectories and discharged ammunition and their location
- Ejected cartridge case near place of firing
- Penetrating slug
- Places in walls if there / tree for lodging of fired bullets
- Points of reflection in walls, trees, pillar, vehicle etc
- Place of firing and angle of travel of projectile

At the time of postmortem examination

- Standard Photographs as already mentioned in general section.
- All clothing defects and discoloration.
- Mid and close-up photographs of all injuries entry, exit , graze or otherwise with and without scale and reference number.
- Track of wound with dimensions.
- Cavity effect of bullet.
- Hands.
- Photograph of available X-rays for easier documentation.

Social Forensic Message

Majority of licensed firearm are used towards self and family. These are methods of affluence otherwise other people manage with bricks and bats.

ROAD TRAFFIC ACCIDENTS DEATHS [1,2,4,5,6,7,10,63,64]

Following procedure is in addition to what described under Sudden Natural Deaths

History(from IO/Relatives/ eyewitnesses)

- Whether the victim is a pedestrian, driver, passenger

(Front or Back seat), rider or pillion rider (with or without helmet).

- How the incident occurred? Hit and run Incident? Run -over? Date and Time.
- Death occurred on the spot or after some time. Conscious level and activities after the accident.
- Consumption of Alcohol or Drugs.
- Medical History specially CAD /Epilepsy/Vision/ hearing impairment etc

External Examination

- Description of clothing, shoes and other belongings
- Description and Measurements of injuries and exact location and direction .
- Presence of contact traces and their collection.
- Tyre marks and patterned injuries must be noted.
- Photography/sketch of patterned injuries.
- Examination of eyes for cataracts, prosthesis, eye spectacles etc.
- Examination of ears for signs of natural diseases

Attempts must be made to identify Primary Impact, Secondary Impact and Secondary Injuries.

Internal Examination

Central Nervous system

- Injuries to scalp and skull –Nature and extent
- Extradural, Subdural, Intracerebral and Intracerebeller and Subarachnoid Hemorrhages –Extent and blood amount/volume.
- Measure and comment on the extent of the brain laceration and contusions
- Presence of Primary Brainstem Hemorrhages. Coup and Contra-coup injuries
- Comment on the evidence of Diffuse Axonal Injuries by observing grossly and on histopathology
- Comment on signs of brain herniation and oedema
- Integrity of Cervical Spine

Cardiovascular system

Presence of myocardial contusions and lacerations; presence of intravascular catheters and pacemakers.[6,7]

Respiratory system

- Injuries to chest wall and ribs, sternum and clavicles
- Lungs contusions and laceration (estimate the percentage of lung parenchyma involved)
- Integrity of diaphragm
- Measure the blood volume/amount in pleural cavities
- Position of intercostals Catheters

Gastrointestinal system

- Liver capsular tears. Comment on the depth/size of the injuries.
- Hemo-peritoneum – Measurement of the volume
- Retroperitoneal hemorrhages –extent in relation to anatomical markings
- Mesenteric and bowel tears, contusions- Comment

Reticulo-endothelial System

- Spleen- integrity of capsule and parenchyma

Musculoskeletal System

- Injuries to limbs, pelvis and fractures
- Measurements of injuries, exact location and height from the level of the heel.

Specimens[6]

1. Histology- Retain samples from brain, lungs, kidneys for examination for fat embolism as indicated

   Brain for examination for Diffuse Axonal Injury (from Corpus callosum, Parasagittal white matter, pons, internal capsule, superior cerebellar peduncle) as indicated
2. Blood for alcohol, drugs as indicated
3. Radiology (if felt necessary)
4. Broken pieces of glasses/paint pieces/gravel

Comment

- Reconstruction of the Event.
- Photography / Sketch as indicated
- Gravity and details of fatal Injuries
- Summary of Major injuries and pattern which can be helpful in making diagnosis about position of victim (pedestrian, driver, occupant etc)

Audit Sheet[5,7,11]

PROCEDURE/check points	Yes	No
Overall scene		
Overall body photographs		
Clothing Examination		
External injuries documented		
Patterned injuries identified		
Internal bleeding Measured		
Reconstruction of the accident attempted		
Blood sample for Alcohol and Drugs retained		
Blood /tissue for grouping or DNA for matching if found on vehicles		

Common Causes of Death

- Head Injuries
- Chest Injuries (Hemo-pneumothorax)
- Hemorrhagic Shock (abdominal Injury)
- Multiple Injuries
- Air embolism in head and neck injuries or Fat embolism especially in limb injuries

Photographic evidences in vehicular Accident

At scene

- Overall scene
- Position of victim and degree of injuries
- Deceased Activity at the time of incident
- Position of vehicle
- Posted speed limit of signposts
- Weather conditions – visibility, rain , fog , lightening
- Road condition –even/ uneven/ broken /pits / eroded / slippery /oily etc
- Skid marks and their length
- Speed breakers
- Condition of tyre – wear and tear
- Skid Place from where it occurred

At the time of postmortem

- Overall scenario
- Clothing condition
- Material over clothing – paint/ grease/mud / tyre marks/
- Broken pieces if glass
- Blood
- Tissue scattered /crushed
- Crushed part of bones or muscles
- Injuries in detail
- Internal important findings of trauma
- Any natural disease
- Cause of death

Autopsy surgeon should be well versed with different forms of traffic accidents like involvement of cyclists, pedestrian, two- wheeler, three wheeler, four wheeler, trucks, bus, tankers etc.

Social Forensic Message

Learn traffic manners first before driving a vehicle, a must test for all drivers

Drunken driving can produce disability or will bring miseries to your love one.

FACTORY ACCIDENTS

Industrialization has increased number of factories in urban and semi urban areas in India. Any fatality occurring at work place is a big issue between workers and management . Main reasons for confrontation remains safety and compensation to deceased family. There is emotional outburst among workers and at times lead to rioting situation. There is legal issue of compensation and fixing responsibility for negligence. Death certification and relationship with employment activity has serious impact of these issues.

In factory accidents , enquire for following circumstances depending on nature of incident :

General enquiry

Location

Overall view of scene

Machinery involvement

Electricity leakage

Fire eruption

Leakage of gases

Chemical toxicity

Chemical burns

Falling of objects

Bursting of machine

Broken missiles from machine

Human error/ factors

Intoxication

Drug / substance abuse

Deprivation of sleep

Ill health –Tuberculosis, diabetes, hemi paresis

Vision- cataract, retinopathy

Heart ailments – CAD, IHD, MI

What to look for at the time of post-mortem

General condition of deceased

Clothing with trace material related to employment

Injury pattern – general and patterned injuries produced by machinery

Fatal Injury like crushed head, crushed limbs

Complete external and internal examination

Any peculiarity related to long term association with job

Sampling

From clothing – trace material like grease, cement, dust, fine metal dust etc

From body – Swabs for material present over body for corroboration

Photographs and sketches of patterned injuries

Blood, urine for toxicology screening

Photographic points

Scene

Overall view of scene

Position of body

Blood and tissue over machinery

Hair and blood over object if something has fallen over head

Machinery involved

Body mid and close-up range

At the time of post mortem

Overall view of body

Clothing

Full body photography as per routine protocol

Patterned injuries

Important external and internal findings

Cause of death

Common cause of death

Crushed head

Crushed limbs

Head injuries

Electrocution

Suffocation

Multiple Injuries

Audit Sheet

Check points	Yes	No
Overall scene		
History		
Body overall		
Clothing		
Photography		
Sampling		
Cause of death		
Any other issue of relevance		

LIFT / ESCALATOR ACCIDENTS

There is increase in high rising buildings and business establishment in recent past in majority of metropolitan cities of the world. At many times , accidents do happen due to mechanical failure and human errors. Most common situation occur due to sudden collapse of lifts due to broken iron strings /pullies or electrical failure or lack of preventive measures. The injury patterns depends on nature of accidents.

Out side lift

Head crushing while curious looking into depth or above through defective doors.

Crushing or bifurcation of bodies while trapped in between sharp iron doors of lift

Falling inside the pit and then being crushed by incoming lift towards basement

Inside the lift

Head and neck injuries during sudden collapse of lift

Spine fractures

Limb fractures

Crushed between the doors while making forced exit or entry

Escalator

Accidental fall due to loss of balance

Missing steps while walking in running escalator

Recreation riding on sides and falling

Trapping of clothing like gown, duppata / chunni, shoe laces

Patterned injuries due to projecting spikes from steps

Patterned injuries to head and neck

Asphyxiation while being trapped

Sampling

Blood, urine for intoxicant / drug screening

Common causes of death

Lift accidents – Head Injuries , multiple injuries , neck fractures, suffocation in ill-ventilated lift while being trapped in it due to long electric failure

Escalator – Head Injuries, neck injuries, asphyxiation

Photographic points

Scene

Overall scene

Faulty lift

Blood stains and scalp hair over sides of lift

Overall condition and position of boy

Injuries

At the time of post-mortem

Overall condition of body

Clothing

External Injuries, any patterned injury

Internal Injuries

Cause of death

Audit Sheet

Check points	Yes	No
Overall scene		
Body with clothing		
History		
External Injuries		
Internal Injuries		
Sampling		
Cause of death		

Social Forensic Message

Don't panic when stranded, lift has sufficient air to breathe; keep calm and call for help.

Pressing of all buttons together may be helpful in putting on the siren for help.

CONSTRUCTION INDUSTRY ACCIDENTS [57,71,7283,84]

Construction work is labour intensive work and injuries are part and parcel of this work. Construction activities may result in work place fatalities. Majority of people involved are male. The issues of negligence and compensation arise and have serious consequences. Postmortem are important to establish or refute the link. Most of the accidents occur due to lack of energy caused by hunger, fatigue, long working hours, sleepiness, compromised safety measures. Fall from height is responsible for than 50% fatality and next is by falling objects[57,72].

Construction failure

Collapse of roof

Collapse of building

Collapse of wall

Fall from broken support platform

Slip and fall from height

Breaking of escalator

Buried under sand, debris, excavation rock

Electrocution

Cradle collapse

Rotten ropes

Weak stations

Falling material

Crane accidents

Human error

Intoxication

Carelessness

Lack of protective measures

Injuries depend on type of incident

External –multiple injuries, head injury, fractures, spine injuries

Internal – fracture ribs cage, rupture/ laceration of organs

Human diseases- cardiac, neurological, vision

Sampling – Blood and urine for Intoxicants like alcohol; Vitreous humor for sugar levels

Photographic points

Scene

Overall scene

Body

Trace material like cement, cement gravel mixture etc

Boots

Helmet

Position

Injuries

At the time of post mortem

Overall body

Clothing

External injuries

Internal injuries

Cause of death

Body and face reconstruction in disfigured bodies

Common cause of death

Multiple Injuries as a result of fall from height

Head Injuries by falling objects or falls

Electrocution - wet surfaces or broken wires

Suffocation when buried in trenches or under falling objects or sands etc

Traumatic Asphyxia falling of heavy object over chest

Suffocation due lack of oxygen in deep trenches

Audit Sheet

Check Points	Yes	No
Overall Scene		
History		
Overall body condition		
Clothing and protective measures worn		
External Injuries		
Internal Injuries		
Cause of death		
Sampling		
Any thing peculiarity		

DEATHS DUE TO RAILWAY ACCIDENTS[7,11,12,13,14]

India has wider network of railways throughout the country. Injuries may be sustained while boarding a running train, crossing the railway lines, traveling on steps, ejection from open doors, hanging from door handles, jumping from trains, lying over tracks for self killing, head injuries from projections while head is being taken out in running train and collusion of trains. These happenings can lead to injuries as well as fatalities. Pattern of injuries varies according to accident.

Following procedures in addition to what described under sudden natural deaths.

History

1. Date and time of incident?
2. Whether victim jumped himself or pushed by someone?
3. If accident, then whether victim was on the train, or outside the train as in railway level crossing or at station?
4. Whether he was seen falling down or not?
5. In case of mass casualties the engine driver is one of the prime interest to know the exact cause, hence thorough medical history as well as autopsy is mandated with screening for blood alcohol or drugs
6. Exact location of body in relation to the railway track.
7. History of alcohol intake or drug abuse.
8. Whether driver / victim suffering from mental illness or medical conditions like hearing problems or poor vision?
9. Whether brought dead to hospital or died during the course of treatment?

External examination

In general, injuries due to railway collision cause extreme destruction of body and may cause separation of limbs, decapitation or extrusion of organs.

A careful description of external injuries with dating of injuries and ruling out other causes of death is needed

- Description of clothing, shoes (wearing or not, damages present) and other belongings
- Description and measurements of injuries, exact location and direction
- Wheel mark patterns on the body, dirt grease and manner of severing must be noted
- Photography/sketch of relevant and important injuries as indicated
- Attempt to be made to identify the area of impact to the wall/pole/ground

Internal examination

Central Nervous system:

- Injuries to scalp and skull-nature and extent
- Extradural, subdural, intracerebral and intercerebellar, and subarachnoid hemorrhages-Extent and blood volume/amount.
- Measure and comment on the extent of brain laceration and contusions.
- Presence of primary brainstem hemorrhages. Coup and contra-coup injuries.
- Comment on brain herniation, spinal cord examination with special interest to integrity of cervical spine.
- Decapitation injuries are common especially in a determined suicidal person who places his head across the track for self destruction.

Cardiovascular system

- Presence of natural disease- coronary artery as well as the myocardium examination.
- Presence of existing intravascular devices or pacemakers
- Presence of myocardial contusions, lacerations

Respiratory system

- Injuries to chest wall and ribs, sternum and clavicles
- Lung contusions and lacerations (estimate the percentage of lung parenchyma involved)
- Integrity of diaphragm
- Measurement of blood amount/volume in pleural cavities, check for signs of pneumothorax.
- Position of any inter-coastal catheters

Gastrointestinal system

- Liver capsular tears, comment on the depth/size of

injuries

- Hemo-peritoneum- measurement of volume
- Retroperitoneal hemorrhages- extent in relation to anatomical markings.
- Mesenteric and bowel tears, contusions- comment

Reticulo-endothelial system

- Spleen- integrity of capsule, parenchyma and amount of clot surrounding the spleen

Musculo-skeletal system:

- Injuries to limbs, pelvis and fractures. Extreme injuries include amputation of one or more limbs
- Presence of any congenital/ acquired anomaly may have role while crossing track or boarding train.
- Measurements of injuries, exact location and height from the level of heel.

Specimens

1. Blood for alcohol, drugs
2. Radiology for bony injuries likely to be missed
3. Histology (If necessary as indicated)
4. DNA in mass casualties

Comment

- Reconstruction of the event along with crime scene visit- may help to corroborate the circumstantial evidence.
- Gravity of injuries
- Summary of major injuries

Audit Sheet

Procedure	Yes	No
History		
Clothing examination		
External injuries documented		
Rule out foul play		
Wheel pattern injuries/ dirt, grease identified		
Internal bleeding measured		
Reconstruction of event with crime scene visit		
Blood sample for alcohol and drugs		
DNA for identification		

Common causes of death

- Multiple Injuries
- Head injuries- Decapitation
- Traumatic amputation of limbs
- Chest injuries (hemo-pneumothorax)
- Hemorrhagic shock
- Septicemia (delayed deaths)

Important Photographic points

Scene

- Over all view
- Personal items
- Position of body
- Body parts if transected
- Any suicide note

At the time of postmortem

- Overall body view
- Clothing
- Body photographs
- Pattern of injuries
- Important external and internal findings.

Social Forensic Message

Don't have competition with running train while crossing , let it go first

DEATHS ASSOCIATED WITH FALL FROM HEIGHT [11,52,57,71,72,73, 74,83,84]

Following procedures in addition to what described under sudden natural deaths.

History

1. Date and time of incidence?
2. Place of incident: whether workplace, residence, deserted buildings.
3. Whether victim accidentally slipped or jumped himself or pushed by someone?
4. Whether he was seen falling down or not?
5. History of alcohol intake or drug abuse.
6. Whether brought dead to hospital or died during the course of treatment?
7. Whether suffering from mental illness or medical conditions?
8. Was there sufficient lighting
9. Safety measures adopted to prevent mishap
10. Presence of suicide note
11. Personal belongings at site

Scene Visit (recommended where it is going to be informative and confirmatory)

- Look for the height of building or object from where person has jumped / fallen
- Landing surface formation and blood or other tissues over it
- Any intervening objects and their pattern, peculiarity, damage, any blood stain or other biological material present over it
- Ante-mortem jump or fall or it was a drop of a dead body
- Keep in mind the height; low (10-15 feet), moderate (20-25 feet) or great height more than 25 feet.
- Projected path of falling and expected distance of recovery of body
- Dummy exercise in controversial cases is helpful, if feasible by resources ; it is not essential but just of corroborative value.

External examination

- Description of clothing, shoes (wearing or not, recovery from the place of fall, damages present).
- Description and measurements of injuries, exact location and direction.
- Presence of contact traces and their collection
- Grazed abrasion patterns or patterned injuries must be noted
- Photography/sketch of important and relevant injuries
- Attempt to be made to identify the area of impact to the wall/ground after the fall.
- In slip and fall , only a few minor abrasions or bruises, major trauma is to head or wrist/elbow fracture or fracture femur (in old osteoporotic people).

Internal examination

Central Nervous system:

- Injuries to scalp and skull-nature and extent
- Extradural, subdural, intracerebral and intracerebellar, and subarachnoid hemorrhages- Extent and blood volume
- Measure and comment on the extent of brain laceration and contusions
- Presence of primary brainstem hemorrhages. Coup and contra-coup injuries.
- Comment on brain herniation, spinal cord examination with special interest to integrity of cervical spine

Cardiovascular system

- Presence of natural disease- coronary artery as well as the myocardium examination.
- Presence of existing intravascular devices or pacemakers
- Presence of myocardial contusions, lacerations

Respiratory system

- Injuries to chest wall and ribs, sternum and clavicles
- Lung contusions and lacerations (estimate the percentage of lung parenchyma involved)
- Integrity of diaphragm
- Measurement of blood volume in pleural cavities, check for signs of pneumothorax.
- Position of any inter-coastal catheters

Gastrointestinal system

- Liver capsular tears, comment on the severity , size and depth of injuries
- Hemoperitoneum- measurement of amount
- Retroperitoneal hemorrhages- extent in relation to anatomical markings.
- Mesenteric and bowel tears, contusions- comment

Reticulo-endothelial system

- Spleen- integrity of capsule, parenchyma and amount of clot surrounding the spleen

Musculo-skeletal system:

- Injuries to limbs, pelvis and fractures
- Measurements of injuries, exact location and height from the level of heel.

Specimens

1. Blood for alcohol, drugs as indicated
2. Radiology for bony injuries which likely to be missed or poorly documentated . It also established pattern of fractures.
3. Histology (If necessary and indicated), not required routinely

Comment

- Reconstruction of the event along with crime scene visit- may help to corroborate the circumstantial evidence.
- Gravity of injuries
- Summary of major injuries.

Audit Sheet

Procedure	Yes	No
History relevant to issue		
Crime Scene evaluation photos /visit/reconstruction		
Clothing examination		
External injuries documented		
Grazed abrasion/ patterned injuries identified		
Internal bleeding measured		
Dust/botanical material over palms and soles		
Blood sample for alcohol and drugs		

COMMON CAUSES OF DEATH

- Multiple Injuries
- Head injuries
- Spinal Injuries
- Hemorrhagic shock
- Limb bones fractures (lower end of tibia and fibula, femur)
- Chest injuries (hemo-pneumothorax)
- Septicemia (delayed deaths)
- Fat embolism

Characteristic pattern of injuries in form of – Calcaneum and talus bone fracture while landing on feet; ring fracture in base of skull when impact get transmitted through spine in sitting like posture or buttock portion strikes or there or erect standing landing posture is there; rib fractures if sides are involved.

Important photographic points in deaths due to fall

Fall or slip from standing height (average height as per age)- slip and fall cases

- Causes of Tripping (slippery surface during floor washing, wet mud in raining, oil leaks, uneven surface, stairs etc)
- Imbalance (stepping, slippery slippers/ foot wear, uneven
- Stopping surface
- Sudden pushing
- Imbalance
- Obesity
- Objects present over scene like brick/ stone / pavement/ projecting stones
- Surface hitting the body
- Major impact is seen in head, mainly in occipital , temporal and frontal parts depending on side of slip
- Injuries over elbow, side of chest, trunk and upper portion of lower limbs may be there
- Take close-up of patterned injuries (mainly abrasions produced by gravel or any projecting object like bath room fittings etc)

Jumping/fall from more than standing height , one should assess

Scene

- Total height
- Body mass
- Body orientation
- Distribution of impact forces
- Age
- Vision
- Landing point/ Stopping distance

At the time of postmortem

- Overall view of body with clothing
- Shoes with lower part of legs
- External Injuries
- Head and neck
- Trunk showing its integrity
- Fracture bones
- Organ lacerations and tears

Fall from first floor up to third floor (25-30 feet)

- Overall view
- Jumping surface feet and palm prints with dust
- Shoes or footwear near jumping point
- Suicide note near jumping points
- Projections in the jumping path
- Ground surface where body was recovered
- Overall view of the body
- Close range of head and neck
- Close range of ankle and thigh areas

At the time of post mortem

- Overall view of body with clothing
- Surface injuries
- Internal injuries in head, neck chest , abdomen , pelvis and limbs

- Fracture sites
- Bleeding pools
- Close up of patterned injuries

Fall from heights more (third to tenth floor) roughly more than 25 feet

- Same as above mentioned
- Bursting of head
- Multiple bone fractures
- Multiple spine fracture

When falling from high building air cushion drives body little away from the foot of building so body may fall little away from the wall.[74]

More than 80- 100 feet (10th floor and even more heights)

- Body is like a jumbled mass with multiple fracture and disruption of body parts
- Bursting of head, skull bone pieces may be present in vicinity with scattered brain matter
- Tissue and blood may be spotted in larger periphery
- Rest depends on type of landing surfaces
- Sometimes, there may severing of body due to intervening projections in the fall trajectory

Social Forensic Message

Keep balcony railing height above the waist level

High rising buildings shifts mode of committing suicide to jumping in spur of moment!

Principle of easy accessibility in impulsive suicides

FATAL ANIMAL ATTACKS [108-112]

Animal whether predator or prey has well developed and effective weapon for attacking its prey or to defend from the other predators. Animal are good friends of humans since inception of civilization but at times they kill them too Parts used to cause injuries by different animals could be – teeth , head, horn, tusk, paws, claws, tail , trunk , feet as per possession and convenience. For simplicity, these animal can be categorized as below:

Pet animals – dogs, cats

Domestic Cattles- cow, buffalo, ox, goat, camel, horse

Stray animals – dogs, cats, cow, buffalo, ox

Aquatic pet animals like crocodiles, alligators

Forest / zoo animals- tiger, lion, jaguar, leopard

A brief account of injuries produced by them is as:

Dogs: Dog bites are commonest injuries in day to day life. The size and age are of the victims determine sites of bites. Children are bitten over neck, face, head and extremities. Adults are bitten over hands, lower and upper extremities. Injuries varies from puncture, crush, tear, avulsion.

Cat: cause small puncture wounds, scratches with paws and teeth.

Cow: blunt trauma to groin, abdomen or head either by head or horn or legs. Horn injuries are large penetrating lacerations to abdomen , chest or face regions. Bull injuries are common in groin and abdomen or blunts trauma to chest and head. It cause injuries to organs and thus results in crushing and lacerations. The injuries are more towards right side of body and groin area as a result of natural reflex of defence. Once horn get entangled in groin then there could be tears and laceration in groin.

Buffalo: same as above

Ox : same as above, more severe variety due to aggression and repeated trauma.

Camel: Crushing and grinding of tissues with lacerations. Teeth indentation marks

Horse: Blunt trauma by leg and bits are common

Donkey: Unlikely but sometimes kicks

Elephants: Goring , throwing and stamping . Crushing effect over chest, abdomen, head and neck are common. Look for foot pad marks. Injuries are severe due to heavy crushing.

Tiger / Lion/ Jaguar: Cause tearing, lacerations and avulsions by teeth and paws. Most attacks are directed towards neck as their teeth and jaw are adjustable and even penetrate spine of victim easily.

Jackal, fox, have dog like bites and injuries. .

Crocodile/ alligator: They take a tight grip and shake victim vigoursly to separate it from other parts of the body. They produce injuries by biting and crushing force of strong jaws.

Autopsy

Overall body view

External Findings – condition of clothing, Injuries, bites, any pattern injury

Internal findings at neck – crushing and tearing

Internal findings to abdomen and chest – tearing by horns, lacerations, crushing effect

Groin- bruises, tears, avulsion and protrusion

Photographic points depends on type of animal

Condition of clothing

Details of neck trauma

External body injuries

Important internal findings

Groin injuries

Patterned injuries with oriental and close-up shots.

Sampling –

1. Blood or saliva of animal from human victim
2. Blood and human tissues from animal if killed

Audit Sheet

Check Points	Yes	No
Overall view of body		
Clothing details		
External Injuries		
Internal Injuries		
Photography		
Cause of death		
Human tissues and blood from animal mouth or GIT if killed		

Cause of death

Crushing of neck

Multiple injuries

Haemorrhage from penetrating injuries

Large open tears and penetrations to chest and abdomen

Note: Many times, big animals like cow comes suddenly on road then fast moving vehicles may have accident then those fatalities will be dealt under RTA.

Social Forensic Message

Never irritate an animal when hungry or in hormonal peak.

Ragging Deaths

In Indian institutions, when ever new admissions are there in colleges then fresher are subjected to an unique way of introduction to seniors in the college. This relevant in majority of the institutions but at times, it takes ugly shape and even results in fatalities and suicides

In 2009, there were registered 88 cases of suicide and there were total 12 deaths. After this a serious view was taken by Indian Courts and UGC. The University Grants Commission vide its letter no F.1-16/2007 (CPP-II) dated June 17, 2009**, Ragging** constitutes one or any of the follows acts[127]

"Any conduct by any student or students whether by words spoken or written or by an act which has the effect of teasing, treating or handling with rudeness a fresher or any other student.

Indulging in rowdy or undisciplined activities by any student or students which causes or is likely to cause annoyance, hardship, physical or psychological harm or to raise fear or apprehension thereof in any fresher or any other student;

Asking any student to do any act which such student will not in the ordinary course do and which has the effect of causing or generating a sense of shame, or torment or embarrassment so as to adversely affect the physique or psyche of such fresher or any other student.

Any act by a senior student that prevents, disrupts or disturbs the regular academic activity of any other student or a fresher.

Exploiting the services of a fresher or any other student for completing the academic tasks assigned to an individual or a group of students.

Any act of financial extortion or forceful expenditure burden put on a fresher or any other student by students;

Any act of physical abuse including all variants of it: sexual abuse, homosexual assaults, stripping, forcing obscene and lewd acts, gestures, causing bodily harm or any other danger to health or person;

Any act or abuse by spoken words, emails, post, public insults which would also include deriving perverted pleasure, vicarious or sadistic thrill from actively or passively participating in the discomfiture to fresher or any other student;"

Any act that affects the mental health and self-confidence of a fresher or any other student.

With or without an intent to derive a sadistic pleasure or showing off power, authority or superiority by a student over any fresher or any other student.

Whenever such a case is brought for postmortem examination then meticulous job is required to substantiate or negate the findings. A systematic approach is always desired.

History

College entry, behavior, exposure to outer world, schooling, social background, any previous incidence of bullying, sadness, emotional disturbance etc.

Circumstantial

- Detention period
- Clothing for semen and fecal stains
- Ropes
- Restraint objects
- Beating objects
- Food and water deprivation
- Suicide Notes

Psychological and social factors

- Minority

- Deprived class
- Inhuman behavior
- Maturity level
- Non- exposure to such environment
- Making nude

Post mortem findings

- Injuries due to beating
- Forced posture
- Sexual exploitation – sodomy / vaginal sex
- Forced masturbation
- Electrocution marks
- Torture injuries – pulling body hairs

Histopatholgy (for corroboration)

- Lungs for asphyxia findings
- Brain for hypoxial findings
- Injury lesions for duration of infliction

Toxicology

- Routine screening for abuse substances in blood, urine and vitreous
- Urine for myoglobin resulting from muscle crushing in beating

Photographic evidence

Scene

- Place of ragging
- Items in vicinity
- Clothing
- Body injuries

At the time of postmortem

- Body photographs in detail
- Mouth
- Eyes
- Nostrils
- Sexual organs for injuries
- Stomach – food material
- Injuries
- Cause of death

Common manner of death

- Suicides
- Culpable Homicides

Common cause of death

Homicidal

- Head Injuries
- Shock as a result of multiple injuries

Suicidal

- Hanging
- Poisoning

Audit Sheet

Check Points	Yes	No
History		
Crime Scene assessment		
Clothing examination and photography		
Body examination and photography		
Sampling		
Toxicology screening		
Cause of death		
Opinion		

STAB /SLASH WOUNDS [1,2,4,5,6,7,10, 11,14,45]

The following procedure is in addition to what described under sudden Natural Deaths

History

- History about the incident and clinical records if the deceased has been subjected to operative procedure.
- Handedness (Dominant hand) of the victim in cases of suicide and assailant in cases of homicide must be established

External Examination[1,39]

- Examination of clothes while still on the body and its relation to injuries on the body. Sketches / photography should be done and proper description has to be recorded in the report.
- Cuts in the clothing must be measured, described and traces must be collected and submitted for analysis and whether they correspond with the bodily injuries.
- Blood stains on the cloths must be described.
- Size, site, shape, disposition of injuries, direction, margins, edges, surrounding tissue injuries must be described and documented.
- Injury length is measured with and without edge apposition.
- Distance of the injuries from heel level should be measured.
- Special attempt must be made to identify hesitation

marks, defense wounds in hands, hilt marks etc.

- Photography of injuries with scale parallel and sides to injuries is recommended. Relationship of injuries to body parts to be shown whenever possible. One photograph should be perpendicular to the injury with close-up features.
- Nails must be examined and clipping must be done to find foreign skin or blood, if indicated
- Use of transparent sheet is very handy to draw sketches of injuries with the help of permanent ink marker. Place transparency plastic sheet over the injury part and draw picture of wound. After this clean undersurface of plastic sheet. After cleaning and drying , put a white paper and make a photocopy ,which can attached with PM report.
- When clubbing the several wounds in one particular region, always use word "MULTIPLE STAB/SLASH/ CUT WOUNDS", with minimum and maximum dimensions. Use of transparent plastic is helpful in drawing these multiple wounds.

Internal Examination

- Injury must be explored layer by layer and measurements should be taken ;and features in each layer must be documented[4]
- Injury damage must be documented.
- Blood volume/amount in cavities must be measured.

SAMPLES

Trace materials around wounds must be collected and sent for forensic analysis.

Hair and blood samples should be retained if injuries are there in those areas having hairs for future comparison with suspected weapon which may have these stains and hair.

Opinion

Weapon examination: IO is advised to bring photograph of weapon if recovered at crime scene along with inquest papers. Firstly, recovered weapon should be subjected for DNA and trace material examination to avoid contamination.

A weapon may be subjected for comparison to autopsy surgeon only after DNA, Trace material, and finger print examination.

Opinion on the probable nature of the causative weapon may be expressed on basis of injuries.

Audit Sheet[5,7,11]

Procedure	Yes	No
Clothing examined		
Hairs of involved part		
Blood in gauze piece dried and packed		
Finger nail scrapings		
Photographs without cleaning		
Photographs after cleaning		
Examination of external wounds completed		
Handedness of the deceased established		
Track of the wound described		
Internal bleeding measured		

Common Circumstances

- Homicidal
- Accidental
- Suicidal

Common Causes

- Injury to heart
- Injuries to Lungs and Hemo-pneumothorax
- Hemorrhagic Shock
- Injuries to neck structures
- Head injuries caused by heavy cutting weapon

Photographic points in stab injury cases

Suicidal Stab

- Overall view of scene
- Close up of body
- Items near body
- Look for suicide note
- Personal history/treatment record – mental/ social/ financial/ domestic / disturbance / depression
- Suicide threats –old scars over wrist /arms
- Weapon and its relation with body
- Bleeding pools
- Prints on weapon
- Cut on finger and thumb

At the time of postmortem

- Overall view
- Clothing defects
- Hands for stains , cuts

- Overview of injured body area like abdomen epigatric area or chest
- Wound in detail with close-up view with and without scale
- Minute details of wound edges and angles
- Track of wound
- Depth of wounds

Homicidal Stab

- The principal feature of stabbed wound is their depth which is usually greater than their width. The external wound gives no indication of its depth.
- Clothing defects with and without scale
- Wound size with and without scale
- Unique features / pattern
- Track length
- Any where on body through clothing
- Multiple
- Single or multiple weapon
- Clothing tearing, missing buttons, prints on weapon
- Close up of edges
- Gelatin cast of wound
- Weapon marks in organs/ bones
- Defence wounds over body

Chop wounds/ slash wounds

- Overall body view
- Clothing cuts
- Individual or group wise systematic coverage in detail with and without scale before and after cleaning
- Close up of wounds after cleaning
- Defense wounds
- Peculiar features
- Weapon marks

Suicide by light sharp force

- Incised wounds are inflicted by instruments with a sharp cutting edge such as razor blade or a sharp knife
- Quite place
- No disturbance
- In front of mirror
- Disorderly scene is rare
- Can walk to some other place also before final collapse

Social Forensic Message

Anger control counseling in aggressive individuals

BLUNT FORCE INJURIES

Blunt force injuries are most common injuries encountered by forensic man. Blunt force injuries may present as abrasions, bruise, lacerations and fracture. The surfaces of objects may be patterned , rough or highly irregular. These objects may inflict patterned or irregular shape injuries over body surface depending on their shape and make up.

Recording of Injuries – individually or collectively , size , location, distance from nearest anatomical landmark, photograph with and without scale, make a sketch over body chart, if patterned record in detail, healing stage, if some foreign material is there then photograph and record in detail.

Photography

i. Distant orientation photograph showing presence of injuries

ii. Mid view- Showing injury in relation to anatomical parts of body

iii. Close-up view showing injury from near range

iv. Very close view showing details and pattern in the injury

Always take photograph with and without scale.

It is always helpful to record and preserve material over these injuries which may be in form of mud, grit, coal dust, cement, plaster-of-paris, sand, red sand, lime-dust ,pebbles, grease, botanical material, paint etc. These may reflect contact or causing surface.

Extent of injuries will depend on extent of force, body part, health status of sufferer, clothing over area, vascularity of area, resiliency of area, layer of subcutaneous tissue, underneath bony areas.

Easy bruising is found in females, children, alcoholics, liver disease, anaemia, purpura, scurvy and malnourished people. Bruises are unlikely to be seen when abdominal walls, diffuse flat or hard surface, thick layer of clothing is involved.

If a blood or tissue laden weapon is brought for examination to autopsy surgeon. It is advised that it should be sent to biological division for obtaining DNA material. After obtaining /procuring stains , it should be examined for injuries correlations for causation.

All Injuries should be photographed and should also be shown on sketch diagrams as a practice.

Most important blunt injury from morbidity and mortality point of view is head injury which is being specifically

discussed here.

Audit Sheet

Check Point	Yes	No
Mapping on sketch diagrams		
Photography with and without scale		
Description of injuries – identification of injury(type), Size, shape, colour, healing process, Infection, foreign material in it		

HEAD INJURY

Head Injury is serious trauma in terms of morbidity and mortality. Head and neck regions remain centre of attack in homicidal injuries due to their fatal outcomes. In accidents and falls, these remain areas of concern as impact to this region will bring either death or serious mental disability to person.

Head injury has wider connotation and implies

- Injuries to scalp skin and tissues underneath
- Injuries to skull bones
- Injuries to cranial content of cranial cavity

Injuries to cranial contents are of more serious consequences. In majority cases, multiple and overlapping injuries are seen. Injuries to scalp may be abrasions, laceration(incised-looking lacerated wound), incised wound, slash wounds, cut lacerations with indentation in bones.

Skull bones may have indentation marks of weapon, different varieties of fractures depending on their causative agent and circumstances. Most informative fractures are 'signature' fracture, gutter fracture and fractures from blunt weapons.

Among intracranial haemorrhages, outside the dura is extradural haemorrhage, beneath the dura is termed as subdural harmoorhage, in arachnoid plexuses these are known as subarachnoid haemorrhage, next variety is sub-pial haemoorahge. Inside brain substance are intracerebral haemorrhage.

Brain may show counter (impact side) and countercoup(opposite the impact) contusions.

Documentation is very important and sketch, photographs, videos should be used to document injuries and haemorrhages in sensitive and academic cases. Ready made diagrams of skull should be made available in mortuary for documentation of injuries and fractures. X-ray, CT Scan and MRI record should be maintained in soft files for further use. Special mention should about volume of

When duration of injuries is important then colour of harmorrhage or injury with degradation, reparative changes should be noted.

Steps of scalp, skull, dura and brain examination

- Examine scalp for injuries
- Open skull as per practice
- Examine skull bones for fracture
- Make a sketch of fracture
- Take photographs with and without scale of important findings
- Open skull by saw
- Examine Dura, size and spread of haemorrhages
- Open dura and examine subdural space for blood , pus, adhesions and estimate volume
- Examine surface of cerebrum and describe haemorrhagic areas and spread
- Examine base for haemorrhage
- Cut dura to expose cerebellum and examine areas
- Delivery of brain
- Examine in detail as per need of case
- Take photographs of important findings
- Make coronal sections at 1-2 cm interval
- Take section for histopthology as required.

Histopathology of lesions also help in determining the duration of injury. Histology is most useful in the assessment of diffuse axonal injury. For diffuse injury at least 8-10 areas are screened for proper assessment. In a simplified approach sections from frontal lobes, motor area of temporal lobe, occipital lobes, midbrain area, white matter from corpus callosum area where crossing of fibres is more, thalamus area, cerebellum tonsillar area are sufficient in routine screening rest of samples are according to gross findings and what we are planning to screen. In pliable brains, these can be kept for few hours in hours before dissection for better exposure of findings. The selected sites are flexible and depend on gross examination, in practice the following areas are sampled as suggested by Royal College. Pathologists, 2005. It is good document to read as good points are given to remember during performing such cases. A summary of important blocks are mentioned below for convenience.

- Block1: Frontal to include parasagittal white matter areas and corpus callosum at the level of the head of the caudate nucleus
- Block 2: Basal ganglion, including the internal capsule;
- Block 3: Hippocampus (at the level of the lateral geniculate body)
- Block4: Thalalmus, including internal capsule;
- Block 5: Posterior corpus callosum and parietal

parasaggital white matter;

- Block 6: Parietal convexity
- Block 7: Pons, including the superior cerebellar peduncle
- Block 8: Cerebellum, vernix
- Block 9: cerebellum, dentate nucleus
- Block 10 Cerebellum, including cerebral peduncle
- Block 11: Medulla Oblongata
- Block 12: Mid brain
- Block 13 : Spinal cord at the level of injury
- Block14: any other relevant area

In concluding head injury, Glasgow Scale, X-ray, CT Scan and MRI if available are important to make a proper opinion about severity. Glasgow coma scale less than 8 is indicative of serious injury. Opening skull and examining brain at autopsy has no alternative to record findings as findings are under or over report reported.

Audit Sheet

Check Points	Yes	No
History		
X-ray, MRI, CT Scan, if available		
Examination for injuries		
Photography		
Opening Skull		
Detailed examination of skull bones and dura		
Delivery of brain		
Detail examination of brain		
Photography		
Sketch representation of injuries and fractures		
Histopathology		

Rest as per the protocol

Skull fractures should also be represented by sketch diagrams as linear fractures are not appreciated well in photography. Main Traumatic reasons for fatality remain damage to intracranial contents. Blood collection of more than 70 ml produces serious pressure effects. Maximum adjusting capacity of brain remain 150-200 ml which has rapid fatality. Herniation sites like cerebellar tonsils, parahippocapal gyrus, and uncal area may look blackish or discloured due to pressure necrosis and will show marked indentation of bony projections. These should be photographed and sections for histopathological examination is also informative.

Haemorrhage more than 30 ml at base produces fatality. In cases of pontine haemorrhage, any size more than big pin head size is almost fatal. Subdural and subarachnoid haemorrhage combination is maximally seen in head injury cases.[159] Contusion and diffuse axonal injuries are another prominent findings in these cases.

Social Forensic Message

External appearance of head injuries can be very deceptive even serious intracranial injuries may be present without any obvious signs of external injuries.

All Injuries to head require proper observation and evaluation. Clinical signs of mental calrity, vomiting, pupils siz, increased intracranial pressure are good indicators for clinical diagnosis.

DEATH ASSOCIATED WITH SEXUAL ASSUALTS [1,2,4,5,6,7,10, 11,14,45,59,89,90]

Following procedure is addition to what described under Sudden Natural Deaths

History

Detail history of the incident, time, place, exact nature of the act, number of people involved, place where the body found and the stage of decomposition, nature of clothing etc.

Personal History of the deceased (married or not, pregnant or not, drug and alcohol abuse, medical history, last sexual act). Findings should be noted for penetrative assault or non-penetrative sexual assault.

Preliminaries

- Scene visit as indicated- Position in which body was recovered, clothing, items present nearby, blood and stains over the spot, intoxicant containers, drugs, condom/ condom covers are important in solving case
- Photography as indicated - body and genital injuries, bite marks , botanical material, stains are important items to be photographed
- Collection of samples and swabs before attempting to record temperature.
- Examination and retention of clothing.
- Collecting traces found on cloths or body

External Examination

- Look for bite marks, saliva, semen, blood stains
- Injuries on genital, peri-genital (thighs, anus) and para-sexual parts (breast, lips, neck, thighs etc.). Adopt systematic approach to record injuries. Use photography and sketching as per need. Minor injuries have great corroborative value.
- Injuries due to restrain around neck, wrists, ankles
- Injuries due to rough surface on back
- All orifices for fresh or old injuries. Presence or absence of semen, blood, saliva
- Loose foreign or self hair on the body
- Matting of pubic hair due to semen.

- Stains near orifices, thighs, clothing should be properly documented and preserved for further analysis.

Injuries are seen in form of abrasions, bruises, minor tears over body during restrain or fight or overpowering. There may patterned injuries like finger nail abrasions, disc shaped bruises from finger tips.

Bite marks may be present over face, neck, breast, thighs and buttocks during sexual act and forcible foreplay. Defence bites may be also present over assailant. Bite marks are patterned injuries produced by teeth when used with force. These are seen in form of abrasion, cut-lacerations and bruises. Every human has a specific pattern so it can be used for comparison. If it is a fresh case then swab from bite should be preserved for DNA profiling.

Bite marks should be photographed with and without scale. At least take overall view, mid view and finer close-up of injury showing details. The human bite may be identified by its gross, class and individual features. The size, shape, canine distance, angulations, front and back of occlusal surface are of great value. One must read guideline American Association of forensic odontologist[75].

Description of bite mark

Type in form of- Abrasion/ bruise/ laceration/ avulsion/ crushed	**Location** on body	**Shape-** round/ovoid/ moon crescent like/irregular	**Colour-** red/blue/purple /green/yellow	**Size-** horizontal /oblique/v ertical	**Healing** Bleeding/pus/ healing /healed

- *Semen- Vagina, Anus, Mouth, Thighs, any other place*
- *Fecal Matter on penis*
- *Blood for DNA Profiling*
- *Hair for DNA profiling or Comparison*
- *Foreign Bodies over body or in the genitalia*
- *Nail Scrapings / clippings*
- *Vaginal washouts*
- *General Lubricant – oil, cream over genitalia*

Bite marks should be differentiated from love-suction marks, defibrillator, hair curler, resuscitative devices , cardiac ECG electrode etc.

In children sexual assault cases , injuries to genitalia may be prominent due to disproportionate genital organs. Injuries should be properly documented. These injuries may extend to pelvis , urethra, anal canal. Photographic evidence may be preserved but should be kept away from public viewing. Bite marks present over child may relate presence and act of adult perpetrator.[119]

Internal examination

Standard Neck Dissection

Standard En -Bloc Pelvic Dissection[4]

Samples

Samples collected in sexual assault cases are to establish the identity of the victim, assailant, and determining the place of assault. (Locard's Principle)

In addition special test done as indicated.

- *Saliva- on lips, breast, or any bite mark; keep samples for DNA profiling also*
- *Condom Lubricant –Inside genitalia from walls*

Swabs should be collected from Vagina (Introitus, high and low, posterior fornix), Anus, Mouth, Ears, Nose, Thighs, Pubic area or any other suspected area or place and Smears on Slides should be made. Examination should be done for Sperms, Prostatic acid phosphates, Prostate Specific Antigens. Special Test for Blood group antigens and DNA Studies should be done as indicated. In suspected cases screening for HIV and Sexually Transmitted Diseases must be done. Lubricant material present over condoms is specific and can be correlated from covers recovered from crime scene.

Evidence type	Collection/procuring by photographs	Purpose
Hair (Pubic, head and body)	By combing	Can help in identification of assailantMay link victim to crime sceneLinking assailant to victim
Blood	From peripheral vessels	For drugs and alcohol screening Presence of these may show inability of victim to give consent
Urine	From Bladder	Drugs and alcoholInability to give consent
Semen stains	Swabbing	May identify assailant Suggestive of recent Sexual activityMay indicate Penetrative Sexual Assault
Body Injuries	Bruise, abrasions, laceration, bite marks	Show use of force
Genital Injuries	Tear, bruise, abrasions	Show force and penetration
Clothing	Tears, wrinkles, stains debris, botanical material	Link with assailant Identification of assailant Use of force
Fingernails scrapings	Blood, skin, fibers and hair	Identification of assailant Indicative of resistance Linking victim and assailant

Ref : WHO. In: Sexual Violence Research Initiative by Janice Du Mont and D White , ,2007:10.[167]

CEHAT. In: Manual for Sexual Offences, Mumbai, India.

Wet smear examination

Wet smear hanging drop should be prepared to see spermatozoa and their motility. This part can be easily be done in hospital. The slides should also be seen after H& E staining for sperms, bacteria and type of vaginal cells. Medical staff should be given orientation course before reporting.

For Forensic laboratory

Swabs -4, Blood control , blood for sedative/ rape drugs, urine for drugs , clothing for semen and blood and other physical trace material should be sent routinely to laboratory. Idea is to find out identity of assailants and confirmation of commission of sexual act.

Swabs

a. **Mouth** – Take 2-3 swabs, from margins of teeth, posterior part, control

b. **Breast** (3 or more) – from nipple areas on both sides, from bite mark

c. **Vagina** (4)- from external apart of vagina near valvular area, from external orifice, from posterior part , from cervix.

d. Matted pubic hairs with semen – one or two swabs with cutting of bunch for an analysis.

For taking swabs, to moisten area one or two drops of distilled water or normal saline or normal boiled and cooled water or injection water can be used.

Smears

a. **Vaginal smears**(6) – From external part(2) , from vagina(2), cervix(2)

b. **Anus** (2) – from external part and internal rectum

c. **Mouth(2**) from lips and teeth margins and posterior part

d. **Stains** over thigh, abdomen or any other part as per the case

For making smears, take clean slides; dip swab tip in one or two drops of distilled water or normal saline or normal boiled and cooled water or injection water; rub this over stain and smear it over glass slides by rolling. Preserve the swabs.

Air dry slides and put in card box or slide carrier to avoid breakage.

There is no harm in taking 2 sets of samples in high stake cases. Smears can be examined in forensic department/ laboratory medicine or FSL as per the practice of the hospital.

Fixing of slides is not recommended if examination is immediate or in a day or two. In undue delay, few drops of alcohol should be put over the slides and then dry it. Heat fixing is not recommended as it may denature DNA.

Give clear instruction to laboratory as for what you are sending these samples like

DNA material extraction for DNA Profiling. Detection of semen by presence of sperms; if sperms are not detected or destroyed by lapse of time then confirm semen presence by P30 (Prostatic Antigen) and other chemical methods like Acid Phosphates concentration.

Special Note: Genital photography should be taken in injuries and positive findings but these should be given to police or court if specifically asked with advisory as these should be made public and their interpretation should be done with the help of medical man. Caution should be issued to them as not to make public display in the court. Sketches are more than sufficient for police and court purposes.

Findings expected in male-female physical sexual contact

1. Semen – sperms and chemical part of semen (semen plasma)
2. Pubic hair exchange
3. Blood from injuries to female genitalia or male injury frenulum tear or menstrual blood
4. Skin tissue – if struggle in female nails
5. Sweat – if summer and hot
6. Saliva – if oral use is there
7. Cloth fibers from underwear or other body clothing

Vaginal smear examination in forensic practice

In sexual offences, vaginal smear examination is an integral part of assessment. Examination of smear gives important clues. These slides become important when there is allegation of change of slides under motivation or inadvertently. Evaluation of vaginal smear is likely to have following component:

1. Vaginal cells – basal , intermediate and superficial type.
2. Micro-organism – Doderlein bacilli, fungi, Candida, STD organisms.
3. Spermatozoa – motile / non-motile, complete/ incomplete, normal/ abnormal shaped.
4. Blood- menstrual blood, blood from injured female parts, blood from accused.
5. Foreign material – pubic hair, oil , condom fragments, cotton /cloth fibers, botanical material.

6. Fecal stains – if multi assailant, vaginal and anal sexual intercourse is there

7. Salivary stains and buccal cells – if oral contact is there

Presence of spermatozoa in vaginal smear : Detection of spermatozoa in vaginal smears is an important clue of male – female physical relationship. At times , it becomes only source of DNA extraction for DNA profiling for positive identification. There are three ways of evaluation in sexual assault cases.

1. Evaluation of **wet-smear** hanging drop preparation for motile spermatozoa to comment upon on recent activity

2. Fresh Smear – air dried smear directly seen under microscope and is commented

3. Fresh smear –air dried and then fixed in alcohol , after fixation it stained with Hematoxylin and Eosin (H&E)

4. Three Smears are sent to Forensic Science Laboratory

All forensic experts who wish to practice smear evaluation should take up orientation course at tertiary centers. They should undergo evaluating at least 25 slides of vaginal smears, anal smears, buccal smears and slides prepared from surface of body.

Motility of sperms in female, average duration of detection

Out of vagina	Vagina	Cervix
up to 12 hours	up to 24 hours	up to 5 days

Sperms condition in genitalia of dead female

Sperms state	Vagina	Cervix	Uterus	Body Surface	Clothing
Intact Sperms in dead bodies	Up to 2 days in average conditions. If well preserved body then even up to weeks	Up to one week in average normal conditions. In well preserved bodies upto several weeks	Up to 7 - 10 days	If dried then no time limit In wet up to 12 hours	If dried no time limit
Broken sperms	Up to one week	One week or more	1-2 weeks	In dried stains , can be recovered in fair quantity	In dried stains can be obtained in fair quantity. Over sanitary pads , a large number can be there.

Another important component of vaginal smears is **vaginal cells** , uterine shedding in menstrual cycle. In vaginal smears, presence of different stages of cells is very informative about hormonal status , uterine condition and pregnancy. Representation of vaginal cells is expressed as Maturation Index. Maturation Index(MI) is relative percentage of cells expressed in the order as para-basal, intermediate and superficial cells. It involvesfive random fields(x10 magnification) and counting 100 epithelial cells in each area determining the type of cells. Maturation Index in different situations is given below.

Condition of female	Maturation Index [*163,168,169] (Para basal/ Intermediate/ Superficial)	Remarks
At Birth	0/95/5	Hormonal effect of pregnancy of mother has effects on body of new born
Pre-pubertal	90/10/10	There is lack of sex hormones
Menstrual phase		
Before Ovulation	0/30/70	Oestrogen dominance
Secretary phase	0/70/30	Progestrogen dominance
Pregnancy	0/95/5	Progesterone+ steroid effect (Intermediate cell dominance)
Post-partum	100/0/0	Infancy like
Early Menopause	0/100/0	Steroid effect is more, atrophy starts
Late Menopause	100/0/0	Atrophic changes
Threatened abortion	0/80/20	Poor progesterone effect There is increase in superficial cells
Intrauterine death	40/50/10	Large number of para basal cells

*Ref: 163 .Chaudhari MK. In: An Essential Guide to Pathology, Central Book Agency, Kolkata, 1998:84-85.

168.McEndre B. Clinical application of vaginal maturation

index. Nurse Pract 1999 Sept;24(9):48,51-2,55-6.

169.Meisels A. The maturation value. Acta Cytol 1967;11(4):249.

Para basal are not usually seen in reproductive life of female. Intermediate cells and superficial cells are in dominance in reproductive age groups. Para-basal cells are found in massive infection, intrauterine death (IUD), post-partum period, lactation.

Role Division in fatal sex-related crimes in relation to swabs and slides preparation

Job description	Forensic Medicine Expert	Forensic Scientist / Trained Evidence Technician / Nurse	Overlapping Roles
Swab Taking	Duty of FME but other trained person can also take	Can but should under supervision of FME	In some situations , overlapping can be there
Smear Preparation	Yes, in hospital / Mortuary by FME	-	-
Hanging drop preparation	Yes, In Mortuary/ hospital by FME	-	-
Wet smear examination	In hospital / Mortuary by FME	-	-
Smear cytological examination in different stains	By Medical Trained person like Laboratory Medicine / trained FME	Can do but Forensic Scientist are not trained in cellular part	Overlapping exists because majority FME try to avoid this part
DNA extraction from spermatozoa in smear	Not trained	DNA Profiling Unit in Forensic Science Division	Forensic Scientist trained in DNA profiling is the right person
Seminal plasma component	Trained but do not practice	Chemical detection semen is done by Biological Division of Forensic Science Laboratory	Role of Forensic Scientist

These samples should be collected for screening of Alcohol, Drugs or other poisons as indicated. Toxicology analysis is helpful in detecting date rape drugs like GBH, GBL, Flunitrazapam, cannabis, benzodiazepine, cocaine etc. These drugs can be detected from 6 hours to three days. Alcohol is detected up to 10 hours, depending on consumption.

Urine and blood remains the best samples for their detection.

Appropriate Histological sampling done as per the requirement of case–Exclusion of Pregnancy

In sexual assault case, one can follow following step by step examination as :

A. Handling original condition of body with clothing –

Action	Yes	No
Finger nail scrapping and cutting		
Photography		
Clothing examination		
Sampling of trace material – mud grass, hair, oil , cream etc		
Hair		
Blood		
Semen stains		

B. After removal of clothing at the time of Postmortem Examination

Systematic Recording of Injuries		
Complete Photography		
Evidence Collection as required		
Sketch of bodily injuries / appearance before cleaning		
Sketch of bodily injuries / appearance after cleaning		
Photography as required with orientation and close-up shots		
Wet smears examination		

D. During Autopsy with details of findings

External findings		
Internal findings		
Swabs from uterus		
Injury to genitalia documentation		
Cause of death findings		

D. After Autopsy

Proper documentation of external and internal findings		
Proper preservation, sealing and transportation of samples and viscera		
Wet smear examination		
Custody of photographs		
PM report finalization		
Documentation to Police		
Documentation to relatives		
Final opinion after getting reports and investigations		

Role Division

Actually in medico-legal work, overlapping of some roles may be there but still we can fix some responsibility on involved people.

In hospital premises

General Doctor /GDMO	Forensic Medicine expert	Dentist	Nursing staff	Technician	Forensic Scientist
Identification of Injuries Documentation of injuries Preservation of samples like swab, smears, clothing	In addition to GDMO's role Identification and analysis of patterned injuries Examination of wet smears Proper documentation and photography of patterned injuries like bite mark , weapon mark etc In bite mark analysis help of a dentist should be taken while commenting on inclusion or exclusion some one. They should attend orientation workshops	Documentation of bite in more specific manner Preparation of cast Lifting bite pattern Analysis of bite marks	Custody of samples Attending and helping while examining females Sample taking and preservation	Staining Smears Sealing of samples follow other instructions as required	DNA extraction / Chemical test / Grouping

Unnecessary barrier should not be created among professionals as science is overlapping and if a person is trained and given proper exposure on particular science , it is more than sufficient to make a proper use of it. Medico-legal management of any patterned injury is ,part of forensic medicine course a trained dentist is of added value and helpful colleague.

Most of the mobile with public also has photography facility so any photo taken by them in beginning phase when victim is located first is a precious information. This can be utilized by specialist later in the process of investigation. Even public should be made aware if there is delay in hospital examination then stains and liquid falling from genitalia by victim should be taken dry cotton / surgical bandage or cotton clothing or any clean fabric and air dry it, may be used for the forensic examination purpose. This may be handed over to police or doctor examining. It will be helpful in preserving stains and thus extracting DNA.

Outside hospital

Forensic Science Laboratory (Biology, DNA Fingerprinting and Chemistry Divisions- Forensic Scientist)

Forensic Scientist's role - Chemical test for semen, DNA Profiling, Isolation of DNA from slides, swabs, clothing.

Social NGO (Social Forensics) - To spread awareness about value of evidence preservation and legal requirement in such cases. Telling simple methods and techniques of preserving semen stains on a plain cotton wool, cotton cloth, panties; dry it and keep in envelope and hand it over to medical / social / police person who can seal it as 'material given by victim' in clinical/ live cases. This material may be forwarded to forensic laboratory for DNA and other tests through IO of the case.

3.Crime Scene Reconstruction - It is team work constituting investigator, forensic scientist, forensic medicine expert, artist, photographer and computer programmer and others as required.

Audit Sheet[5,7,11]

Procedure	Yes	No
History of incident complete		
Overall scene view		
Scene visit/evaluation as indicated		
Photography as indicated		
External Examination and Sampling and Swabbing		
All orifices examined and sampling and Swabbing		
Formal Neck examination and dissection		
Formal Pelvic examination and dissection		

On high risk of sexual assault

- Commercial sex workers
- Domestic servants
- Handicap People
- Living alone
- Multiple partners
- Homosexuals
- Drug addicts
- Landless field, brick- clan, construction labourers

- Young immature girls

Common Causes of death

- Smothering
- Strangulation
- Injuries
- Shooting
- Gagging
- Stabs/cuts
- Blunt trauma

Photographic evidence in sexual assault case

At scene

- Position of body
- Condition of clothing
- Position of personal effects
- Condoms
- Lubricants
- Panties
- Lower garments
- Items in vicinity
- Body photographs without disturbing
- Hands and nails
- Injuries present in visible parts

At the time of post-mortem

- Overall scenario
- Clothing
- Limbs
- Injuries
- Visible stains
- Important findings

Evaluation of injured hymen, average usual findings in normal female

Duration of Injury	Findings in dead	Findings in living
First 8 hours	Swollen, red, blood oozed, dried up stains	Swollen, red, painful, bleeding on touch, stains around
8-24 hours	Congested, blood tinged stains and ooze, swollen	Oedematous, swollen, sero-sanguineous oozing
2nd day	Same as above, serous clear dried oozed stains	Serous ooze, edema start subsiding if not infected otherwise infection may set in. Healing process starts
3rd day	No oozing, only little crusts, inflammation marked	No serous oozing, healing process sets in, oedema and swelling still persisting
3-7 days	Oedema is less, healing progress	Oedema is less, healing is in progress
7-10 days	Oedema negligible	Oedema is very light or almost normal appearing healed wound
15 days	No oedema , healing complete, well set margins, take their post- rupture shape and size. These are of gray-white colour	No oedema, healed hymen tears are visible. Gray-white colour tags

Evaluation of freshly injured anus

Time duration of sodomy act	Findings in dead	Findings in living
Up to 24 hours	Blood present in anus , smeared around ; reddened appearance.	Blood oozing is prominent Painful , spasm of muscles if tear is lar ge. Oedematous ring , abraded and bruised
At 2-3 days	Edema , congestion , infection , blood tinged stains	Painful , spasm , congestion swollen with oozing of blood tined stains.
3-7 days	Mildly swollen , clear stains of oozed material , tears appr eciated with inflammation	Painful , spasm start reducing , painful defecation with lubricants and Nitroprusside
7-10 days	Normal appearance with healed tears	No pain an dozing , wounds are fairly healed . Normal functions starts appearing and shape also become normal.

Anal and rectal tears with smearing of blood around anus due to repeated penile movements. Presence of semen, funneling effect of anus, sexually transmitted disease, chronic proctitis, multiple healed tears with smoothening

of skin around. One can safely commit that these are consistent with sodomy. In acute cases with trauma and chronic cases, it is not difficult to comment about it. Wet smear examination is very helpful in detecting sperms.

163. Sugar NF, Fine DN, Eckert LO. Physical Injury after sexual assault: Findings of a large case series. *Am J Obs & Gynae* 2004;190:71-76.

Other useful further readings:

164. Marilyn Sawyer Sommers. Defining patterns of genital injury from sexual assault: A Review. *Trauma Violence and Abuse* 2007;8 (3):270-280.

165. Heger AH, McConnell, Ticson Lynne, Guera Lisa, Lister Julie, Zaragoza Toni. Healing Patterns in Anogenital Injuries: A longitudinal study of inuries associated with sexual abuse, accidental injuries, or genital surgery in preadolescent child. Paediatrics 2003;112(4):829-837.

166.RN Karmakar. Editor: In : JB Mukherjee's Forensic Medicine and Toxicology, 3rd edition , Academic Press, Kolkata 2007:839-846.

Social Forensic Message

Rape is a serious social problem and shows degrading social norms and **disregard to law and disrespect to a woman**.

DOWRY DEATHS[66,78,86]

If a woman dies within seven years of marriage then inquest is being carried out by Magistrate under section 176 Cr P C. Sections applicable in such deaths are :

498A: A husband or relative of husband subjecting her to cruelty.

113 A: Presumption as to abetment of suicide by a married woman.

113 B: presumption as to dowry death.

The reasons for such death may be maladjustment, harassment, humiliation, physical incompatibility, family discord, shattering of unrealistic dreams and expectations, infidelity, unreasonable materialistic demands , sadistic acts and alcoholism of husband, suspected out of wedlock pregnancy and infertility. At times morbid obesity(BMI more than 35)[80], hairy body and ugly facial looks are also precipitating reasons for suicides. Deaths can be classified as :

Suicide: Hanging, poisoning, burning, jumping from heights, cutting wrist.

Homicide: strangulation, blunt force injuries due sever beating, head injuries

Accident: Electrocution, slip and fall, burns

Natural: tuberculosis, systematic disease

Finding during post mortem beside cause of death, look for signs of neglect, physical Injuries, poisoning, infertility, pregnancy and menstrual phase.

Photographic evidence at scene – overall scene, signs of struggle, position of body, suicide note, poisoning material

Photographic evidence at the time of postmortem- overall body view, full photography, neck, head, injuries, pelvic organs, tubal block, menstrual sings or pregnancy signs of uterus.

Autopsy

Signs of neglect – malnourishment, clothing condition, detergent dermatitis, Body Mass index (less than 20).

Examine body for injuries.

Neck for ligature mark and finger nail abrasions or bruises.

All cavities to be examined.

Bloc dissection of neck and pelvis.

Fallopian tubes for blockage, calcification, tuberculosis, infection.

Ovaries - cyst

Uterus - fibroid, menstrual phase, endometritis, tuberculosis, infections; If pregnant, preserve foetus if paternity is in dispute. Preserve foetus plain if can be transported early otherwise preserve in absolute alcohol (70%) .

Cervix - unusual dilatation, scarring, blockage, ulcers

Ovarian steroidogenic activity in women reaches peak during luteal and premenstrual period. This gives physical and psychological tension in women. Suicidal tendency is more in some females luteal and premenstrual phase[116].

Audit Sheet

Check Points	Yes	No
Overall Scene		
History		
Photography		
Clothing examination		
Sampling		
External Examiation		
Internal Examiantion		
Viscera preservation for toxicology as deemed necessary		
Pelvic organ examination		
Cause of death		

Common cause of death

Suicidal

Hanging

Poisoning

Burns

Cutting wrist

Jumping from height

Homicidal

Manual strangulation

Ligature strangulation

Smothering

Head Injury by blunt object

Shooting

Social Forensic Message

Avoid arguments with a female when she is menstrual phase as trivial matters can become suicide trigger points. As majority of the suicides in females occur during this phase.

Take care of your spouse during this premenstrual and menstrual phase and consult physician for diruetics, hormonal and anti- anxiety/ ant depressant drugs, if suicidal threats are recurrent.

MATERNAL DEATHS [1,2,4,5,6,7,10, 11,14,,40,41,44,45]

The following procedure is in addition to what described under Sudden Natural Death

Definition

A death of woman occurring during pregnancy, at child birth or within six weeks (forty two days) after child birth of the duration and the site of the pregnancy from a medical cause related to, or aggravated by, the pregnancy or its management.[6]

Preliminaries

All the clinical details and clinical materials must be scrutinized before commencing the postmortem examination.

Radiology

Radiograph of the chest to exclude pneumothorax and air embolism before opening body cavities.

It is advisable to perform radiographs of Chest, Abdomen and Head before the Autopsy as there is high possibility of air / amniotic/ thrombus embolism in these cases.

Internal Examination

Cardiovascular System

AIR EMBOLISM

1. Inspect and Comment on the presence of air bubbles (FROTHY BLOOD) within the great veins.
2. Fill the pericardial sac with water and open the right atrium and ventricle under water and observe for air bubble escaping

Amniotic Fluid Embolism

1. Remove heart and lungs en bloc without further dissection
2. Incise the main pulmonary trunk and right and left pulmonary arteries and their branches looking carefully for thrombotic and amniotic emboli i.e. meconium, vernix, and lanugo hair.

Coronary Arteries

Specific comments on important findings.

Gastrointestinal System

Examine the Liver with specific reference to the degree of fatty changes, necrosis or hemorrhages.

Genitourinary System

UTERUS

1. Consider microbiological swabs from the cervix, placenta and blood cultures
2. Prior to removal, examine the vulva, vagina, cervix and external surface of the uterus for evidence of trauma and tears
3. Removal of Uterus and genitalia intact en bloc if trauma is suspected.
4. Open the uterus from anterior approach and carefully pack the vagina and uterine cavity with cotton wool soaked with 10% Formalin and fix it (ideally for 5 days) before detail examination if indicated. Usually, normal screening is quite alright and informative.

   Look for previous scars and search carefully for tears and placental remnants
5. Retention and preservation of the entire specimen.

Note

The prerequisite for amniotic fluid embolism to occur is amnion to be torn. The tear may be in the amnion enclosing the fore or hind waters. Hence clinically intact membranes do not exclude the diagnosis.

Lethal amniotic fluid embolism is most commonly associated with relatively small tears in the uterus; cervix or vagina where there may not be complete disruption of the wall[6].

Placenta

Abnormal placentation is an important factor in a significant proportion of the deaths associated with hemorrhage. Adverse perinatal outcomes are noticed in form

of infections, infarctions, placentomegalay, retroplacental haematoma, placentasuccenturia,single umbilical artery cord haemorrhage and odema.[114]

There are two major patterns of abnormality.

a. Site-Typified by ectopic pregnancy and placenta previa

b. Attachment- Typified by a morbidly adherent placenta (Placenta accreta, increta and precreta)

Weight and the measurements of the placenta must be recorded. Specific comments on the appearance of the placenta with reference to meconium staining and estimation of the degree of any placental infarcts and hemorrhages.

Specific comments on the length and insertion of the umbilical cord and knotting of the blood vessels must be made.

Site

As it is the lower segment attachment of the placenta which is of major importance, the uterus must be opened from fundus to display the placenta.

Attachment

- Morbidly adherent placenta is frequently associated with a clinical history of difficulty in delivering the placenta which is often incomplete.
- Careful examination of the post partum uterus and all raised lesions as well as those clearly related to retained products must be examined histologically.

The full term placenta is about 500 grams; a placenta has than 350grams has adverse effects of pregnancy. In anemia, weight of placenta may go up to 650 grams[114].

On histopathology: Chrionic villi should be examined for size, stromal density, synctial knots, inflammation, infarction, calcification, hemorrhage and fibrinoid deposition. Inter villous space is evaluated for crowding of villi, fibrin deposition and intervillous thrombi[114].

Central Nervous system

- The brain and the entire dura including the sinuses should be removed by the pathologist and submitted for examination.
- Blocks from all regions of hemorrhage should be submitted as foci of hemorrhage may relate to metastatic choriocarcinoma.
- If spinal or epidural anesthesia has been performed the spinal cord should be referred for formal neuropathological examination.
- It is highly recommended that formal neuropathological examination of the brain to be performed if consultation is available.

Endocrine system

Examine and embed the pituitary for evidence of infarction.

SPECIMENS[6]

HISTOLOGY

- One block from each lobe of lung
- Pituitary gland
- Placental site of the uterus and additional sections as indicated.

(It is recommended that additional tissue be retained for possible further examination including lung, heart, kidney, liver, tubes and ovaries)

Specialized Histopathology

Amniotic Fluid Embolism

Histopathological examination of the lungs is always necessary in the diagnosis of the amniotic fluid embolism. The histological component of the amniotic fluid emboli have been defined as follows

i. Epithelial Squamous cells shed from fetal skin

ii. Lanugo Hairs which increases in number with gestation

iii. Fatty Material Caseosa Vernix

iv. Mucin-generally derived from the fetal intestine and associated with passage of meconium

v. Bile pigments derived from the meconium

Though all these components may be identified in routine Hematoxylin and Eosin sections, it is recommended to use Alcian Phloxin (Attwood's) stain[6].

Pre-eclampsia, Eclampsia and Hypertension

In pre eclamptic toxemia, a major abnormality is seen in the uterine vasculature:

Fibrinoid necrosis associated with large number of lipophages in the vessel wall, the latter being cuffed by mononuclear cells. This change is typically found in the terminations of the spiral arteries in the deciduas parietalis, the basal arteries of the deciduas basalis and the myometrium and in the myometrial segments of the spiral arteries of the placental bed.

Acute fatty liver of Pregnancy

Acute fatty liver in the late pregnancy can present with abdominal pain and recurrent vomiting without prior warning of jaundice.

The salient feature includes the features of fat in small vacuoles in the centrilobular hepatocytes while a ring of normal hepatocytes remains around portal systems.

Necrosis is not a feature

TOXICOLOGY

Toxicology screening as indicated. Drug levels if indicated and facilities available.

Approximate uterus length at different periods of pregnancy[14,43,44,45]

Full term 36 weeks onwards	**26-28 cm**	
36 weeks	26 cm	Forwardly inclined or slip a bit down
32 weeks	24 cm	At xiphoid tip
28 weeks	20 cm	Between umbilicus and xiphoid tip
24 weeks	16 cm	At umbilicus
20 weeks	14.5 cm	Between pubic symphysis and umbilicus
16 Weeks	13.5 cm	Just above pubic symphysis
12 weeks	12.5 cm	Within pelvis
Non pregnant uterus	6-7.5 cm	In pelvis

Placental attachment size in regressing uterus[14,43,44,45]

Immediately after delivery	10 cm
After 3 days	7.5 cm
After one week	4 -5 cm
After 2 weeks	2.5 cm
After 6 weeks	1.5 cm
After 8 weeks	1 cm
After 10 weeks	Unidentifiable grossly
After re- menstrual period	Unidentifiable even on HP
Uterus ready for next pregnancy	Even endometrium

Common Causes of death

list is in addition to points mentioned in natural death sheet

- Hemorrhages (Ante-partum or Post-partum)
- Embolisation (Amniotic fluid, Air)
- Infections
- Eclampsia
- Aggravation of Natural Diseases

Involution of uterus after delivery –levels of upper most part [14,43,44,45]

Approximate rate of reducing size of uterus is 1.5 cm per day

Duration after delivery	**Upper end of uterus can be at**	Dimensions	Uterine weight
Immediate after delivery	3cm below umbilicus	24-20cmx14cmx5 cm	800-1000 grams
3 days	5cm below umbilicus	17 cmx10cmx 4-5cm	500 grams
One week	Between umbilicus and pubic symphysis	14cmx 8cmx4cm	350 grams
Two weeks	Pubic symphysis	12cmx7cmx3cm	300grams
Three weeks onward	Pelvic		
Six weeks	Near Normal size	10cmx6cmx2.5cm	120grams
Eight to ten weeks	Normal size	8-10cmx5cmx2cm	80-100 grams

Audit Sheet [5,7, 11,45]

Procedure	**Yes**	**No**
Clinical documents scrutinized		
Radiography		
Examination of placenta		
System wise dissection		
Special attention paid to look for air/amniotic embolisation		
Lungs screening and Histopathological evaluation		
All organs subjected for histology with special stains if necessary		
Central nervous system subjected to neuropathological examination		

Photographic points in maternal death

- Overall body pictures
- Face for swollen , paleness
- Lower limbs for oedema and deep vein thrombosis
- Abdomen size
- Surgical wound

Internal

- Abdominal cavity for blood
- Lungs for oedema , aspiration , fat embolism
- Uterus size , thickness

- Placental site
- Cervical tears
- Lacerations
- Ovaries and fallopian tubes

Social Forensic Message

No mother should die due to lack of health care facilities.

Abortion Deaths

Abortions are quite common in reproductive age group in India . Pregnancy in wedlock relations can be terminated as per MTP Act 1971. MTP, if it is carried out at authorized centres has lesser chances of death due to sterile instrumentation and proper anatomical knowledge. In cases of illegal abortions, various conventional or non-conventional methods are adopted by qualified as well as non qualified people to terminate the pregnancy which put life at greater risk. Illegal abortions at the hands of unqualified persons results in more injuries and complications. Possibility of death increases due to lack proper knowledge, no anaesthesia, and non-sterile instrumentation.

History: period of gestation, physical changes in body, place of abortion, place notified or unrecognized

General Findings: Breast changes, pigmentation, fluid retention, DVT

Abdomen: Abdominal wall, distension, blood, chemical peritonitis, adhesions, pus pockets, fat **necrosis**

Genital parts: Swelling, injuries, bleeding, pus, foul smell, distension with crepitus

Cervix : signs of instrumentation, injuries, infection, size, shape

Uterus: size , shape , walls, curetting over inner surface, conception products and placental remains, blackish- green pus in anaerobic infective cases, soft and crepitus myometrium , placental attachment site, examine placental site for chorionic villi under microscope. Air bubbles under outer surface in gangrenous pelvic organs,walls crepitus, myometrium discoloured.

Fallopian tubes: size, shape, blockage, calcification, pus, swelling , haemorrrhage

Ovaries: Size, shape, presence of corpus luteum

Heart: walls, coronaries, frothy blood, clot, DVT dislodged thrombus

Lungs: embolism, congestion, consolidation

Aborted material: It depends on duration of conception. In early period, if embryo is not found look for presence of chorionic villi. If fetus is recorgnized then examine it as done for fetus age and maturity evaluation.

In abortion cases, basically all findings of delivery should be looked for but it depends on duration gestation period.

All important findings should be photographed. Fetus material may be retained for DNA profiling. It can be done in five ways:

1. Take one cotton gauze piece, rub it over skin of fetus, dry it and then put it paper envelope.
2. Take tissue as such and keep it in minus 20^0C freezer.
3. Keep fetal remains in absolute alcohol or 70% alcohol.
4. If nothing is available at centre then preserve it in saturated solution of common salt.
5. If there is difficulty in getting absolute alcohol then whisky / scotch/ liquor which usually have 40-50% alcohol , can be used as last resort.

Special Note: Never use formalin if DNA profiling is desired.

Samples: Blood**,**Urine**,** abortus material, uterus, cervix, culture in infective cases chemical material in genital tract, botanical material present in cervix or uterus or vagina.

Scene Visit

At clinic: it is always better to visit scene with Gynecology and Obstetrics Specialist**.**

- Place
- Instrumentation
- First aid measures
- Anaesthetic measures
- Minimum facilities as per MTP Act 1971 and Rules 1972
- Qualification of abortionists
- Abortus material
- Bleeding and soiled garments
- Place of disposal of clothes

At the times of post mortem

Complete examination and photography

Photography

- Important external findings
- Important Internal findings
- Local genital findings
- Chemical present
- Botanical material present
- Instrumentation signs
- Hot water bottle marks
- Bleeding

- Infection
- Tears
- Cause of death

Cause of death in legal abortion

- Pulmonary thrombo-embolism
- Hypoxia resulting from anesthetic procedures
- Uterine Perforation
- Vaso-gvagal stimulation from cervix manipulation
- Infection
- Septicemia
- DIC
- Bleeding
- Amniotic fluid embolism
- Air embolism

Causes of death in Illegal Abortions

- Shock from dilation of cervix
- Tear in cervix and bleeding
- Uterine perforation
- Infection
- Gangrene
- Embolisms – thrombus, air and amniotic fluid embolism

Audit Sheet

Check Points	Yes	No
History		
Scene		
Photography		
External examination		
Internal examination		
Genital examination		
Sampling		
Cause of death		

Social Forensics

In highly populated India, liberal policies about abortion are in the interest of country.

ECTOPIC PREGNANCY DEATHS [128-137]

Ectopic pregnancy is defined as pregnancy that develops after implantation of the blastocyst anywhere other than the endometrial lining the uterine cavity.[128] Generally, it refers to the implantation of a fertilized egg in a location outside of the uterine cavity, fallopian tubes, ovaries, cervix, uterine cornue, and abdominal cavity. The most common site is within fallopian tubes. Salpingitis is the main cause of tubal pregnancy and now is considered due to Chlamydia.[129] The other sites are ovary, abdominal cavity and uterine end of fallopian tubes. The most common reason for ectopic pregnancy remains infection in tubes / PID. Other reasons can be leiomyomas, adhesions, previous surgery.

It is one of the leading cause of pregnancy-related death in the first trimester, accounting for 9% of all pregnancy-related deaths. [130] The incidence of ectopic pregnancy has been reported to increase about four folds due to multi factorial reasons like increase age for marriage, previous caesarians, parity, smoking, previous ectopic, endometriosis, structural anomalies and life style of the women affected.[131] More than 95% of the ectopic pregnancies occur in fallopian tubes. Another 2.5 % occur in corona of the uterus and the remainders are found in the ovary.[132]

Ruptured tubal or ectopic pregnancy is one of the acute abdomens which necessitate immediate surgery; misdiagnosis or delay in starting of treatment has high chances of fatality. On an average tubal pregnancy usually does not go beyond 8-10 weeks due to lack of decidual reaction in the fallopian tube, the weak and thin wall of tube, there is bleeding due to trophoblastic invasion into the wall. Thus the tissues of the tubal wall form a gestation sac for the growing ovum, and haemorrhage may occur in the tubal lumen or into the layers of broad ligament. Rupture is usually occur after 6 weeks of pregnancy. Mean age at death due to rupture of ectopic pregnancy was found 27 (+_ 6) years.[133] Presentation is acute abdomen and if goes undetected , can have fatal outcome. Massive haemoperitoneum is the usual cause of death when ruptured ectopic pregnancy is missed or left unattended.

Early diagnosis before ectopic pregnancy ruptures reduces both mortality and morbidity. The blood and urine level of HCG level should be obtained. The level of beta HCG in blood is 1190 + 320IU/l for unruptured and 4160 + 400 IU/l for ruptured ectopic is quite helpful in making diagnosis.[135] Urinary HCG levels correlate well with that in blood.[136] It is certainly inadequate to use clinical features alone in making diagnosis of ectopic pregnancy. Diagnostic aids such as Immunological urine pregnancy test, ultrasonography, culdocentesis, and laprotomy when needed, make the job much easier. It is extremely difficult to diagnose heterotopic pregnancy (intrauterine as well tubal pregnancy), and 50% of such cases are identified only after tubal rupture. [132]

Postmortem Findings

- Bloated abdomen
- Blood in pelvis cavity / abdomen
- Bleeding at the site of implantation

- Fertilized ovum undergoes normal development with formation of placenta, aminiotic sac and decidual changes at implantation site.

Investigation

- HCG assay
- Ultrasound

Histopathology

- Uterus – endometrial for decidual changes , may be or may not be
- Site of rupture for bleeding and other changes
- Conception products

Photographs

- Face for pallor look
- Clothing
- Lower abdomen for hot water application , trauma
- Rest as per need of case
- Bleeding volume in abdomen
- Rupture site
- Conception products
- Utreus, ovaries and fallopian tubes

Cause of death

- Haemorrhagic Shock
- Air embolism

Audit Sheet

Check Points	Yes	No
History		
Amenorrhea of 6-8 weeks		
Pain Abdomen		
HCG		
Ultrasound		
Abdomenal aspiration		
Abdomen examination		
Pelvis examination		
Conception products		
Blood Volume measured		
Cause of death		

Note: The other conditions which may simulate ectopic pregnancy are: 1. acute appendicitis; 2.perforating peptic ulcer; 3.twisted ovarian tumour; 4. ruptured endometrial cyst and 5.acute haemoperitoneum from rupture of vessels of ruptured corpus luteal cyst.[134]

One should rule out these possibilities.

STILL BIRTH [45,50,14]

Intrauterine/ Intra partum fetal death after the age of legal viability i.e. born with no "signs of life" from 28 weeks to full term 40 weeks. Major problem faced by autopsy surgeon is to decide whether it was dead fetus or it died during process of labour.

A simple answer to these queries is to conduct meticulous postmortem examination.

Protocol adopted is as follows

- Place of recovery
- Condition at recovery
- Covering
- Clotting
- Placenta
- Height
- Weight

External features and measurements

- Body weight
- Crown-rump length(sitting posture height) about 2/3 of crown to heel length
- Crown-heel length (standing height)
- Shape of Head
- Occipito-frontal circumference (important in contracted pelvis cases)
- Chest circumference at nipple level(expanded or non-expanded chest)
- Abdominal circumference at umbilicus
- Umbilical position
- Nasal patency
- Palate
- Lips
- Ear position(low , high, normal)- Chromosomal aberrations
- Ear shape
- Nasal bridge (depressed/ elevated/ flattened)
- Thickening skin in posterior neck
- Hands shape and fingers shape
- Foot length and foot print
- Spinal integrity
- Genital position (Testes descended/not descended)

- Anus patency
- Vernix caseosa
- Skin condition (fresh/ peeled off / discolored)
- Skin blebs, sloughing
- Hair length
- Finger nails
- Eyebrows
- Eyelids
- Laxity of joints
- Integrity of joints

Special features of hard and soft palate, choancal atresia, ear size and position, tongue protrusion, nuchal thickening(Trisomy21), short sternum (Trisomy 18), polydactyl(Trisomy 13), finger lengths, genitalia , patency of orifices are of special importance in such cases.

Internal

- Softening of organs
- Collapse of head
- Sub scalp bleeding
- Sub arachnoid haemorrhage
- Make specific incisions
- Note position of chest and abdominal organs
- Muconium

Common causes

Fresh still births are quite common in obstructed labor due to contracted pelvis, prolonged second stage of labour.

History	Yes	No
Skin		
Shape of head		
Circumferences		
Anatomical abnormality		
Chest expansion		
Umbilical cord		
Scalp trauma		
Cord		
Internal organ maturity		
Position of organs		

Examination of placenta

Placental disc weighs about 500 grams near term. If it weighs less than 350grams and over 700 grams , is indicative of pathology. The usual dimension o placental disc is about 18 cm and shape is oval and round. The thickness varies 2 to 2.5 cm. If placental thickness less than 1 cm and above 3 cm is indicative of pathology. Thickness is measured after giving a cut. Placenta should be cut at 1-2 cm interval, consistency should be noted

Fresh/ New Infarct – red in colour

Old Infarct – pale and hard

Firm area- infarct, collection of fibrin, thrombosis

Placenta examination points

Photograph with covering / container, overall and close up shots

Weight with umbilical cord

Weight without umbilical cord

Diameter

Thickness maximum

Thickness minimum

Cotyledons

Foetal Surface

Maternal surface

Maternal attachment site

Umbilical cord length, haemorrhage, knots, varicosity, method of cutting

HP Blocks: Maternal surface, foetal surface, umbilical cord, from thickness of placenta-attachment site. Membrane is made as a roll then one section is taken; any scarring, infective, shrunken or hypertrophied area. If thrombosis then one sample for age of thrombus.

Method of dissection of placenta

Make serial sections of 1-1.5 cm from one to another end and look for infection, haemorrhage and thrombosis.

Umbilical Cord Examination

The average length of umbilical cord is about 60 cm ; short cord is considered when it is less than 32 cm and

Gestational Age (weeks)	Umbilical Cord Length in cm
20-21	32.4
22-23	36.4
24-25	40.1
26-27	42.5
28-29	45.0
30-31	47.6
32-33	50.2
34-35	52.5
36-37	55.6
38-39	57.4
40-41	59.6
42-43	60.3

while long cord is labeled when it is 100 cm or above at full term. The simplified average length with gestation period is mentioned below in the table (Benirschke and Kaufmann), average length is with plus minus range of 8 cm to 12 cm on either side with advancing gestation weeks.

Histo-pathological sections – one near fetus and another nearer to placenta

Cord insertion can be central, eccentric, marginal.

Method of autopsy of conception products[50]

Up to 12 weeks – Sectioning methods

12- 22 weeks – mini necropsy

22weeks – 40 weeks – Full autopsy

Common cause of death

Immaturity

Nonviable foetus

Congenital abnormality

Asphyxia during birth process (fresh intra-partum still births)

Instrumentation

Photographic evidence at the time of postmortem

- Overall photo
- Head shape
- Skin changes
- Diameters
- Umbilicus
- Sub-scalp haemorrhage or fluid collection
- Any fracture or any injury
- Lungs and chest cavity
- Any other peculiarity

Caput succedaneum presents as scalp swelling that extends across the midline and over suture lines and is associated with head moulding.. It is mainly a fluid collection in subscalp subcutaneous space. It resolves in few days.

A cephalohaematoma is haemorrhage of blood between the skull and the periosteum of a recently born baby and is secondary to rupture of blood vessels crossing periosteum.

Prolonged second stage of labour depends on pelvis size, condition of uterus, position of fetus, pushing efforts of mother. One must know reasons for pbstructed labour in such cases. Normal period of second stage varies from 30 minutes to three hours in nulliparous woman. In multiparous it is up to 30 minutes.

Assessing time of death in still birth- If skin is intact and red, the death should be less than 8 hours. If there is skin slippage with detachment od epidermis , death should be more than 8hours and upto 72 hours . If there is sever skin slippage and discoloration of organs with serosanguinous efuusion in the body spaces, fetal death is more than 72 hours. If skull bones overlap, death may have occurred for 4-5 days. In this regard, Langley's grading of maceration is quite helpful.

Social Forensic Message

Encourage hospital delivery where trained personnel are there.

INFANTICIDE [1,2,4,5,6,7,8,9,10, 11,44,45]

The following procedure is in addition to the procedures described under Sudden Natural Deaths and Deaths associated with Child Abuse and Deaths of Suspected SIDS.

History

- Marital status of parents, antenatal history of the pregnancy, Birth history and Post natal complications of the infant and the mother must be looked into in detail.
- Birth Weight of the child must be recorded.
- Clinical notes must be scrutinized.

Preliminaries

- If the Placenta is available, it must be examined and necessary samples must be taken for histology and genetic screening. Umbilical cord must be examined
- Photography must be done.
- Radiography as indicated and where it could be of help.
- Weight, Crown rump and Crown heel length, Head, chest and abdominal circumference must be measured.
- Presence or absence of clothing must be noted.

External Examination

- Injuries and abnormalities must be documented and photography must be done.
- Maturity of the child must be estimated.
- Any congenital abnormality incompatible with life must be noted.
- Examination of Umbilical cord in detail (Length, ends, Watson Jelly).
- Presence or absence of caput succedaneum.

Internal Examination

- Special technique- after removing cerebral hemispheres inspection of falx cerebri and tentorium cerebelli to exclude hemorrhage during birth[1,2,4]

- Cardiovascular and respiratory systems must be dissected en bloc[1,2]
- Lungs must be examined for signs of respiration
- Gastrointestinal system must be examined for presence or absence of food materials and samples must be retained for further analysis.
- Dissection of ends of the relevant bones for age estimation

SAMPLES

- All organs including placenta and umbilical cord for histological examination.
- Blood samples for toxicology as indicated.
- Blood culture and virology as indicated
- Genetic screening as indicated

Changes in circulation[45]

Umbilical cord has two arteries and one vein, surrounded by Wharton jelly. Umbilical arteries and vein start contracting after birth and are completely closed by third day. These are completely obliterated by fourth or fifth day. The ductus arteriosus is closed by 10th day. The closure of foramnen ovale occurs by second or third month after birth.

Audit Sheet[5,7, 11]

Procedure Check Points	Yes	No
Overall condition		
Body photography		
Covering		
Prenatal and postnatal history scrutinized		
Placenta and umbilical cord examined		
Maturity of the baby estimated		
Heart and lung examined en bloc		
Sample of all organs retained for histology		
Microbiological samples collected as indicated		

Common Causes

- Head injuries
- Chest injuries
- Strangulation
- Smothering
- Starvation
- Drowning in milk /water etc
- Untied umbilical cord

Photographic points in Infant death

Scene

- Overall view
- Bed with pillows, quilt and other clothing
- Preventive margins
- Sleeping positions
- Medication around of recent use
- Hygienic condition of residence / place of stay
- Wall for any scalp hair / blood
- Instruments of hitting around
- Co-sleeper with infant and their relative position

At the time of post-mortem

- Overall all view of body
- Clothing
- Full body photography
- Injuries with and without scale
- Important findings
- Important internal findings
- Cause of death

Social Forensic Message

People should practice equality towards both sexes as they are required by society.

All measures should be taken to prevent female feticide and infanticide.

SUDDEN INFANT DEATH SYNDROME[1,2,4,5,6,7,8,9,10, 11]

The following procedure is in addition to what described under Sudden Natural Death and infanticide

History

In the history following points must be stressed

- Consanguinity of parents (blood relationship of mother and father)
- Family history of previous deaths in childhood and details about siblings
- History of the Family tree
- Maternal and Paternal ages and medical and social history
- Maternal illness during pregnancy
- Mode of Birth. Period of gestation, birth weight, complications after birth
- Immunization History
- Parental Habits (Smoking, Alcohol, Drugs, etc)
- Details about beddings

- Details about child's last meal
- Details of the incident. Position of sleeping (on back, face down), with whom, etc.

Scene Visit

To inspect the room and the condition of bedding. (Even though the bed is not there, scene visit will be a benefit)

Preliminaries

Photographs of the body and Radiography of the body as indicated

External Examination

- Clothing must be described
- Distribution of Rigor Mortis and Hypostasis must be described
- Weight and the Height of the body must be documented and whether it is compatible with the chronological age must be analysed. Head, chest and abdominal circumference must be measured
- Body must be examined to exclude injuries and if any injury is found, explanation of it must be sought.

Internal Examination[1,4,8,9,]

Special neck and facial dissection as indicated

Central Nervous System

Any development abnormality must be noted.

Falx and Tentorium ceribelli examined after removing hemispheres.

Middle ear must be examined for signs of infections after removing the brain by removing the petreous part of temporal bone.

Cervical spine should be examined as indicated.

Respiratory System and Cardiovascular System

- Description of the Thymus and its weight must be noted
- Heart and Lungs must be dissected en bloc. Patent Ductus Arteriosus must be excluded.
- Heart must be examined for congenital abnormalities.
- Larynx, trachea and major bronchi and peripheral bronchi must be examined for aspirated materials

Dissection of all systems including Reticulo-endothelial system, endocrine system and collection of samples[1,4]

Special Investigations

Histology

Retaining tissues of all organs for Histopathological examination.

Special Staining as indicated

Microbiology

Blood for virology, bacteriology and culture as indicated.

Toxicology

Full screening for common poisons and special toxins as indicated.

Biochemical Studies of Vitreous for Glucose, Electrolytes and other metabolites.

Screening for metabolic disorders as indicated (1,2)

Screening for Genetic Disorders as indicated

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risk factors identified in the history		
Bedding examined		
Maturity assessed		
Central nervous system examined by neuro-pathologically		
Microbiological Screening		
Biochemical screening		

Probable Mechanisms

- Electrolyte imbalance
- Conduction disorders
- Respiratory distress
- Metabolic disorders
- Overlaying
- Viral infection
- Prominent trachea-bronchial secretions

Photographic points in sudden death in childhood

- Overall view of body
- Full body photograph
- Face
- Neck
- Limbs
- Back of trunk
- Any peculiarity
- Important internal findings
- Cause of death

Social Forensic Message

Give special care to young children in rainy and winter season

NEW BORN DEATHS WHERE MATERNITY OR PATERNITY IS DISPUTED[1,2,4,5,6,7,10, 11]

The following procedure is in addition to what is described under Sudden Natural Deaths. Here, efforts are directed towards parentage determination.

History

History of allegation

Exchange of babies in labor room

Fire in hospital nursery

Prenatal and postnatal history

Birth history

History of consanguinity

History of recovery of the body and the state of it.

Preliminaries

Photography of the body.

Foot print analysis

Collection of blood samples from Alleged Father, Mother, Siblings and relatives as is the case may be, after getting the authority and consent.

Safety and custody of the samples must be maintained.

External Examination

Exclusion of injuries and malformations.

Internal examination

Collection of Blood samples for Blood grouping and DNA analysis

Exclusion of congenital abnormalities incompatible with life.

System wise dissection and collecting samples for histology.

Samples

Blood for grouping

Blood for DNA Profiling

Material for DNA Profiling -Bone marrow, tooth pulp, hair with roots, psoas or thigh muscles samples in decomposed bodies

Routine Histology sections , specifically of lungs and brain

Toxicological Screening

Preferred family samples in order of preference

1. Parents (Biological mother and father)

2. Twin brother / sister

3. One parent , children

4. Siblings

5. Grand children

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risk identified in history		
Proper authority obtained for taking samples form Alleged Mother /Father / Siblings		
Chain of Custody of samples maintained		
DNA studies arranged		
Proper documentation done		

Common Risks

- Unmarried Couples
- Unwanted pregnancies
- Single mothers
- Domestic servants
- Hospital mix-ups
- After natural Disasters

Photographic points

Scene

- Overall scenario
- Nursery pictures
- CCTV footage if available
- Documentary foot prints

At the time of PM

- Body
- Foot length with scale
- Blood for DNA
- Clothing
- Important external and internal findings

Social Forensic Message

Always advocate counseling of parents as no child is illegitimate

Identify mental illness sings!

DEATHS SUSPICIOUS OF CHILD ABUSE (NON-ACCIDENTAL INJURY IN CHILDREN)[1,2,4,5,6,7,8,9,10, 11,60]

Child abuse is social disease where perpetrators are those who are entrusted to care for the child.. 'Child abuse

consists of anything which individuals, institutions, or processes do or fail to do which directly or indirectly harms children or damages their prospects of safe and healthy development into adulthood.

'Physical Abuse of Child is also known as battering or non accidental injury. A physically abused child is defined as 'any child who receives physical injury (or injuries) as a result of acts (or omissions) on the parts of his parents or guardians'[142,143] For clinicians, another version of definition is also used to fit on their needs:

'Child abuse and neglect is any interaction or lack of interaction between family members which results in non accidental harm to the individual's physical and/or developmental states.

Non accidental injury in children or child abuse can be categorized into: physical abuse, neglect, sexual abuse, emotional abuse, abandonment. According to Cantwell & Rosenberg, the child has a right to expect and the adult care taker has a duty to provide: food, clothing, shelter, safekeeping, nurturing and teaching[144]. Failure to provide these constitutes neglect[145]. There are some acts of omission of not providing proper clothing of winter, nutritious food and beating on small mistakes out proportionately.

Actually, parent's socioeconomic, emotional and relationship status plays an important risk factor in child abuse here. If the parent is a drug addict or alcohol consumer or unemployed, surely, the risk of child abuse are higher.[60]

Child abuse carries a significant mortality and morbidity with consequences including: [142]

- Death or disability in severe case
- Affective and behavior disorders
- Developmental delay and learning difficulties
- Failure to thrive and growth retardation
- Predisposition to adult psychiatric disorders
- Increased risk of the abused becoming abuser

This is applicable universally to all unfortunate children who survive the pain and trauma of child abuse. It is more in countries where poverty, illiteracy, and unemployment is rampant. Innocent children become target of psychopathic, mentally disturbed and, suspected infidelity frustrated parents or caretakers.

Minimum Standard in addition to what is described under Sudden Natural Deaths and Standard Procedure for Sudden Infant Death Syndrome

Preliminaries

It is mandatory that all cases where death has occurred in the setting of potential child abuse, full body radiographs should be taken. Also take appropriate photography prior to postmortem examination. Bite marks present over child may relate presence and act of adult perpetrator[119].

Radiographs should ideally be interpreted for features of bone diseases, fractures and estimation of age of injuries.

External Examination

- Special comments on hygiene, built (Height and Weight for age), nourishment
- Documentation of hair loss
- Shaving of scalp hair to reveal occult injuries
- Examination of the Tympanic Membrane for injuries and ear discharge using an otoscope.
- Examination of lips , mouth and frenulum for injuries
- Examination of eyes for subconjuctival hemorrhages and fundus for retinal detachment and bleeding.
- Anus and External genitalia must be examined for injuries and signs of infection or abuse
- Special attention must be paid for the determination of age and multiplicity of injuries.

Internal Examination

Central Nervous System

- Special comments on the presence or absence of subgaleal hematomas
- Special comments on the presence or absence of type and extent of skull fractures
- Special comments on intracranial hemorrhages (Extradural, Subdural, Subarachnoid and Intracerebral) and their extent and ageing.
- Cervical spinal cord dissection and description. Spinal cord and the eyes must be examined if indicated.

Respiratory system

Formal neck dissection in situ, in bloodless field, layer by layer (after opening the skull and removing the brain and excision of thoracic contents at the level of thoracic inlet and draining blood)

Musculo-skeletal System

Skeletal injuries detected in radiography or postmortem examination can be excised for Histopathological examination for ageing of injuries.

Subcutaneous dissection of upper and lower limbs, Facial dissection, Back and buttocks dissection must be done.

Genito-urinary System

- Appropriate swabs and smears should be taken.
- Opinion of Clinical Forensic Physician or Pediatrician is optional
- A formal perineal dissection is optional

Respiratory System

Formal neck dissection must be done in situ, bloodless field, layer by layer. (Achieved by removing brain and thoracic contents at thoracic inlet level before dissecting the neck.[1,6]

Specimens[6]

In addition to sudden natural deaths and SIDS deaths

1. Oral, Anal, High and Low Vaginal swabs and smears when indicated for sperms, seminal fluid and any other foreign bodies
2. Full toxicology examination of blood, stomach contents (including vitreous electrolytes , glucose and urea when indicated)

Radiological Examination

Photography

Audit Sheet[5,7, 11]

Procedure	Yes	No
Photographic documentation of Injuries		
Radiography done before autopsy		
Genital examination and swabbing		
Formal neck dissection as indicated		
Central nervous system subjected to Neuropathological examination		
Tissues and fluids retained for toxicological screening		

Common Causes

- Head Injuries (SDH, EDH, ICH, SAH)
- Chest injuries (pneumothorax)
- Abdominal Injuries (Hemorrhagic Shock)
- Strangulation or smothering
- Starvation and Neglect

Social Forensic Message

Children require care and protection, not exploitation and abuse

They have faith in you as you have in Almighty!

ELDERLY DEATH [49,79]

As civilization is advancing, distances are reducing, values in regard to joint family system is reducing day by day, isolation of elderly people is becoming more common. People migrate due to varied reasons so a large majority of people beyond 65 years live independently. There is a common perception that elderly die only due to natural causes is incorrect, there are other reasons too are responsible for their death. Among elderly road traffic accidents, fall from height, slip and fall, poisoning, hanging are common causes of unnatural deaths .[49] Male are three times more prone to trauma in comparison to females due to mobility.

These cases should be dealt with special attention in the history before starting the case. Focus on getting information on vision, cataract, hearing, medication, existing diseases, mental equilibrium and financial health. Living conditions and circumstances at place of stay. Previous attempts of suicide and deliberate self harm.

Abuse findings: non-accidental multiple injuries, multiple duration injuries, cataract, malnutrition, poor and inappropriate clothing , uncared , bedsores, beating injuries

Photographic points: clothing, General body condition, chronic disease signs, injuries, diseased organs, abused and neglect findings, cause of death

Common causes of unnatural deaths

- Road Traffic deaths- accidental
- Fall and fracture head or femur – accidental
- Poisoning –common suicidal method
- Hanging – Next common cause of death
- Murders by blunt force and strangulation and stabs

Natural causes of death in elderly are

- Ischaemic Heart Disease due to coronary artery disease
- Coronary thrombosis in atherosclerosed vessels
- Hypertensive intracranial haemorrhage
- Renal failure due hypertension and diabetes
- Complications of diabetes
- Tuberculosis

Audit sheet

History	Yes	No
Scene assessment		
Old Investigations /treatment record as per the case		
Photography of important findings		
Any other important finding to show neglect		
Toxicology screening, if required		
Diseases present		
Cause of death		
Opinion		
Arrangement for funeral /Social Agency information		

Common cause of death

- Cardiac lesions
- Head Injuries

- COPD
- Uncontrolled Diabetes
- Intracranial hemorrhage

Photographic evidences

- Overall condition of house / old age home
- Clothing
- Condition of body
- Injuries
- Bed sores

At the time of postmortem

- Overall body
- Clothing
- Malnutrition
- Ankle oedema
- Eyelid swelling
- Bed sores
- Injuries
- Multiple duration injuries

Social Forensic Message

Take care of your elders !

DOMESTIC WORKER DEATH[42]

Increasing mobility in the era globalization and unable to find adequate employment landless labour migrate to urban and suburban areas. It may be due to varied reasons like unemployment, poverty, desire to progress , violence and exploitation in villages. Most of female are employed as maid / domestic workers. In India both sexes are employed as domestic help.

Domestic maid violence is an assault and coercive behaviour including physical, psychological and at times sexual exploitation too by employer and his house against a person hired as domestic help[42].

When there are fatalities, then it could be accidental, suicidal, natural or homicidal. Post -mortem findings depend on type of death. In suicidal or homicidal death , pregnancy arising from boy friend, co-workers, guard, adulterous activities, master or any house hold male members could be the precipitating reason.

Accidental reasons: fall during cleaning floor over soapy and slippery surface, fall from stairs, accidental burns, accidental electrocution etc.

Suicidal deaths: Mainly due to hanging, consuming poison, burning self, cutting wrists, jumping from building etc.

Homicidal deaths: Are rare but could be due to strangulation, beating, head injury etc. It is usually out of anger in extreme cases of defiance, theft, neglect of work, cheating and their involvement in sexual exploitation of minors of the house.

Abuse: Physical injuries of beating of different duration, fracture of bones, allergic dermatitis in hands and feet due to detergents, nutritional neglect if full time worker, sexual abuse (deal as given separately under sexual offences)

Natural disease: Tuberculosis, cardiac disease in aged

Photographic evidences

Scene

- Overall scene
- Clothing
- Body surfaces
- Items in vicinity
- Floors
- Ceiling

At the time of post-mortem

- Overall body
- Clothing
- Full photography as indicated
- Close up of important wounds
- Important external findings
- Important internal findings
- Cause of death

Audit Sheet

What to examine	Yes	No
History		
Overall view of scene		
Clothing		
Full photography		
X-ray if fracture		
Sampling as required		
If pregnancy, DNA profiling sampling in 70%-absolute Alcohol or in kit		
Injuries close up		
Cause of death		

Common cause of death

- Hanging
- Poisoning
- Jumping from building

- Injuries
- Tuberculosis
- Abortion

Social Forensic Message

People should inculcate habit of doing their work themselves

Self-help is the best help!

DEATHS ASSOCIATED WITH FIRE [1,2,4,5,6,7,10, 11,66]

Following procedure is in addition to what described under Sudden Natural Deaths

History

History of the incident with nature of the inflammable substance and condition of the victim immediately after the incident must be recorded. Any statement by the victim regarding the circumstances must be recorded.

Preliminaries

- It is mandatory that in all cases where carbonization of the body has occurred potentially obscuring evidence of ante mortem injuries (Firearm, Blast etc), full body radiograph is performed prior to postmortem examination.[6]
- Photography must be performed to record the distribution of soot, burns and other injuries and visible artifacts.

External Examination

- Clothing must be examined, described, sketch drawn, and retained for analysis of inflammable materials.
- Body surface area of burn must be calculated as per (Rule of Nine). Keep in mind that body parts ratio is slightly different. Total percentage can be summed up at end. Use different formulae for children (Lund), adolescent and adults (rule of nine).
- Description of the extent and the distribution of burn injuries and the depth.
- Description of the un-burnt area.
- Head hair and body hair must be examined and described and samples must be retained for analysis of inflammable materials.
- If the victim has survived for a period after burns, Healing process and the infective process must be described.

Internal Examination

Central Nervous system

Scalp and skull must be examined and attempt must be made to differentiate ante-mortem hematomas and fracture from post mortem artifacts.

Cardiovascular System

- Heart must be examined for features of shock.
- Blood must be examined for color (Cherry Pink in CO poisoning) and retained for analysis

Respiratory System

Larynx, Trachea, Major bronchi must be examined to document the presence or absence of soot and signs of inflammation. Consider photography and Histology when necessary.

Gastrointestinal system

Upper gastrointestinal tract must be examined for presence or absence of soot and inflammation.

Genitourinary system

Detail dissection and Swabs if possible including histology to confirm or exclude Sexual violence and pregnancy in the cases of Women subjected to burns.

Specimens

Histology

Larynx, Trachea and Bronchi, lungs and upper gastrointestinal tract

Toxicology

Full Toxicology Analysis including qualitative and quantitative assays for Carboxyhemoglobin and Hydrogen Cyanide[6]

Clothing and Swabs for analysis of Inflammable Substances.

Comments

Opinion whether the Burns are Ante mortem or Post mortem?

Whether the Pattern is suggestive of Suicide, Homicide or accident

Audit Sheet[5,7, 11]

Procedure	Yes	No
Radiography		
Examination and retention of clothing		
Burn area estimated		
Un-burnt area described		
Upper respiratory tract examined for soot		
Histology of lungs		
Toxicology and CO screening estimation		

Common Circumstances

- Accidental

- Homicidal
- Suicidal

Common Mechanisms

- Inhalation of irrespirable gases
- CO or CN poisoning
- Pain and shock
- Hypovolemic Shock
- Septicemia after some time

Antemortem signs: red lines at margin , inflammatory reactions, blisters, intact soles, armbits and sides of eyelids (crow foot appearance), reddish discoloration of trachea, soot particles in lower respiratory tract, CO levels.

Photographic evidence in burns

At Scene

- Overall view of scene
- Location of body
- Extent of fire
- Circumstances
- Attempt to conceal crime
- Cause of onset of fire
- Intoxication signs or empty bottles
- How the person is being identified
- Position of different bodies , if more than one
- Place after removing bodies
- Position of other items etc.

At the time of postmortem examination

- Overall view of body and clothing
- Area of burns
- Feature and depth of burns at different points
- Close of vital reaction findings
- Infection, eschar, sloughing, granulation tissue
- Condition of clothing at different points
- Hair singeing
- Soot deposition over skin
- Heat ruptures
- Mucus membrane of tracheal and GIT
- Soot deposition in respiratory track
- Lungs, display of soot particles in deep bronchioles on compression
- Any other remarkable findings

Scalds

- Clothing
- Area involved
- Dribbling marks of liquid material and its direction
- Blister
- Depth of burns
- Inflammatory and healing signs
- Close-up of features

Social Forensic Message

Safety first in fire situations

Always **x-ray** burnt human remains

DECOMPOSED BODY [1,2,4,5,6,7,10, 11]

The following procedure is in addition to what described under Sudden Natural Deaths

Preliminaries

Scene Visit

As indicated and felt necessary

Crime Scene evaluation report by Police

Surrounding area must be scrutinized for signs of violence, personal effects.

Photography

Whole body as it is, before and after removing clothes.

In unknown cases a minimum set of photographs should be taken routinely which cover face (Front, right side and left side, Front of body up to neck area, front of chest, pelvis area with thighs, lower limbs, feet soles, palmar areas, sides of body, back in three portions –head and neck with shoulder are, back of trunk, buttocks and thigh and lower limb.

Specific features as required.

Radiography

As indicated. It is helpful in determining age, firearm injuries and skeleton trauma

FINGERPRINTING BY POLICE, otherwise staff should be trained these. Removal of digits should be avoided as it is mutilating. No harm in asking training under fingerprint division of FSL for efficient management of evidences.

SAFE CUSTODY OF ALL PERSONAL EFFECTS- All items should be kept in transparent plastic envelope.

External Examination

- Scars, Tattoos, Birth marks, Deformities or any other specific features must be recorded in documents and

photography.

- Dental Examination should be arranged with a Forensic Odontologist if possible.
- Hair, teeth retained for analysis and comparison.
- De-gloving hands must be preserved in concentrated glycerin for finger printing[1]. For Toxicology preservation saturated NaCl is required.
- Attempts must be made to differentiate injuries from effects of animals and weather, machinery and elements.
- Stage of the decomposition must be clearly documented and photographed.

Internal Examination

- Dissection of systems as much as possible and retaining tissues for histology and toxicology
- Skeletal examination for the purpose of identification (Age, Sex, Stature, Race and Specific Identification features- Old Factures, Deformities, Prostheses, etc) and any Injuries (Fractures, Cuts, Firearm Injuries etc)

Samples

Histology

As much as circumstances allow

Toxicology

Available body fluids and soft tissues

SAMPLE FOR DNA PROFILING (See General Instructions)

Any of the following samples

Hair with root/ Teeth with pulp/Bone with marrow/any other soft tissue

No harm in keeping little extra material.

PERSONAL EFFECTS

For comparison and identification

Reporting

- Identity- General And Specific
- Cause of Death
- Circumstances of Death
- Time Since Death
- State of Disposal

Audit Sheet[5,7,11]

Procedure	Yes	No
Scene Visit		
Photography		
Radiology		
Collection of personal belongings and custody of them		
Dental charting / opinion on teeth		
Finger Printing		
Sample for DNA studies		
Sample for Histology		
Sample for Toxicology		
Skeletal Survey		
Medico-Legal Issues addressed		

Common causes

- Firearm injuries
- Stabs
- Strangling and smothering
- Multiple injuries
- Head injuries

UNCLAIMED BODIES

There is rapid migration and mobility of people from one area to another area. Unclaimed dead bodies are brought to every morgue. Majority of these dead bodies are found in vicinity of religious places, hospital, road side and water bodies.[113]

Every unknown remains requires proper disposal as the per the protocol of the state

Before disposing remains of unclaimed one should ensure that :

1. Make a proper entry and follow protocol of Institution (Height, Weight, age, clothing description, skin texture, any unique observation and cause of death)
2. Basic information- Body found on date and timings, location of scene, Police station, mortuary arrival and disposal, PM date, cause of death, DNA samples stored at which center etc)
3. Take photographs of face from different angles
4. Photographs of belongings
5. Photographs of clothings
6. Photographs of identifying features like tattoos, skeleton deformities, artificial prosthesis and dentition
7. Tissues (muscle, bones, blood in dry gauze piece,

pulled scalp hair) for DNA Profiling as and when required. Wet tissues should be kept in a polythene under / plastic bottle under minus seventy degree temperature. Take all precaution to contamination of samples. Instruments should be cleaned twice with bleach powder and sterilized or use new disposable items.

8. Name of persons authorized to dispose off
9. One month preservation of body is a reasonable period in India depending on condition of body. It may be extended to any limit depending on circumstances of case.
10. One should not insist on disposal if preservation facilities are available and body can be preserved without any environment hazard (72 hours as Police Manual)
11. Bodies in high decomposed stage with maggots and strong foul smells are very repulsive so their preservation can hasten decomposition of other bodies
12. Sloughed skin of hands should be preserved for finger prints in saturated saline / alcohol/ or glycerin
13. DNA Profiling samples should be cleared within one year.
14. In addition, radiographs of skull and full sinus view can also be considered.

In Non- MLC bodies, disposal of remains is carried out by hospital. In MLC bodies, disposal is carried out by police.

(Radiograph comparison of facial points lies within medical domain)

Clothing Examination Format

- Type
- Texture
- Observation
- Tags prepared
- Photographs
- Sketches
- Any thing of evidentiary value
- Special mention

Photographic evidence

- Clothing
- Personal effects (belongings)
- Dentition
- Penis circumcision
- Jewelry
- Peculiarity
- Injuries
- Fractures
- Important external and internal findings
- Entomology – eggs, larvae, puppa, flies

Common Cause of deaths [113,115] **are** ;

- Starvation
- Peumonia
- Chronic Illness – Pulmonary Tuberculosis , diabetes, renal and hepatic failure
- Road Traffic Accidents
- Railways accidents
- Drowning where water bodies are there

For disposal of unclaimed bodies in the hospital If address in recorded then procedure would be through record section of the hospital. Record officer must send letter to relatives to give them opportunity

1. Send registered letter on noted address in hospital record with a copy to area local police of that region
2. Send first reminder after two weeks asking them to take possession of the body
3. Send second notice after another two weeks as a final chance to take possession of body.
4. Start process for cremation and bural as per recorded religion . A specimen copy of a such a letter can be as under.

Ref/ Mortuary / 2013 No. Dated :……..

Subject : Disposal of unclaimed body preserved at Mortuary

Sir ,

It is submitted that the dead of …… s/d/w of…… Aged ……Sex …… R/0 ……Via hospital registration number on dated in ward no……bedno……Diedon …….. Under care of Dr…… is lying in the mortuary since……..

No one has come forward to claim the body. Therefore, it is requested to start process of disposal of dead body as per the policy of the hospital of the body. Kindly sanction requisite funds as allocated for this purpose to following attendant to do the needful.

People assigned the job of disposal of this body are

Sanitary Attendant…….

Morgue Attendant……

Verified by Mortuary Clerk/ Technician

Please send notice on above address by registered post through record officer,

Thanking you

yours Sincerely

Officer Incharge Mortuary

Social Forensic Message

Standard of society is judged from the respect given to its dead

EXAMINATION OF THE SKELETON REMAINS[7,11,12,14]

Whenever completely skeletonised or partially skeletonised remains are brought for medicolegal autopsy, it becomes a challenge for the autopsy surgeon to give his opinion.

History whether deceased is known or unknown, last seen alive, site of recovery of skeleton etc.

A skeleton chart is prepared and all the bones are counted.

It is advised to consult with an anatomist, anthropologist, radiologist and a dentist with forensic knowledge , where facilities are available for formulating a scientific opinion. In ordinary circumstances forensic medicine expert with little more training is sufficient for forensic purposes to reach on conclusion. The following queries have to be answered:

Whether human or animal bones

- Examine gross anatomical characteristics –Medical man
- Microscopic characteristics - Medical man /FSL
- Chemical analysis of bone ash- FSL
- Precipitin test- species identification - FSL/ FMT

Whether bones belong to one or more individuals

Mix up of bones is possible in mass disasters/ natural calamities, common burials, aircraft accidents.

- Examine the number of bones received for examination
- Note the side to which the bone belongs whether left or the right side
- Check for the fitting of adjacent bones and morphological similarities
- Determine whether all the bones ascribed to one individual belong to same age
- Due consideration to anatomical variations should be given as in supernumerary ribs, fingers etc.
- Ultra-violet light can be used up to certain extent to segregate bones based on the spectrum of colours emitting from bones(due to varying amounts of minerals in them)
- X-ray examination for trabecular pattern for age and sex
- Neutron activation analysis to distinguish the relative mineral contents in the bones can be performed, if facilities are there. Currently , not practiced.

Race

- Examination of skull, mandible and teeth, limb bones and pelvis- Racial profiling can be done based on numerous differentiating features

Age at the time of death

- Examination of epiphysis of long bones
- Dental examination
- Calcification of costal, laryngeal cartilages and hyoid bone; changes in the sacrum; closure of cranial sutures; parietal bone thinning; changes in the joints; histological examination of teeth and bones

Sex of the individual

- Examination of skull, pelvic bones, mandible and other long bones
- Recognizable sex differences are appreciable only after puberty

Stature

Measurement of long bones and use of multiplication formulae (Indian population)

Identification

- Characteristic features of bones when present are carefully noted. e.g malunited fractures, deformities or peculiarities of bones are helpful.
- Superimposition technique if skull is available and a photograph of the alleged victim is made available from Forensic Science Laboratory
- Reconstruction of face when skull available
- X-ray comparison of corresponding bones with the one taken during life if available
- Determination of blood group antigens from the teeth pulp material
- DNA analysis from the teeth or bones
- Examination and collection of exhibits found along with the skeleton - clothes, identify cards, jewellery, bullets, weapons, soil (in exhumed bodies)

- Currently DNA profiling is method of choice for absolute diagnosis
- DNA profiling and Fingerprinting are absolute methods of identification

Cause of death

Look for clues of unnatural deaths- Position, manner and site of skeletal recovery- crime scene evaluation

- Injury to the bones available- fractures especially skull, hyoid, ribs and spine, missing teeth
- Examination and preservation of any foreign bodies- bullet, glass, knife blade or any such weapons
- Screening for toxicology- arsenic, antimony lead or heavy metals
- Examination of exhibits- any missing articles, look for clothes for signs of struggle, tears, soiling, chemical analysis if indicated.

Time since death

History of last seen alive, interaction with friends or relatives, call records on cell phones or any other available means should be corroborated

- Examination whether completely skeletonised or soft tissue attached
- Presence or absence of odour
- Entomological examination of maggots/insects present on the body
- Examination of exhibits- clothing- sweaters, blankets, socks etc- seasonal corroboration

Special features like manner of separation in case of fragments of skeleton is present, whether any animal gnaw/ bite marks present on the bones should also be noted

Photography

- Crime scene evaluation - Position, site of recovery of skeleton
- IO should be encouraged to bring crime scene digital photographs in CD/pen-drive when requesting for examination of remains
- Exhibits – weapons, clothings, jewellery or other articles
- Entire skeleton after arranging in anatomical position on table
- Special photography techniques for facial reconstruction, superimposition etc from FSL

Radiology where required and felt necessary

- Age estimation
- Stature estimation
- Special features for identification
- Determination of fractures or metallic foreign bodies

Audit Sheet

Procedure	Yes	No
History		
Skeleton chart prepared and bones counted		
Consultation with anatomist, anth opologist, dentist, radiologist -opinion taken if required		
Examination of clothes and other exhibits found along with it		
Superimposition technique advised if Previous comparable material is there		
X-ray and other special radiological techniques used		
Crime scene visit and reconstruction done		
Photography as deemed fit		
Toxicology Screening for heavy metal and other toxicity		
Entomology evidence evaluated		
Blood group analysis		
DNA analysis for positive identification		

DISMEMBERED REMAINS[14,45,105]

Done mainly for disposing the body (homicidal) and sometimes by animals, mainly post-mortem

Post-mortem examination's purpose: identification, determination of cause of death and time since death

History

- Circumstances from where the remains discovered

Identification

- Determine human or non-human, by anatomical features, by DNA analysis or by Precipitin test
- If more than one remains, determine they belong to one human or more
- Age: by determination from ossification centers and if skull, by sutural fusion
- Sex: by features of bone, skull and pelvis
- Height by using multiplication factors
- DNA sampling is very important and essential for positive identification
- Any peculiarities to the part: congenital deformity/ lesion, acquired deformity/lesion: scars, tattoos
- Dental examination

- X-ray of remains is quite helpful in knowing age , foreign body and peculiarities.

External Examination

- Examine the dissected margins to determine how the parts were dismembered
- Any disease or injuries to the part, determine if they are sufficient to cause death or not
- Try to differentiate homicidal, accidental, suicidal injuries and defense wounds
- Determine the extent of decomposition for time since death
- Subject skin for histology for ante-mortem and postmortem issue

Internal Examination

- Dissect the part as usual
- Look for any disease to the part
- Look for any injury or fracture and determine the age of the injury/fracture
- Determine if the lesions are sufficient to cause death or not
- Determine the manner of the lesion: suicidal, homicidal and accidental

X-ray

In dismembered remains x-ray should be taken as it is quite helpful in giving idea about sex , age and method of separation like sharp instruments or crushing force etc.

Sampling

- Sample of skin, tissue, bone or blood for DNA analysis
- Sample the viscera, if available, for analysis
- Histology of skin for Ante Mortem/Post Mortem issue or any other relevant tissue.

Audit Sheet

Procedure	Yes	No
History		
Crime Scene Evaluation		
Photography		
Evidence Collection		
DNA sampling		
X-ray		
External Examination		
Internal Examination		
Age, sex and race determination		
Description of Injuries		
Toxicology screening		
Time Since death		
Medico-Legal Questions		

Common reasons

- Sexual Jealousy
- Extortion and Killing
- Disposal of dead body
- Homicide and disposal

Common causes of death

- Ligature Strangulation
- Throttling
- Cut throat
- Cranio-cerebral damage

SUSPECTED POISONING CASE[1,2,4,5,6,7,10, 11,77,91]

The following procedure is in addition to what described under Sudden Natural Deaths. Please see relevant section SOP and Auditing of Poisoning cases.

History

- Detail history about the onset and progression of the signs and symptoms, foods and drinks, about the health of other people who shared the same food and drink source should be obtained.
- Clinical notes should be scrutinized for details of signs, symptoms and treatments.

Preliminaries

Vomitus, clothing soaked with vomitus, remaining food and drinks, their containers should be submitted for analysis

External Examination

- Color of skin, mucus membranes and eyes should be noted.
- Presence or absence of froth and nature must be documented.
- All orifices including mouth should be examined for injuries, remnants of poison.
- Site and direction of IV drip marks must be noted.
- Skin should be examined carefully for injection marks and retained for analysis.

Internal Examination

- Tongue, oral mucosa, esophagus, stomach and the gut should be examined for contents, mucosal changes etc. Any content must be retained for analysis.
- Facial dissection can be done in cases with doubtful circumstances to exclude evidence of force used to make the victim drink poison by holding mouth (Not necessary in every case).
- If volatile substance abuse is suspected Lungs tied at

bronchi should be submitted for analysis in air tight bags[1,2]. Material should be kept in fridge after collection if not analyzed immediately.

- Gases can also be collected in air tight syringe, for blood gas analysis.

Samples

Histology

All organs including mucosa of upper GIT, skin and other orifices as indicated.

TOXICOLGICALANALYSIS (Please refer to SAMPLING AND PRESERVATION OF SPECIMENS)

Blood, Bile, Urine, Stomach contents, Vitreous, and Organ samples as indicated.

When ingestion of poisons is suspected intestinal content from 3 different sites like stomach, small intestine and jejunum or a piece of large intestine[4]. Muscles, bones, joint fluids can also be subjected for analysis in decomposed and skeletonized bodies.

Standard colour tubes

Red Tube (plain tubes)

Serology-Hepatitis, HIV, Dengue

Endocrine- Cortisol

Liver Function

Renal Function, Electrolytes

Yellow Tube (SST II Bottle)

Blood Urea, Serum Creatinine

Serum Electrolytes

Blood Grouping

Gray Tube (Fluoride)

Blood Sugar

Blood Alcohol

Common Drugs (Heroin, Opioids, Cocaine)

Purple Tube (EDTA)

Full Blood Count

Hemoglobin content, Hemoglobinopathies

Glycosylated Hemoglobin

DNA Studies

Bone Marrow

Quantity Requirement as specified or as available

Blood- 10-25ml

Urine-25-50ml

Vomitus- 100g as avaialble

Liver, Kidney, Spleen-100g

Vitreous- 2.5ml or as Available

Bile- as available; Gall bladder if bile is not aspirated in sufficient quantity

Muscle -50-100g

Audit Sheet

Procedure	Yes	No
Risk Factors identified in History		
Preliminary samples retained		
External features of poisoning looked for		
Internal features of poisoning described		
Tissues from affected and target organ for HP retained		
Full toxicological Analysis arranged		

Common substances: Aluminum phosphate in rural India, Pesticides in agriculturists; benzodiazepine; cough syrups with alcohol ; opium products- crude opium, smake , brown sugar; house cleaning agent and insect killers are more common in urban and semi urban areas.

Common Risk factors

- Working in Factories
- Working in Laboratories
- Working in new environment
- Food and drink scarcity
- Drug and alcohol addiction
- Children and elderly
- Psychiatric patients
- People with financial or marital problems

Photographic evidences

At scene

Overall view

Position of body

Facial look

Materials in vicinity

Vomitus

Medicine

Alcohol bottles

Suicide Note

Involvement of people

At the time of postmortem

Overall body

Face

Fingertips

Oropharynx

Oesophagus

Stomach

Small Intestine

Lungs

Kidney

Heart

SNAKE BITES FATALITIES[14,44-47,51,56,68-70, 81,82,95]

There are many thousand species of snakes throughout world. Only about 10% of total snakes are poisonous. In India, about 10 variety are poisonous but only four common poisonous snakes i.e. Cobra, krait, saw-scaled viper, Russell's viper are blamed for envenomation. These are most encountered in forest, hilly lands, farms, unused desolate spaces. In India, 15000-20000 death are reported due to snake envenomation out of 2 lacs bites every year. Over seashores poisonous sea snakes are seen, they have peculiar nostrils and flattened tail. Snakes likes to eat rodents, frogs, lizard and prefer to live under some type of cover.

They can pass through very small holes and can enter in houses through pipes, holes, space under doors. One should watch movies on national geographical channel to understand their habits.

Poisonous snakes have fangs which are collapsible, modified tubular teeth like structure and inject venom and leave needle like puncture marks after penetrating victim's body. These fangs are attached to parotid salivary gland which is situated behind the both eyes a and produces toxic saliva (venom). These fangs are straightened when snake bites the person and goes about 1-2 cm deep. Snake bite location depends on the position of victim,s body at the time of attack. It could be on buttocks, thighs while defecating in open fields, hands and forearm while working in fields, head area while cleaning roof of hut or plucking fruits from trees, raised crops (grapes, loki, cucumber, tori, ghiya etc.), dried dung stores (Bitoda); neck, face or exposed limbs while sleeping over ground ; lower limbs in ankle, feet or area above it.

Fang marks are in pair in upper jaw and are adjacent to each other depending on size of jaw of biting snake. At times fang mark may be single also if fang is broken or has poor grip over biting area, sideswipe as majority snakes bite due to defence or panicky situation or threatened situation. The depth of fang mark depends on the part of body involved. Fang marks distance to each other varies from 0.5cm onwards depending on size and age of snake.

Venom has neurotoxic, cytotoxic and haemtotoxic effects depending on type of snake

History: Time of incident , snake seen, colour and size of snake, first aid**, antivenom given.** Viper's and sea snakes bites are very painful in comparison to cobra. Krait bites are almost painless**.**

Findings in snake bite case (sea snakes are also discussed in marine envenomation)

Use magnifying lens as these fang marks are **very small** especially viper bites are not clearly visible to naked eye

Colubrine: Froth in nostrils and mouth , puncture marks (0.8-2 cm), asphyxia, CNS – fragmentation of nuclei of cells, degeneration; dry gangrene.

Viperine: Puncture mark(1.5-2.5 cm) , bleeding, marked swelling, cellulitis, purpura, patechial haemorrhages, wet gangrene. Viper's fangs are almost double than cobra and krait.

General appearance: Cyanosis is very marked in cobra and krait; DIC , haemorrhages, renal failure and paleness is prominent in viper bites**.** Gangrene of limbs, necrosis, peeling of skin, blisters may be present later.

Clothing: Amber colour fluid, becomes yellowish needles on drying.

Skin: It has needle puncture mark like appearance ,few mm size, and may be skin, subcutaneous or muscle deep. Venom spreads rapidly through subcutaneous areolar space very rapidly. There is swelling and cellulitis in the area in and around the bite. Bitten skin is swollen, bluish discoloured in cobra and krait bites. In viper bites, small clots may present in vicinity of fang marks and blood vessels. Venom over skin will be present as yellow crystals.Local incision for examining the extent of extravasation, oedema and tissue necrosis if any. Keep skin for histopathology.

Internal Examination

Nostrils and mouth – froth , blood tinged secretions and froth

There is intense asphyxia, congestion, haemorrhages under visceral surfaces

Larynx – angio-oedema , mucus

Lungs – oedema , secretions, haemorrhages in sub-pleural and interstitial spaces .

Liver – Necrosis

Heart – toxic myocarditis (on HP)

Muscles – myositis

Lymphnodes –axillary and inguinal region enlarged

Kidney –haemorrhagic nephritis ,interstitial haemorrhages (on HP), necrosis. Renal findings are very informative so special emphasis should be given on renal changes.[51,68-70] A brief method as how to look for findings in kidney is given for conveneience.

- Blunt dissection to separate the peri-nephric fat.
- Examine kidneys in situ.
- Remove kidneys by cutting the ureter and vessels.
- Examined for haemorrhages [subcapsular pin point haemorrhages]
- Weigh the kidneys
- Make Longitudinal sagital slice with a brain knife.
- Section through the kidney from the convexity towards the hilum.
- Lift the capsule off the cortex with toothed forceps.
- Examine the cortex, corticomedullary junction, and the corticomedulary ratio. Measure cortical thickness at level of hilum.
- Look for scattered haemorrhages and intensity of congestion
- Take Blocks from the upper pole of both the sides.
- Cut Tissue size of 2cm x 2cm x 2cm and preserve in formalin for histopathology

What Investigations to look for making diagnosis at post-mortem examination.

1. **Blood smear** – for haemolysis (immediate sampling, or ante mortem blood taken in hospital
2. Blood clotting and bleeding time from hospital records. Incoaguable blood in 20 minutes due to effect on factor, V, IX, and factor X.
3. **Urine** – red or brown colour urine, protein, myoglobinurea, haematuria
4. **Vitreous humor** – Electrolyte imbalance
5. **ELISA** – Enzyme Linked Immunoabsorbent Assay (enquire from clinical laboratory as Forensic Science Laboratory).

   (Snake centres are maintaining Snake Venom detection kit for several variety of land and sea poisonous snakes. Common available kit test for 5-7 poisonous snakes. These are used mainly used to confirm the variety of snake to give specific mono-valent antivenom therapy).
6. **Swabs** from bitten area for venom testing is the **best sample** before cleaning the wound.
7. **Second best sample is urine** for testing venom if bitten area is cleaned or washed. Blood is more prone to give false positive and false negative tests[46].
8. **Fluid in blisters** is also a good sample for detection
9. Raised blood urea and creatinine indicates kidney damage
10. Histopathology of kidneys is also helpful in diagnosing type of snake bites.[51]
11. Histopathology of skin, if multiple bite then one bite area should be included.

One must remember that venom may not be detected if it is a dry bite, area washed, thick layer of clothing, heavy boots, leakage or superficial bite on mobile part of the body. A snake,who is resting or hibernating has high concentration of venom. Any snake usually eats once a week so hungry snake has more lethal and concentrated venom.

In fatal cases, how to preserve the bitten area for species identification.

The usual method is saturated solution of common salt as done in most of the places. If rapid services are available sample should be sent at 4^0C or in glass vial on dry ice cubes(remember venom is water and alcohol soluble).

Another method[47], which suggests that tissues should be preserved in solution having 70% ethanol,2 % glycerol,28% [0.02M] PBS, $_p$H 7.4, and 0.05%thimerosal is being recommended for preservation of forensic samples. It is always a better option to discuss with laboratory about tissue/ sample requirement which is going to provide venom detection services.

Kidneys are of great help in diagnosing and classifying the snake type [70].

How to declare whether it is a case of snake bite?

1. Evidence to suggest the bite occurred
2. Bite mark identified
3. Dead snake brought with body or statement given by deceased to rescuers or police
4. Signs of envenomation
5. Specific findings of cobra or viperine or sea snake bite.
6. Species detected from venom recovered from bite mark.

Photographic evidences

- General condition of body
- Nostrils and mouth
- Nail beds
- Bitten area – fang marks
- Dry venom over skin
- Bleeding gums , bitten site
- Lungs - oedema, fluid, haemorrhages

- Kidneys – necrosis, congestion, bleeding, sub capsular haemorrhages
- Urine Colour – brown/red

Audit Sheet

What to look for	Yes	No
History		
Bite mark		
Use of lens		
Swabs from bite for venom		
Urine for venom		
Lungs gross and HP		
Kidney gross and HP		
Liver gross and HP		
Hospital Investigation		

Best samples are swab from bite, urine, blister fluid, bitten tissue and blood.

Social Forensic Message!

Keep house free from rodents as snakes like them for food.

Once bitten, take patient to hospital for ante venom therapy or 24 hours observation

INSECT BITES/STINGS DEATHS [14,45,47,81,95]

The commons stinging and other creatures sting human beings and at times produce sever local and systematic envenomation. The common ones honey bees, wasps, hornets, fireants , scorpion, black and brown spiders, ticks, centipede, millipedes.

Envenomations signs depends on single or multiple stings. One sting leaves about 50 microgram venom. Scorpion venom is more poisonous than snake venom, only it's injecting quantity is less.

Postmortem findings

Local – oedema, discolored area, swelling, bleeding, urticaria

Systematic – angio-oedema, pulmonary oedema, increaded bronchial secretions

Death usually results from hypersentivity, circulatory failure and pulmonary oedema

Samples –

Skin- Local skin with sting; control skin

HP – Lungs , kidneys, adrenals, heart

Blood for immunological studies

Photographic evidences

Sting

Skin condition

Oro-laryngo-pharynx for oedema

Pulmonary oedema

Harmorrhages over visceral surfaces

Lungs – surface and pulmonary oedema

Kidneys-haemorrhages

Audit Sheet

Check Points	Yes	No
History		
Sting Mark		
Photography		
Compete external examination		
Complete Internal examination		
Histopathology		
Immunology		

MARINE ENVENOMATION[45,47,81,82,106,107]

Poisonous fishes, sea-snakes, blue octopus and a few other creatures bites or sting human involved in marine activities. Only about 10% of sea creatures are having venom while rest of them are innocuous Significant morbidity and confirmed deaths have occurred following envenomation with jelly fish , spiny fish, cone snails, blue octopi, sea snakes[81].

Marine envenomation occurs through injection or application of venom produced by glands.

Theses sea creatures can be divided into vertebrates and invertebrates.

Method of injecting venom

Bites- sea snakes, blue octopi and other octopi

Nematocysts- sea-wasp, man-of-war , jelly fish

Stings – bony fish, urchins, starfish, stingray

1.Vertebrates- sea snakes , stingrays, scorpaenidae(turkey fish, tigerfish, zebrafish, scorpion fish, lionship, stone fish)

2.Invertebrates- sea urchin, corals, sponges, shells, sea-anenomes, octopus , box –jelly fish, Portuguese man-of-war.

1.Vertebrates

1.1Stingrays- Tail has injecting power and fires the victim. Venom contains serotonin and phosphodiesterase

1.2Stonefish or lionfish – stings . venom galds are located at the tip of spines. Venom has stonustoxin, trytphan, nor-epinephrine and verrucatoxin.

1.3 Lion fish- has venom glands. Venom contains thromboxane, Prostaglandin-2

1.4 Sea snakes- Majority of sea snakes are poisonous. All are toxic, bites through small fangs. The fang marks varies from 1 to 4 , and in some cases up to 20 also. There are about 52 species but 6 are commonly involved human fatality, most commonest are beaked snake and yellow bellied sea snake . Majority of snakes are bright in colour. Venom contains neurotoxin, myotoxins and haemolysins. Presence of heavy urine myoglobinurea and increased hepatic enzymes are indicative of serious envenomation. Renal failure is due to combined effect of rhabdomyolysis and direct venom effects on the kidneys[82].

2. Invertebrates

2.1 Jelly fish-. Majority of species of jelly fishes have microscopic **cnidae**, which are highly specialized organelles consisting of an encapsulated hollow barbed thread bathed in venom. These have long tentacles hanging from peumatophore.

Venom is injected by nematocysts. These stinging organelles, called nematocysts, are distributed along tentacles Nematocysts are spring like venom glands which everts to deliver venom. Penetration of flesh leads to hypodermic delivery of venom. Venom has serotonin, histamine, bradykinin, fibrinolysin, hemolysin .

2.2 Portugese Man-of-war – Multiple stings through tentacles. Venom causes circulatory collapse.

2.3 Box jelly fish (sea wasp)- venom is very strong and one sting release can kill many human beings. . Mostly person dies within few minutes.

2.4 Sea urchin- spicules has venom glands

2.5 Blue- Octopus-Venom has tetrdotoxins

2.6 Cone shells- inject venom through long tooth.

2.7 Fire coral – has nematocysts

2.8 Sponges- Spicules inject venom when comes in contact with skin

Local findings at the time of autopsy

The common findings involve sting or bite marks. Area may show skin changes, reddened area, swelling, oozing, inflammation.

Bites- sea snakes, blue octopi and other octopi

Nematocysts- sea-wasp, man-of-war, jelly fish

Stings – bony fish, urchins, starfish, stingray

(Repeated for emphasis)

Systematic findings

The may be findings of hypersensitivity, circulatory and respiratory failure. There are findings of asphyxia , generalized congestion.

Samples

Sting mark and skin

Blood for immunology

Venom testing kit especially developed for snakes and scorpions

Muscles for myositis

Urine – myoglobin

Cause of death

It depends on stinging creature or biting sea-snake. Hypersensitivity, respiratory failure and cardiac toxicity are predominant.

Audit Sheet

Check Points	Yes	No
Over all condition		
Clothing		
Face		
Skin		
Sting/ bite		
Any evidence of biting/stinging creature		
Immunology		
Toxicology		
Complete external examination		
Complete Internal examination		
Cause of death		

DEATHS ASSOCIATED WITH DRUG ADDICTION/ ABUSE [1,2,4,5,6,7,10, 11,14,44,45,95]

The following procedure is in addition to what described under Sudden Natural Deaths

History

- Detail Personal and Social History (Age, Sex, Marital status, Occupation, Foreign Travels, Present and past illness, Treatments and drugs taking, Allergies).
- Details about the Illegal Drugs (Source of Drugs, Rout of administration, Frequency and amount, Associates, Alcohol intake, Smoking).
- Detail history of illness and Death (Symptoms and Signs developed suddenly, Gradually, Found Dead in lonely place, Posture, Signs of Violence and struggle, Presence or absence of drugs and other items like Syringes, Tubes, Foils, Matches, Filters, Needles, Condoms, packets, Pills, Bags, Chemical Bottles, Glue Tubes etc. in the vicinity)
- History of previous hospitalization or Institutionalization.

Scene Visit and Photography as indicated

External Examination

- Description of Clothing (Dirty, Stains, Tears, Any drug or items recovered from pockets, Identity cards or other items in Unidentified cases.)

- Description of personal hygiene and appearance (Unkept Hair and Beard)
- Presence of Tattoos, Scars, Lumps, Skin Sepsis, Injection sites, Contusions and Ecchymotic patches, Hardened veins, Thickened Nasal Mucosa, Burnt Fingers etc.
- Examination of all orifices for injuries, sepsis, thickening of mucosa, foreign bodies etc.
- Presence of Wasting and features of Malnutrition.
- Any other injury

Internal Examination (special attention must be paid to following areas)

Respiratory System

Heavy congested lungs, Presence of froth in airways, petechial hemorrhages on pleura.

Pleural effusions

Gastro-intestinal tract

Peritoneal effusions

Stomach contained un-dissolved tablets, packets,

Entire small and large bowel must be opened and contents must be scrutinized for packets, tablets, etc.

Cardio-Vascular System

Pericardial Effusions,

Valves must be examined for signs of endocarditis

Central Nervous System

Presence of edema

Areas of Necrosis

Reticulo endothelial system

Enlarged Nodes

SAMPLES

Toxicological Analysis (This should be decided according to the indications, Please refer to SAMPLING AND PRESERVASION OF SPECIMENS)

- Venous Blood in Fluoride bottle
- Vitreous humour
- Stomach content
- Bile for Opioids and Chlorpromazine
- Nasal swabs
- Alcohol Mouth washes for Cannabis
- Urine
- Head Hair with Roots

Histology

- Liver samples form right and left lobes
- Brain in Cocaine related deaths
- Injection sites
- Lungs and Lymph nodes for Granulomatous reactions

Microbiology

- Blood samples for HIV screening, if required
- Blood Samples for Culture if some serious infection is suspected which can be dangerous to staff

Drug Addict Death should be considered as HIGH RISK and appropriate precaution must be taken in postmortem examination, handling samples and disposal of wastes and instruments. Universal precautions are must in these cases

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risk in personal history identified		
Detail drug history		
Scene visit as indicated		
Clothing examination		
Specific points in external examination		
Specific points in internal examination		
Toxicological and drug level estimation		
Appropriate Histology		
Screening for HIV		
Precautionary measures		

Common Risks

- Living alone
- Homosexuals/Prostitutes/commercial sex workers
- Prisoners
- Unemployed
- Living in foreign countries
- People in entertainment industry

Common causes

- Drug over dose
- Poisoning
- Anaphylaxis
- Air embolism
- HIV/Infections

Photographic evidence in Volatile Substance Abuse

Scene

- Overall view of scene
- Items present in the vicinity
- Close up of body
- Mouth and nostrils secretions and froth

- Finger tips
- Injection site
- Other material of abuse
- Sex/ abnormal sex related material

At postmortem examination

- Overall view
- Face
- Hands
- Clothing and pocket details
- Important external findings of drug abuse
- Important internal findings of lungs, stomach
- Injection marks, if present

Social Forensic Message

Drug Abuse is a sure way to immorality in the world.

DEATHS ASSOCIATED WITH VEHICLE EXHAUST GAS INHALATION [1,2,5,6,7,10, 11,91,92]

Following procedure is in addition to what described under Sudden Natural Deaths and Suspected Poisoning Deaths

History

Special attention must be paid on the background of the person

- Psychiatric history,
- Suicidal attempts
- Marital and social disputes
- Technical Knowledge about vehicles and associated apparatus
- Detail history of the incident and circumstances
- Medical history
- History of alcoholism, drug abuse
- Diesel or petrol engine
- Devices used to bring exhaust fumes inside the vehicle/ blocked chamber.

Preliminaries

The scene should be visited as indicated

Precautions should be taken to avoid exposure to gas

Assistance of a knowledgeable person should be obtained to examine the vehicle and associated apparatus by technical to be arranged by police

Switches, tubes, keys should be examined.

Finger Printing must be arrange before handling the instruments as indicated

External Examination

Clothing should be examined for suicidal notes etc.

Body color should be noted and photographer as indicated.

Distribution and color of Hypostasis noted

Injuries should be excluded.

Look for blisters in dependent areas

Mucous membranes must be examined before refrigeration.

Internal examination

System- wise dissection to exclude any contributory pathology.

Changes in basal ganglia region in delayed deaths

Samples

Toxicology

Blood sample should be collected for analysis for CO, Drugs, Alcohol, Psychiatric drugs.

Sample for CO must be in a air tight containers. (See **Sampling And Specimen Collection)**

Autopsy room spot test for CO can be performed. (Few drops of Blood into a solution of 10% NaOH –Normal blood turns brownish but if CO is present the color remained Pink.)

If blood is not available Spleen and Muscle can be sent for analysis

Pieces of Lung can be sent in container tightly sealed and refrigerated. Immediate analysis is recommended. Blood gas analysis can be attempted as in other cases.

Histology

Target organ basal ganglia of brain, lungs

Other organs as indicated

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risks identified in history		
Scene visit		
Instruments assessed		
Specific external features observed		
Specific internal features observed		
Appropriate sampling		
Precaution taken to retain in sampling for CO		

Please note - other situations like closed and unused space, CO produced by Geyser, use of burning coal in winter also

produce CO poisoning and similar findings may be seen.

High Risk

- Psychiatric patients
- Drivers and Mechanics
- Children and Debilitated
- People with poor knowledge about apparatus
- Alcoholics and Drug addicts

Exhaust suffocation

Scene

- Vehicle position
- Parking
- Running engine or stopped
- Position of exhaust and pipes attached to it
- Pipe entry into interior
- Sealing of points to avoid leakage
- Any foreign finger print of the vehicle
- Position of victim
- Articles in surrounding
- Alcohol / beer bottles
- Cigarette
- Any suicide note

At the time of post-mortem

- Face
- Clothing
- Wearings in hands /neck –excessive religious
- Skin colour
- Postmortem staining showing pinkish colour
- CO spot test
- Blood colour
- Important external and internal findings

Social Forensic Message

Inhalation of volatile substances and gases is on the rise, catch them early

Increase mass awareness!

DEATHS ASSOCIATED WITH ELECTROCUTION[1,2,4,5,6,7,10, 11,95,97]

Following procedure is in addition to what described under Sudden Natural Deaths

History

Personal, Medical and Social history of the individual

- Occupation / Mechanical knowledge
- Marital status
- Alcohol or drug abuse
- Suicidal attempts
- Past and present illness / any medical or surgical device in body (pace makers)
- Detail History of the incident
- Place of incident
- Nature of current AC/DC
- Voltage, amperage, resistance, earthing, Trip switch technical verification
- Association of water/dampness at spot / Rain
- Use of Shoes/ Slippers at the time of incident
- Nature of Floor- Wooden/Cemented/Metal , Damp/Dry
- Details of Device handled by the Victim and their particles embedded at contact point

Scene visit and examination of the device must be done with technical person who has knowledge of electricity and devices.

Photography as indicated

Minimum required is Crime Scene, clothing, contact points, exit point, peculiar finding

External Examination

Clothing and slippers/shoes

Other ornaments such as Rings, Belts etc.

Signs of cadaveric spasm of hands

Injuries

- Entry wound (Size, Site , Shape, Burning, Blistering, Charring, Pale areola, Red margin, splitting of Skin, Color change, metallization, other associated injuries)
- Exit wound (Details as described above)
- Examination of Soles and Palms
- Any other injury including head injury
- Arc Eye, Singing of hair
- "Crocodile Skin" appearance
- Congestion, Petechiae, Froth
- Signs of Asphyxia
- Patterned wounds/signature burns
- Sometimes electric wounds may not be formed due to

wet surface.

- Hidden surfaces, examine with magnifying lens.

Internal Examination

Changes may be absent.

Nonspecific changes may be there.

- Petechial Hemorrhages
- Pulmonary edema
- System- wise dissection to exclude other natural illness
- Examination of fractures
- Examination for head injury

Samples

HISTOPATHOLOGY (desirable but not mandatory in all cases)

- ***Skin Specimens*** from suspected Entry and Exit wounds in addition to routine histological samples of internal organs as required
- ***Brain stem,***
- ***Heart including conduction system***
- ***Intercostal muscles***
- ***Kidney for Myoglobinurea***

Toxicological Analysis

Blood and bile samples for alcohol, abusive drugs if indicated

ELECTRICAL DEVICES AND THE INSTALLATION MUST BE EXAMINED BY A COMPETENT PERSON TO AVOID FUTURE CATASTROPIES.

Audit Sheet

Procedure	Yes	No
Personal history		
Details about Current		
Scene visit and Examination of Circuit and devices		
External Examination for Entry and exit		
Internal examination		
Histopahology of Skin lesion		
Toxicology		

Common risks

- Unskilled/ Semiskilled workers
- Domestic servants
- Children and Elderly
- Damp environment
- Damaged /old Houses

Common Mechanisms

- Respiratory arrest
- Arrhythmias
- Thoracic muscle spasm

Photographic evidences in electrocution

Site

- Overall view
- Leakage point
- Type of electric supply
- Solo incident or mass incident
- Broken / wear and tear point
- Entrance marks on body
- Exit marks on bodies
- Electrical equipment involved
- Water point if wet surface
- Place where body fell or landed ultimately
- Work in progress at time of shock

At the time of postmortem examination

- Overall view of body
- Face
- Clothing
- Point of contact
- Electric burns
- Organ involved
- Exit wound

DEATHS ASSOCIATED WITH LIGHTNING[1,2,4,5,6,7,10,11,95,96,97]

The following procedure is in addition to what described under Sudden Natural Death

History

- Date and time of the incident
- Exact site of incident (near high building, flat ground, mountain, shade, tall trees)
- Whether raining or not?
- Whether lightening seen and thundering heard?
- Number of people involved
- Other animals involved

- Destruction to trees and other structures, mobile phones
- Presence of high -tension lines, transformers, and other electrical devices

Incident verification, Scene Visit and photography as indicated\

Crime Scene visit can be informative to find local impact of lightening incident like metallization of objects, burning effect, torn trees, burnt grass and botanical material, remnant of shoes etc may be obtained from scene

External Examination

- Examination of Clothing for destruction
- Examination of metallic objects like Coins, Keys for melting
- External features like Fern Like pattern on skin, burn alone skin creases, other injuries, filigree burns, fire flame burns
- Surface burns are usually superficial in nature
- Examination of ear drums for bleeding and tympanic membrane rupture

Internal examination

- Routine system wise dissection.
- Examination for Pneumothrax,
- Examination for ruptured viscera
- Examination of fractures
- Examination for head injury

Sample

Histology as indicated

Toxicology as indicated, generally there is no need of it as it natural phenomenon beyond control of human. Only in cases of forced labor/construction/ field job, plea may be taken as he did not act on advice to remain inside as he was under influence of alcohol.

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risk factors identified in the history		
Scene visit and Photography		
Clothing and other objects Examination		
External Examination for specific signs		
Histology and toxicology as indicated		

Common Risks

- Tropical countries
- Close to tall trees, buildings
- Outside during rain
- In playgrounds/Paddy-fields
- Use of telephones
- Other recent electronic devices

Common Causes

- Multiple injuries
- Electrocution
- Rupture of viscera
- Head injuries

Photographic points in cases of Lightning

Scene of occurrence

- Overall scene
- Evidence of disruption of ground , building , and other objects
- Incidence of rain and lightening in area
- Place of occurrence
- Clothing may show extensive tears with scorches or burns
- Shoe and tight clothing may burst open
- Body will show extensive tears and splits in the skin, opening of body cavity, entry or exit marks
- Melting of metallic objects

At the time of postmortem

- Overall view of the body
- Type of burns
- Condition of clothing
- Hair Singeing
- Bleeding from ear drum rupture
- Disruption of shoes with holes
- Magnetization and melting of metal objects

Social Forensic Message

Don't use your mobile when it is lightning

DEATHS IN HIV POSITIVE CASES[1,2,4,5,6,7,10, 11]

The following procedure in addition to what described under Sudden Natural Death

History

Detail personal history (Marital status, Sex Habits, Foreign Travels, Occupation, Blood and blood product transfusion, accidents, injuries, Past or Present illness and treatments)

Preliminaries (High Risk Autopsy)

Follow NACO guidelines

- Staff should take precautionary measures (CAPS, MASKS, GOWNS,APRONS, BOOTS, DOUBLE GLOVES,VISORS,GOGGLES)
- Minimum number of staff must attend the case.
- Whenever possible disposable items must be used
- Waste must be disinfected with 2% hypochlorite solution and discard with proper care.
- All instruments must be disinfected.
- Table should be cleaned
- Proper hygienic procedure followed after post mortem like hand washing, baths)

External Examination

- Emaciation and wasting
- Signs of drug addiction
- Signs of sepsis
- Thrombosed veins

Internal Examination

Dissection must be restricted to the target organs. ***Injuries during the Autopsy must be avoided***

- Signs of Lung infections
- Signs of Central Nervous System involvement
- Lymphadenopathy
- Fungal infections in skin folds

(Accidental injury to the staff during autopsy procedure must be reported to Head of Department and all precautionary methods to be followed.)

SAMPLES (with warning like – dangerous or as per laboratory guidelines)

- Histological Samples
- Serology for HIV screening (not to be disclosed openly)

Audit Sheet [5,7,11]

Procedure	Yes	No
Risk identified		
Precautionary methods adopted		
Necessary Dissection done		
Staff took precaution		
Waste disposed properly		
Laboratory staff advise for infective material		

High Risk Persons

- Commercial sex workers
- Casual sexual contacts
- Drug addicts
- Homosexuals
- Multiple blood and blood product transfused patients (e.g. hemophiliacs)
- Domestic Workers
- Foreigners
- Sailors
- Prisoners
- Multiple partners

DEATHS ASSOCIATED WITH BIRD FLU[1,2,3,7, 11]

The following procedure in addition to what described under Sudden Natural Deaths and cases associated with HIV

History

Foreign travels

Association with chickens, birds

Occupation in Zoo

Health care worker

Family member/ Friend of Patient

Preliminaries

ALL THE STAFF MUST BE WARNED AND PROPER PRECAUTIONARY METHODS MUST BE FOLLOWED. Minimal Number of staff should be involved. And they must be followed up for Symptoms of any infection for 10 days.

Record of all involved persons must be kept[3]

Internal Examination

Respiratory system

Fluid samples must be collected from nasopharynx down wards in sealed saline containers and sent to laboratory immediately with warnings

Proper histology samples to be taken into Formalin Containers

If there is delay in sending samples they should be taken into Viral Culture media.

Sample must Not Be Freezed[3]

After the examination body must be bathed in 1:10 Sodium Hypochlorite Solution and kept in sealed waterproof bag. [3]

Samples (With Warning)

VIROLOGY

HISTOLOGY AS INDICATED

Audit Sheet[5,7, 11]

Procedure	Yes	No
Risk identified in history		
Precautionary methods followed		
Samples collected and dispatched properly		
Sterilization of instruments		
Attending staff followed up		

High Risk

- Travelers to Endemic countries
- Workers in Poultries, Zoo,
- Bird Lovers
- Health care workers

Deaths Associated with Disease/ Pyrexia of Unknown Origin[1,2,3,4,5,6,7,10, 11]

The following procedure is in addition to what described under Sudden Natural Deaths and Cases where the Cause of Death Unascertained at Postmortem Examination

History

- Family history of Similar Deaths,
- Tuberculosis, Toxoplasmosis, Hepatitis, Sexually Transmitted Diseases including HIV/AIDS, Tumors and Malignancies, Blood disorders
- Details about occupation- Dealing with animals, Foreign Travels and Dealing with Foreigners, Working as a Health workers, Traveling to Endemic areas
- Details about Foods and Drinks –Taking from restaurants, Vendors etc or homemade foods only and source of water.
- Drugs History- What are the drugs, Injections other therapies
- Sexual History
- Progression of the Disease.
- Weight Loss
- Bowel and bladder habits

Case should be considered as a high risk case and safety Precautions must be followed and warning of people handling the body and samples must be done

External Examination

- Presence or absence of Wasting, Sepsis, Icterus, Pallor, Injection of blood vessels of sclera, Warts (General body and Genital)
- Wounds, Injection marks,
- Hair Loss, General Hygiene.
- Enlargement of lymph nodes
- Examination of Ear, Nose, Throat, Urethra, Vagina

Internal Examination

System- wise dissection

Cardiovascular System

- Examination of Heart valves for vegetations, thickening, ASD, VSD or Prosthesis, other abnormalities

Respiratory System

- Enlarged hilar, mediastinal and other nodes
- Cavitations, signs of Bronchiectasis, Emphysema etc

Central Nervous System

- Signs of Meningitis, Brain abscess,
- Signs of encephalitis
- Sinusitis
- Middle ear infections

Genitourinary System

- Pyelonephritis, Renal Abscess, Renal Stones, Abnormalities in Ureters and Bladder. Nature of Urine
- Genital Warts, Ulcers
- Uterus for Pyometrium.

Gastrointestinal System

- Liver for abscess,
- Gall bladder for stones , abnormalities and pus or signs of infections
- Length wise dissection of Small and Large intestine for signs of infections, ulcers, growths, etc.
- Para aortic and mesenteric nodes
- Examination of Stools

Samples

Histology of all Target organs

In addition- Histology of Uterus, Gall bladder and Urinary bladder any other site as indicated

Blood

- For Culture

- Thick film for special staining for Malaria, filaria and Other parasites
- Blood for Virology
- HIV Screening

Spleen smear- Staining for malaria and other parasites

Bone marrow

Culture and staining for Hematological Disorders

Urine for Culture

Bile for culture

CSF for culture for bacteria and Fungi

Blood for Toxicological screening

Audit Sheet[5,7,11]

Procedure	Yes	No
Risk Identification		
External Examination for specific features		
CVS examination for Endocarditis		
CNS examination		
Attention paid for rear sites of infection		
Cultures taken		
Virology /HIV		
Blood and Marrow staining done		
Toxicology screening		
Safety methods		

High Risk

- HIV positive people
- Sex-workers
- Drug addicts
- People working with animals
- Laboratory workers
- People with valvular heart diseases/ ASD/VSD
- People on Steroids /Immunosuppressant
- Travelers to Foreign Countries

DEATH DUE TO HUNGER STRIKE /STARVATION[8,14,45]

It is equivalent to self-starvation, a diagnosis of exclusion

It is diagnosed by excluded all the natural and other causes of weight loss and decreased immunity

History

- Deceased particulars: Age, Sex, Weight before strike
- Duration
- Only food withdrawal or both food and water withdrawal
- History of any preexisting disease/disorder
- Environmental examination and physical exertion

External Examination

- Physique: thin, emaciated
- Determine the weight loss during the strike
- Skin is usually thin and shiny with associated pigmentation and is usually stretched over the bony prominence.
- Signs of dehydration
- If long duration: signs of vitamin and mineral deficiency
- Trophic skin changes

Internal Examination

- Look for any disease present that can cause death or can contribute to death
- Look for diseases that can cause weight loss like tuberculosis, diabetes, malignancies, etc.
- All the viscera shrunken and atrophied, with the exception of brain which is usually less atrophied.
- Gall bladder distended with bile
- Loss of fat in the subcutaneous tissue, omentum and around viscera (never caused by natural diseases)
- Stomach and intestine show atrophy of all the coats, intestine appears like tissue paper with atrophy of mucosa

Sampling

- Histological sampling of heart, lung, brain, liver, spleen and kidney to rule out natural diseases like tuberculosis, diabetes and carcinoma
- Toxicological analysis of viscera and blood for any intoxication

Causes of death

- Multi-organ failure due to electrolyte disturbance
- Super-added infections due to decreased immunity (it is much difficult to determine whether the infections were pre-existing or started afterwards)

*Medico-legally Death due to hunger strike is considered equivalent to Suicide in India.

Audit Sheet

Procedure	Yes	No
History		
Physical exertion		
Duration of Fasting		
Type of fasting solid/liquid		
Body Weight loss		
Skin condition		
External Examination		
Internal examination		
Viterous Biochemistry		
Blood- fresh samples		
Urine for ketone		

Photographic evidences

Overall body

Skin condition

Subcutaneous fat

Organs

DEATHS RELATED TO ANESTHESIA AND SURGERY[1,2,4,5,6,7,10,14]

Following procedure is in addition to what described under Sudden Natural Deaths.

Definition

These are the cases where the anesthetic agent is considered to have substantially contributed to the death. In general they occur during operative procedure or in the immediate post-operative period[6].

Classification of deaths associated with invasive procedures and anesthesia[160]

A. Those directly caused by the disease or injury for which the invasive procedure or anesthesia was being performed.

B. Those caused by disease or abnormality other that for which the procedure was being performed.

C. Those resulting from a mishap during, or a complication of, the invasive procedure.

d. Those resulting from a mishap during, or as a complication of, the administration of an anesthetic.

Common fatal complications of invasive procedures

Sepsis, including bronchopneumonia, multi-organ failure, pulmonary embolism, peri-operative myocardial infarction, hemorrhage and sepsis.

Specific problem in death associated with surgery and anesthesia

Minimum morphological findings, variety of devices are used during operation, difficulty in assessing multi-factorial deaths.

Preliminaries

- Clinical Condition of the patient prior to operative procedure must be evaluated. (Specially the Cardiac and Respiratory systems)
- It is helpful to perform at least the chest radiograph and radiographs of other areas as indicated[6].
- It is helpful for the pathologist to review the medical records prior to the autopsy.

Review the material available - surgical notes, anaesthetic notes, videos, photographs, laboratory reports, OPD record, Nursing notes.

In Anaesthetic Deaths

- Induction phase - sensitivity, hypotension, heart ischaemia
- Instrumentation - patency of tubes, gas connections, oxygen cylinders
- Electricity- faulty instrument, leakage of current
- Faulty intubation
- Already compromised health
- Aspiration of Gastric contents

Surgery

- Swelling , oedema, exudates
- Bleeder loose, untied, slipping off
- Tying of vessels wrongly - iscahemia like ceoliac plexus in duodenal trauma tying arterial supplying to liver
- Very long surgery
- Late complication of thrombosis, infection , adhesion
- DIC, intravascular coagulation, blood transfusion
- Cardiac enzymes
- Liver function Test
- Kidney function Test
- Therapeutic measures

External Examination

Documentation of all monitoring equipments, vascular cannulae, intercostals tubes, other catheters, endotracheal tubes to be performed. Record the content of label and volume retained in the intravenous bags and bottles. Monitoring of equipments / theatre will be done by IO with the help of medical team consisting of autopsy surgeon and specialty surgeon. Now, Medical council has stressed that Autopsy surgeon should restrict to the cause of death and issue of negligence will be settled by council with the help of medical board to avoid unnecessary harassment of the accused team in cases of registered practitioners. In cases of quack / unregistered practitioner, IO can proceed with medical team for investigation.

Internal Examination

Pathologist may consider performing at least some of the dissection in situ. At least the position of the endotracheal tube should be documented prior to removal of the organ block[6].

Cardiovascular System

Documentation of the presence or absence of the patent foramen ovale.

Peri-operative Myocardial Infarction - The risk of infarction increases with age and severity of pre-existing cardiac disease. Majority of peri-operative myocardial infarctions occur between one and three days after the surgical procedure

Respiratory System

Measurement of volume of blood or other fluids in the pleural cavity

Integrity of Trachea and Major Bronchi•

Central Nervous System

- Consider fixation of the brain and referral for specialist neuropathological examination.
- Examination of venous sinuses.
- Consider dissection and fixation of the spinal cord if indicated.

Genitourinary System

Measurement of the volume of urine in the bladder.

Specimen

Histology

Skeletal Muscle – Must be examined in order to facilitate the diagnosis of Malignant Hyperthermia. as indicated[6]

In addition, samples from major organs must be retained for examination.

Blood

Pre-mortem blood- For Creatinine Phosphokinase activity, if available

Toxicology

Blood, Bile Vitreous, Urine must be retained for toxicological analysis as indicated.

Microbiology

As indicated

Radiology

Chest X-Ray at 45 degree for documentation of gas within the heart and great vessels. Documentation of the degree of Pneumothorax.

Other X-Rays as indicated

Photography

Photograph of the postmortem examination with labels and date and time indicators will be helpful for interested parties in a later date. Videography is also recommended in these cases to prove or disprove findings.

Hematology

If there is the clinical suggestion of transfusion mismatch or accident, relevant material must be retained for analysis by an **independent laboratory**, if required.

Surgery cases have to be assessed in three stages as:

1. Preoperative period
2. Surgery period
3. Post operative period

Anaesthesia realted death can be divided in four parts as :

1. Peri operative phase – over sedation, over medication
2. Starting phase (Induction phase)- inducing anaesthesia, poorly sensitized
3. During operation – long operation so excessive doses
4. Post operative

Deaths by unregistered practitioner is not covered by medical council and it is an issue between state and crime

Common issues and steps to be taken

Questions by IO / Issue	Role of Autopsy Surgeon	Role of Medical Council	Independent opinion
Whether surgery was justified ?	------	MC	Independent witness
Whether competent in that surgery ?	------	Medical Council	……..
Whether he/she possess ordinary skills	can	can	Can
Scene Assessment or visit to clinic on request to assess the scenario	Can (team of autopsy surgeon, anaesthetic and specialist from concerned specialty is recommended)	Team appointed can visit Medical Council is a constitutional Body	----------
Assessment of anaesthetic set up	Can be carried out Forensic specialist with anaesthetic colleague	Can appoint committee	----------
Cause of death	Domain	Committee with the help of Forensic Expert	--------
Interpretation of clinical findings	can	Can	Can
Information to media	No	No (only final outcome after enquiry)	No
Closure of premises Is domain of Investigative agency and court	No	No	No

committed so autopsy surgeon of area is fully authorized to take any steps as required by the case and permissible by local and central law as he senior most medical practitioner in such matters. He can assess scenario, can take technical help of others or any lawful action as per local state rules.

Before making diagnosis , one should analyze and find answer for following questions :

1. What are findings at autopsy?
2. How do you prove these?
3. How do you analyze it ?
4. What is acceptable conclusion?
5. What is cause of death

There should not be in a haste in making conclusions in these cases.

Communications with clinician is encouraged in clinical autopsies but in medico-legal autopsies , there may be hostility and apprehensions so more reliance should be put on written record brought by IO or through court.

Overdose of medicines – This is very difficult part to prove or disprove these allegations. Only early sampling of CSF, vitreous, blood and urine can be done by autopsy surgeon. As far as analysis is concerned a frank discussion with supporting clinical and forensic laboratories. Clinical record is very important to give a list of substances used in the case.

Excessive premedication- Clinical records and analysis thereof can prove or disprove the issue.

Air way obstruction from secretions, failed endo-tracheal tube, putting endo- tracheal tube in oesophagus in place of trachea. A pre- autopsy X-ray is of help if tube is in place .A few other reasons for obstruction are spasm of muscles, posture, aspiration of gastric contents, blood , denture, gauze pieces, cotton wools, and broken piece of any tube or instrument.

In anaesthetic deaths , there is advancement of drugs and these metabolize very fast so detection with exact concentration is a very difficult task. Our forensic Science laboratories are not prepared.

Heart failures may be:

Acute heart Failure – Investigation ECG, C9 Immunichemistry, Cardiac Tropnin, full macroscopic and histopathological screening of heart

Chronic heart failure – Pulmonary hypertension, intraveolar haemosiderin deposition and hepatic venous congestion. Histopathology evaluation is must in these cases.

Failure of heart supported with artificial devices- although rare but battery failure, short-circuiting, dislodgement, fractures, insulation breaks, mainly lead realted problems can result in failure of already a diseased/ unhealthy heart[160].

Cause of Death

In majority of cases death is due to brain hypoxia and it can be easily demonstrated on gross and Histopathological examination.

Blood aspiration, cardiac dysarrythmias, hypersensitivity and undetected, uncontrolled hemorrhage also contribute significantly.

In the view of the fact that autopsy surgeon may have a limited experience with deaths associated with an anesthetics, it may be prudent to list the cause of death in a descriptive and demonstrable way[6].

Audit Sheet[5,7, 11]

Procedure	Yes	No
Clinical Notes scrutinized before autopsy		
Radiography done as per need		
Medical intervention documented		
Samples for overdose, toxicology retained		
Central nervous system subjected to neuro-pathological examination mainly for hypoxic changes		
Histo-pathological Screening of Vita Organs (Heart, lung, liver, brain, rest as per need)		
Muscle samples retained for Enzyme studies (Heat hyperpyrexia)		
Conference with other specialists arranged		

Common Causes

- Injuries or condition for which surgery done
- Natural Diseases (IHD, Diabetes, Asthma), sometimes undiagnosed at PAC
- Anoxia due to displaced tubes
- Hyperpyrexia due to halogenated anesthetic agents
- Hemorrhagic shock
- Drug over-dosage or wrong drugs

DEATHS ASSOCIATED WITH MISMATCHED BLOOD TRANSFUSION [1,2,4,5,6,7,10, 11,54]

Following procedure is in addition to what is described under Sudden Natural Deaths and Death associated with Anesthesia and Surgery.

History

- History of allergies of the deceased person.
- History of illness which required the transfusion
- Chronological order of the illness and the death
- History of previous blood or blood product transfusion
- Drug history of the person.
- Any history of past transfusion reaction

Preliminaries

- Safe custody and retention of the transfusion sets, pilot bottles and the samples from the blood bank by Investigate IO / Autopsy panel/ enquiry team
- Any pre transfusion blood samples from the deceased must be retained for analysis by IO / Autopsy panel/ enquiry team
- Scrutiny of all the clinical records, request forms, cross matching and direct testing records and their safe custody has to be maintained.
- Leftover drugs consumed by the deceased must be retained in safe custody for analysis as indicated

External Examination

External features such as edema, erythema, scratching mark, cyanosis, icterus, frothing, injection and resuscitation marks must be recorded

Internal Examination

Respiratory system

Froths and laryngeal edema must be documented

Genito-urinary system

Kidneys must be examined for signs of acute renal failure

Cardiovascular system

Signs of acute cardiac failure

Samples

Histology

- Samples from all internal organs must be taken for routine histology.
- Samples from Kidneys Heart and Lungs must be retained for special staining.
- Kidney are very informative as cast, myoglobin, ATN, fungal invasion may be seen.

Blood Samples

Blood samples from the body must be preserved.

Smears must be prepared

- They must be subjected to microscopy and analysis
- Vitreous, bile must be retained for analysis as indicated.

Urine

It is very important , sample from the body must be retained for analysis

Audit Sheet[5,7,11]

Procedure	Yes	No
Risk factors identified in history		
Sample of blood to Laboratory		
Blood in bottle		
Victims Blood sample		
Histopathology of Kidney, Lungs heart, brain		
Urine Analysis for blood, Myoglobin cast etc		
Vitreous urea and creatinine levels		
Culture of all blood samples		

Common Risks

- Emergency transfusions
- Multiple transfusions
- Patients with Allergies
- Patients with asthma

Common causes

- Anaphylaxis
- Renal Failure
- Electrolytes imbalances
- Circulatory overload

Social Forensic Message

Blood donation is considered one of the biggest donation to save human lives.

Encourage it!

DEATHS OCCURING IN CUSTODY [1,2,4,5,6,7,10, 11,37,98]

The following description is in addition to what described under Sudden Natural Deaths. Follow NHRC guidelines while conducting such autopsies.

Definition

A death in custody refers to a death of an individual while in prison, under arrest or in the process of being detained by authorities[1].

Scene Visit

- Scene visit have to be done even after removal of the body from the site for crime scene reconstruction if felt

necessary to correlate findings over the body.

- If the body is still in the scene, core body and ambient temperature should be recorded and distribution of rigor mortis, hypostasis must be recorded.
- Photography of original position is of immense value
- Crime scene should be on written request on either side i.e. either Medical Officer is requesting to clarify certain issues or IO is requesting to satisfy his queries or directed by court. It should be writing and should be recorded. It is applicable to all types of cases where case visit is recommended.

Autopsy

Preliminaries

- History of circumstances, any pre-existing natural disease, drug abuse, mental health issue, psychological disease
- The postmortem examination must be carried out after a proper authority as per a homicide case with police personal in attendance and with a police photographer.
- Documentation of injuries present over the body and description.
- Photography and Radiology should be arranged as indicated.
- A record of resuscitative measures under taken by ambulance personnel, warden or co-prisoners should be available to the pathologist. (even after the postmortem examination)

External Examination

- Complete photographs of the body including the close up photographs of the face including teeth and hands.
- If Oleresin (capsicum) spray is suspected, examination under Ultra Violet light and swabs for analysis are recommended.
- Documentation of presence or absence of injuries to anus and external genitalia and swabs for analysis as indicated.
- Document the presence or absence of Petechial hemorrhages in conjunctivae, periorbital and retro-auricular skin and buccal mucosa.

Internal Examination

Respiratory System

Formal neck dissection is recommended in situ, in bloodless field in layer by layer with photography.

Genito-urinary system

Formal perineal dissection is recommended with photography of dissected specimen if there are indications such as injuries, sexual assault or DIC.

Gastro-intestinal System

The gastric contents must be collected. The entire small and large bowel should be opened in order to exclude presence of illegal drugs.

Musculoskeletal system

Musculo-cutaneous and musculo-skeletal dissection to be done including palm and sole dissection as indicated.

Specimens

(As per requirement and circumstances of the case)

a. Swabs and Smears from oral cavity, anus, rectum, perineal, low and high vagina. These must be performed prior to temperature recordings.

b. Fingernail scrapings

c. Full routine toxicology

d. Full body Radiology

e. Swabs for tortuous material preferably- Alcohol swabs for presence of Oleoresin capsicum or any other chemical material.

Audit Sheet[5,7,11]

Procedure	Yes	No
Proper authority obtained/ request for PM		
Scene visit		
Photography of the body & videography		
Radiography		
Nail scraping		
Proper dissection of injured area/ affected part		
Natural orifices Detail examinationNose (hair pulling / infection) Ears (Infection, tympanic membrane rupture, bleeding)Mouth (Gingival hygiene caries, fracture & extraction of teeth, swabs for semen, STD)Anus (old or recent injuries)Vagina (ld or recent injuries, sexual acts, STDs, Semen)		
Sexual organs		
Toxicology screening		
Relevant medico-legal issues addressed (answer to the questions of Inquiring Officer addressed or evaded)		
Documentation done		

Common Causes

- Natural Diseases (MI, TB, CVA, Asthma, Diabetes, Etc)

- Drug overdose
- Head Injury (fall , assault)
- Strangulation and Hanging
- Postural asphyxia
- Aspiration (After Alcohol or drug intake)

Custody Death Photographic points

Scene

- Overall view with original
- Site where person was found unconscious or dead
- Clothing full detail
- Face from different angles
- Neck all around
- Hands- palmar and dorsal view
- Feet – dorsal and plantar view
- Items near by body

At the time of PM

- Videotaping for NHRC
- Overall view
- Standard shots as for any case
- Face from different angles
- Full body photography
- Important findings on external examination
- Important internal finding
- All important natural lesions / diseases
- Rest as per the type of case i.e. Firearm , blunt force, hanging etc
- Cause of death

DEATH ASSOCIATED WITH LYCHING BY MOB

Lynching is homicidal hanging or killing by beating by public mob to punish the deceased in cases of robbery, caste marriages, honor killings, punishment in rage of anger to drivers, thieves etc. is not uncommon.

Purpose of post-mortem is such cases is note pattern of injuries, diagnose torture, determine cause of death and manner of death. The common form of lynching is carried out by hanging from a tree, electric pillar, beating , burning and flogging etc.

History

- Detailed history of the incidence and detailed investigation

External Examination

- Injury to the clothing
- Bodily injuries suggestive of torture and struggle
- Look for signs of asphyxia: purplish lividity, bluish discoloration of nails, lips and other mucosa
- Examine the ligature mark as Lynching is considered as Homicidal Hanging
- Look for the other injuries over the neck as in strangulation: nail marks, penny bruises
- Keep in mind, the injuries over the neck can be inflicted by both the accused or the victim: the linear abrasions more vertically placed are caused usually by victim and the linear abrasion more horizontally placed are caused usually by the accused

Internal Examination

- Dissection of the neck to examine the underlying tissue of ligature mark: subfascial hemorrhage, hematoma or bleeding into the neck musculature, fracture and bleeding to the laryngeal structures
- Dissect the other viscera as usual
- Keep in mind to dissect the neck structure last to avoid spurious bleeding

Sampling

- Collect the fibres from the ligature material to the ligature mark over neck with the help of a cellophane tape
- Collect the foreign materials/biological material underneath the nails
- Usual viscera sampling for toxicological analysis

Audit Sheet

Findings	Yes	No
Place of recovery of body		
History		
Clothing		
External injuries indicative of beating /torture		
Internal Traumatic Injuries		
Multiple weapon injuries		
Duration		

Causes of death

- Asphyxia due to laryngeal blockade
- Cerebral ischemia due to blockage of carotid artery
- Cerebral apoplexy due to venous blockade

- Vagal inhibition of heart
- Multiple Injuries

Lynching –photographic points

Scene

- Overall view
- Position of body
- Suspensions points
- Knot
- Foot wears of deceased
- Condition of clothing
- Other Injuries over the bodies
- Foot prints near by
- Weapons present at scene
- Accessibility approach point to hang

At the time of PM

- Overall view of body
- Ligature details
- Ligature mark details
- Injuries
- Fractures
- Burns
- Rupture internal organs
- Important findings and inside injuries
- Grazed abrasions produced by dragging
- Any other special feature

Mass Disaster

WHO has defined disaster as an occurrence that causes damage, ecological disruption, loss of human life or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area. If more than 12 people are fatally involved in one incident then it is termed as 'disastrous situation', limit of 12 is flexible. Indian Disaster Act deals all these aspects in detail. Natural disasters are beyond the scope of these guidelines.

Man made/ created disasters are bomb blasts, stampede, boat / ship sinking, bus fallen in mountain deeps, or any other transportation mishaps, fires, riots, gas leakages, mass suffocation due to smokes, food poisoning, building collapse, fires etc.

Forensic Department is asked to handle dead bodies in such situations. The simple ways are

Making an area as a make shift mortuary, keeping bodies in a row of 10-20 each, assigning them number, putting tags, making inventory of items, taking identity photographs for display, arranging clothing, air-conditioners.

Make multiple teams to handle 5- 10 bodies (flexible) each team- basic roles, identity photographs, making inventory of personal effects, clothing description, recording injuries , arranging x-ray ,reconstruction if face is disfigured, taking blood samples for DNA profiling or any other use. If theres is shortage of human resource then one person can easily handle 5-10 bodies. It is observed that in mass casualties main problem is identification and storage. Postmortem are usually waived off when there is common cause of death. In these circumstances only sample cases are carried out to corroborate findings. The common causes remain suffocation by smoke in a closed space fire incident, multiple injuries in building collapse, drowning in ship/ boat sinking, fire etc.

It is suggested that every public morgue should 10-20 additional storage spaces for such situations.

Team constitutions can be done for followings tasks:

- Transportation to hospital
- Media Handling
- Relatives handling
- Arranging Identification
- Photogaphy
- Videotaping
- Case handlers / PM staff
- Support staff for shifting, dressing and lifting bodies
- Psychotherapy to bereaved families
- Documentation Assistance with photocopier and scanning facilities.
- CCTV coverage of storage areas.
- Handling multiple claims over body
- DNA profiling material preservations kits

Another major problem is of transport for carrying victims to nearby hospital or morgue. One example of mass disaster due to stampede as commonly seen in Kumbh- ka-mela and Macca and Madina religious visits is given here. Main issue of identification is core concern.

DEATH DUE TO MASS STAMPEDE[7,11,14,95]

History

Place, date and time of incident.

Whether died on the spot, during resuscitation or during course of treatment.

Age of the deceased- infant, adult or elderly

Any pre existing disease

Alcohol or drug intake

Associated incident: Fire outbreak/ mob chase/ bomb blast- need to look for additional injuries thereof.

Deaths due to mass stampede occur as a reason of traumatic asphyxia as in restriction of respiratory movements. It may be due to injuries to the thoracic structures causing impairment in breathing or may be due to multiple injuries to head and abdominal viscera causing internal bleeding and exsanguinations causing death. Neurogenic shock can occur if trauma is associated to head, neck, genitals or to the abdomen region

External examination

- Examination of clothing, shoes etc is done
- Look for asphyxia signs
- Face , neck , chest part distal to the compression is intensely congested
- The level of compression is indicated by a well defined demarcating line between the pale compressed part and the distal congested part
- Description and measurements of injuries and exact location and direction
- Kick marks in the form of patterned abrasions or patterned contusions are noted
- Photography of patterned injuries

Internal examination

Central nervous system

- Injuries to the scalp and skull- Nature and extent
- Pattern of fractures if any
- Extra-dural, subdural intra-cerebral and inter-cerebellar and subarachnoid hemorrhages- extent and blood volume
- Measurement and comment on brain injuries- contusions or lacerations
- Presence of coup and contra-coup injuries
- Injuries to the brain stem and spinal cord

Cardiovascular system

- Presence of myocardial contusions, petechiae hemorrhages

Respiratory system

- Injuries to the chest wall, sternum and clavicles
- Presence of flail chest
- Lung contusions, petechiae, laceration (estimate the percentage of lung parenchyma involved)
- Measure the volume of blood in pleural/chest cavity
- Presence of pneumothorax or intercostal catheters

Gastrointestinal system

- Liver capsular tears or parenchymal blunt injuries- comment on depth of injuries
- Hemo-peritoneum- measurement of volume
- Retroperitoneal hemorrhages- extent in relation to anatomical markings
- Mesenteric and bowel tears, contusions- comment

Reticulo-endothelial system

- Spleen – integrity of capsule, parenchyma and any clots

Musculo-skeletal system

- Injuries to limbs- Exact location and height from the heel
- Injuries to pelvis- fractures

Specimens

Blood for alcohol, carbon monoxide (entrapment in smoke)

Radiology – in case of suspected fracture likely to be missed

Crime scene evaluation with photography

Audit Sheet

Procedure	Yes	No
History		
Patterned injuries noted		
Signs of asphyxia		
Internal bleeding measured		
Blood sample for alcohol and carbon monoxide		
Radiology (if indicated)		
Crime scene visit		
Photography		

Cause of death

Traumatic Asphyxia

Multiple injuries to chest and abdomen

DEATHS DUE TO BOMB EXPLOSIONS[7,11,13,14,45,95,100]

Bomb is a mechanical device filled with a mixture of explosive substance and missiles and is fired by a detonator or a fuse. A bomb on explosion, releases a large amount of energy along with dangerous gases and missiles. Mass casualties are common. The forensic doctors have the

challenge during autopsy due to varying combination of injuries as the body may be blown into pieces during explosion, deaths may be due to shock wave, flash burns, flying missiles or due to fumes and in some cases deaths may be as a result of mass stampede or crushed under the debris of buildings demolished by explosions.

Preliminaries: major objectives to address during autopsy are:

1. Identification of victim- pieces or fragments of victims may only be available. Identification should be made using articles, identity cards, and clothing. Confirmed by DNA matching.
2. Enlisting the injuries- Explosion is extremely directional- localization of injuries may help in detecting the relative position of victim and the bomb explosion
3. Cause of death- depends on nature and intensity of explosion and also location of victim in relation to the explosion- close or distant/closed or open space

Injuries are produced by a bomb due to disruptive effect, flame , radiant heat, air blast flying missiles, falling masonry, smoke , dust and fumes. Most of the times, a classical triad of abrasion, contusion and laceration over the body is seen.[120] Blast injuries are classified into primary, secondary, tertiary and quaternary blast injuires[121].

External examination:

The possibility of contamination of the body with radio-active or chemical material needs to be kept in mind at the time of conducting autopsy

- Complete body X-ray of the victim(s) are compulsory before the clothing is removed-to identify fragments of explosive itself or metallic fragments within the body
- Clothing should be retained for chemical analysis- trace evidence of explosive used
- Note varying sized abrasions, bruises and lacerations – due to explosion as well as flying missiles
- Splinters of wood, dust, glass or the explosive itself may be found deep within the wound
- Signs of crush asphyxia may be present
- Body may be shattered, abdomen disrupted, intracranial hemorrhages or herniation of brain may be present. Limbs may be blown off, decapitation can occur.
- Hemorrhage in the ear drum, hollow organs like bladder, lungs and intestines are present if the victim suffered blast impact.

Internal examination

Central nervous system

- Injuries to the scalp and skull- ranging from laceration of scalp to decapitation
- Pattern of fractures if any
- Extra-dural, subdural intra-cerebral and intra-cerebellar and subarachnoid hemorrhages- extent and blood volume should be noted
- Brain may be found apart from the skull cavity on the crime scene
- Measurement and comment on brain injuries- contusions or lacerations
- Injuries to the brain stem and spinal cord

Cardiovascular system

- Presence of myocardial contusions, petechiae hemorrhages
- Presence of missiles within the heart wall or cavity

Respiratory system

- Injuries to the chest wall, sternum and clavicles
- Presence of pieces of missiles embedded within the muscles, lungs or large vessels.
- Lung contusions, petechiae, laceration (estimate the percentage of lung parenchyma involved)
- Measure the volume of blood in pleural \chest cavity
- Blast lung injury

Gastrointestinal system

- Hollow organs-stomach, bladder and intestine – ruptured-blast injuries, may be blown out of the abdominal cavity
- Solid organs - Liver capsular tears or parenchymal blunt injuries- comment on depth of injuries
- Hemo-peritoneum, measurement of volume of blood
- Retroperitoneal hemorrhages- extent in relation to anatomical markings
- Mesenteric and bowel tears, contusions- comment

Reticulo-endothelial system

Spleen – integrity of capsule, parenchyma and any clots

Musculo-skeletal system

- Injuries to limbs- Exact location and height from the heel, amputation through the joints may be present.
- Look for fragments of explosives embedded in the limbs

***Injuries to pelvis*- open or closed fractures**

Specimens[1]

Histopathology: lung tissues show hemorrhages, contusions and help in detecting injuries caused by shock waves, kidney is looked for myoglobinuria (acute tubular necrosis)- crush syndrome

Blood test for caboxy-haemoglobin, cyanides and phosphorus particularly in fire-related blasts and that which occurs in closed space

Explosive residues need to be collected with extreme caution and dispatched for subsequent examination.

Clothes and other exhibits need to be send for chemical analysis

Radiological examination is imperative as mentioned above.

Photography of crime scene as well as the body is highly recommended .

Audit Sheet

Procedure	Yes	No
Collection of all possible fragments from explosion site		
Crime scene visit		
Photography		
X-ray examination of whole body		
Clothing and other articles examination and preservation		
Identification		
Enlisting the injuries		
Histo-pathology		
Blood tests		
DNA matching		
Chemical analysis of explosive residue		

In persons who survive bomb attack and are hospitalized, must be visited by forensic medicine expert and should record his observation as with lapsing time most of the findings will fade or heal. Protocols are modifiable in such cases as per the need of case. If injured dies later due to complications then these recorded observations are of great value.

Common causes of death

- Blast Lungs and Intra pulmonary hemorrhages
- Multiple Injuries and fragmentation of body parts
- Shock
- Haemorrhage
- Burns due to fire
- Radiation Burns
- Burial in collapsed buildings
- Peculiar – triad of injuries

Photography points- overall scene, bodies and their fragments, complete body photos.

The blast injuries, other than bomb blasts which are seen in practice are as:

- Vehicle Tyre blast (two wheeler, three wheeler, LMV, HMV etc.)
- Domestic gas cylinder blast
- Mobile phone battery blast
- Dynamite blast during excavation and breaking of stones
- Landmine blast
- Air conditioner cylinder blast in cars, AC, freeze
- Cylinder blast in laboratory
- Mobile battery blast
- Fire and blast of collided tankers

Points to be noted

- Radius of spread of broken pieces of cylinder / blasted body
- Damage at spot
- Blast effects over scene and body
- Impregnated pieces in body
- Injuries
- Radiant heat

DEATHS ASSOCIATED SPORTS ACTIVITIES [1,2,4,5,6,7,10, 11,62,138-41]

Sports related death are always be an emotive topic. Sudden death is defined as "an abrupt unexpected death of pathological or idiopathic cause, in which death occurs within 1 to 2 hours of onset of symptoms" [138, 139]. The majority of sudden deaths occurred during or immediately after exercise (game, conditioning, training, etc) are given importance here. Sports are often regarded as a part of lifestyle owing to the widely held perception that it betters health and life in whole. The possibility of those indulge in sports to be susceptible to sudden death often seems to be unlikely, ironic and counter intuitive. Nevertheless, such sudden catastrophes continue to occur, usually in the absence of prior symptoms. Autopsy is most often the only means in making a definitive diagnosis and for determination of the cause of sudden death.

According to American Heart Association, "the commonest forms of heart diseases associated with sudden death during exercise are coronary artery disease and hypertrophic cardiomyopathy. Less common cardiac conditions linked to sports related sudden death include anomalous origin of the coronary arteries, aortic rupture associated with Marfan's syndrome, myocarditis, mitral valve prolapse and various arrhythmias". [140,141]

American Heart Association Recommended as before taking up active sports , person should be screened for [10]:

- Family History: Any premature sudden or cardiac death
- Personal History: excessive fatigue; shortness of breath; exertional chest pain or discomfort; heart murmur; systemic hypertension
- Physical examination: heart auscultation ; brachial and femoral pulses

Therefore, the common concept of "excess of everything is bad" applies here also in avoiding of "intense" physical activity.

When either the family history is suggestive, or clinical suspicion is raised, or risk factors such as hypertension, hypercholesterolemia or cigarette smoking are present, subjects should undergo maximal exercise testing for measurement of exercise performance and the electrocardiographic response to exercise. When abnormalities are detected, further specialist cardiological investigation including echocardiography and possibly coronary angiography is indicated (Murty et al) [62].

The following procedure is in addition to what described under Sudden Natural Deaths

History

Exact History of the Incident (Activities prior to death-Foods and drinks, alcohol, smoking, last complain, area of injury or blow, with what, speed of the ball, fall, associated struggle in case of contact sports, etc.)

(In cases of Indoor Games and some outdoor games presence of electrical items nearby must be enquired).

Personal History (Previous and Current illness, Treatments, Previous syncopal attacks, Drug, Alcohol and Smoking history).

Family History (Sudden deaths, Deaths in young age, Other chronic illness like Hypertension, Diabetes, Ischemic Heart Disease, Epilepsy, Asthma) in deceased and in the family.

Scene Visit as Indicated

External Examination

Look for any sign of injuries, cyanosis, pallor, edema, injection marks, froth.

Internal Examination

System wise dissection of all organs has to be done.

Cardiovascular System

Heart for signs of any abnormality, enlargement. Thickening of walls, Coronary vessels.

Heart valves for any abnormality

Dissection of conducting system and retaining of samples for histopathology.

Respiratory System

Signs of spontaneous pneumothorax, bullae.

Froth in the Bronchial Tree.

Pulmonary edema, Consolidation.

Central nervous system

For Head Injury, Spinal injuries.

Colloid Cysts, Subarachnoid Hemorrhages.

Any injury to internal organs must be excluded

SAMPLES

Histology

All the organs for histology including conducting system of the heart.

Toxicology

Full toxicological Screening.

Blood and Urine for Cortisol levels.

Screening for Illegal Drugs (Amphetamines, heroin, benzodiazepines etc.).

Audit Sheet[5,7,11]

Procedure	Yes	No
Risk factors identified in history		
Details of incident documented		
External injuries looked for		
Internal injuries looked for		
Histopatholgical Screening arranged		
Toxicological screening arranged		
Screening for cortisol and illegal drugs		

Common Risks

- Untrained people
- No supervision
- No facilities
- Bad medical History
- Bad family History
- No first Aid facilities

Common Causes

- Head Injuries
- Neck injuries
- Chest Injuries
- Abdominal Injuries

- Multiple injuries
- Unsuspected heart diseases

ORGAN TRANSPLANTATION DEATHS (DONOR OR RECIPIENT DURING TRANSPLANTATION)

Organ donation is a noble cause and is considered highest kind of sacrifice. But unfortunately because of organ trading and illegal operations, at times cases are brought for postmortem examination.

Scene Examination/ Evaluation

- Scene examination with IO should be assessed
- Basic facilities, registration, qualification, training of retrieval team.
- Tables and instrument where death occurred should be examined with surgeon and anesthetic experts who can advise on technical parts.

Photography as indicated

Wound site photography is must

History

Donor

Recipient

External findings

- General Physical examination
- Retrieved organ site
- Surgical wound
- Surgical wound scar at position of kidney /liver / pancreas etc
- Other findings as in any other case

Internal Examination

Integrity of different organs

Note- In case of recipients of kidney transplant, it will be placed in the inguinal region and in case of liver, it will be in right hypochondrium.

Kidney transplant is placed extra peritoneally in the contra lateral iliac fossa[117]. In man the spermatic cord is mobilized, preserved and medially retracted. In women the round ligament is divided between ligatures. Renal artery is anastomosed with internal iliac, or external iliac or splenic artery.

Investigation

Histopathology

Anesthetic doses analysis

Blood investigation as per need

Urine examination

Transplanted Kidney: Findings to be noted are location of kidney, vascular attachments, infection, rejection, disease flared up, HP, urea level, KFT, Culture, condition of original kidney, clinical records. Normal glomeruli, tubules show cloudy changes, interstitum show oedema and mononuclear infiltration and focal haemorrhges[117].

Transplanted Liver: Site, Gross findings of original and transplanted kidney, rejection findings, attachments, vascular sites, infection, culture, HP and LFT, clinical records.

Transplanted Pancreas: hemorrhage, autolysis, fat necrosis, calcium level, Amylase level, rejection findings, HP, clinical records.

Transplanted Heart: Gross, vascular connections, rejection, infection, valves, pericardium fluid culture.

General

Lungs: Consolidation, pneumonia, pulmonary oedema and haemorrhages.

Brain: Congestion and oedema**, i**nfarctions.

Kidney in end stage: hyalization of glomeruli, throidization of tubules, mononuclear infiltration in interstitium and vessels shows nephrosclerosis[117].

GIT: Necrotizing enterocolitis, diverticulitis, encephalopathy, infacrtions.

The most common complications are renal allograft rejection, which can be hyper acute which is immediate after revasculaization, the second variety is accelerated rejection within a few day to some weeks.

Other major complications can be uncontrolled haemorrhage at the time of operation, postoperative thrombosis, graft vessel thrombosis. Urological complications like urter obstruction, UTI, stones, urinary fistula.

Audit Sheet

Check Points	Yes	No
History		
Legal documentation		
Donor related / unrelated		
Recipient		
Approval of authorization Committee		
Medical Record scrutiny		
External scars / wounds		
Internal organ integrity		
Investigations as required		
Histopathology		
Photography		
Culture		

Cause of death

Infections / rejection

Cirrhosis of liver

Hypoxia

Dysarrythmias

Hemorrhagic shock

Photographic points

Overall view of body

Face

Injection sites for pus or blood

Complications

Site of transplant

Anastomosis of vessels

Bleeders if any

RADIATION INJURY DEATHS[14,118]

Radiation refers to high-energy electromagnetic waves (x-rays, gamma rays) or particles (neutrons, alpha and beta particles). This is also due to radioactive substances like uranium, plutonium and radon, iodine, gold do cause harm to body.

Whenever human body is exposed to radiation beyond threshold limits. It causes damage to tissues. X-rays and therapeutic radiation when given in excess and without precaution can result in serious injury.

Radiation doses are measured by different units:

1. Roentgen
2. Gray (Gy)
3. Sievert (Sv)

The biologic effects of different types of radiation.

About 6 Gy causes death. More than 4 Gy causes symptoms in different systems. When cumulative dose of radiation becomes more than 20 Gy, it causes serious damages.

On human body , there are two types of exposures.

1. Irradiation radioactive ways, passes directly through the body from outside.
2. Contamination is contact or / and retention of radioactive substance in form of liquid/ dust / disposed off equipment etc.

These radiations are called 'ionising radiation' and whatever the source,have the same harmful effects if it is strong enough or is received for along enough time. the urine and blood are drained off rapidly with plenty of running water directly into drain[118].

Dose[14,95]

Dose of radiation	Effects
50 rads disability	Could effect blood but without
50-100 rads	Mild Injury and blood changes
100-200 rads changes	Mild illness in addition to above
200-250 rads	Moderate illness with mortality
500 rads	Early death
More	Likely hood of certain death

History

- Skin falling
- Unexplained sickness , loss of appetite , malaise, severe vomiting , diarrhoea which is not responding to usual therapy after contact with such material
- Necrotic lesions after coming into contact with some instrument/ material
- Blood dyscrasia due to bone marrow effects
- Working in laboratories/Profession /Nuclear plants where these substances are used
- Waste dealers

External examination

Tissue damage

Dehydration

Skin damage

Internal examination

Necrosis of tissues and bones

Bone marrow changes

Blood cells abnormality

Ovulation and sperms defect

Damage to genetic material

Special instructions

Fluid in body cavities may contain radioactive material. Some organs like thyroid, prostate, bladder are more prone to have higher concentration in therapeutic and cancerous conditions.

Special long handled instrument are recommended during dissection. Lead apron used by Radiographers should be used. Devices in the body like pacemakers should be taken out from the body before cremation. All instruments should be washed with detergent and then put under running water. If possible instrument / disposable items should be disposed under guidance of Radiological safety officer.

Audit Sheet

Check Points	Yes	No
History		
Awareness about dangers		
Substance involved and its decaying		
Use of lead aprons		
Special Containers		
Long handle instruments		
External Findings		
Internal Findings		
Handling Instruction		
Giego Meter		
Medico-Legal issues		
Special Disposal of waste		
Radiology Safety Officer (intimation is must)		

Common Cause of death

- Blood dyscrasia
- Bone marrow depression
- Lueukopenia
- Tissue Necrosis
- Sloughing of skin
- Sepsis in necrosed organs

HEAT WAVE DEATHS

In India, summer season from April to July has very high temperatures, it ranges from 35 to 48^{0}C . In day time from 11 am to 4pm, cases of heat effects which are locally termed as 'Loo' are quite common. It results in neuronal failure in unprotected individuals. The findings are more prominent in diabetic, alcoholic, obese, young, weak and ill persons. The clinical condition may have heat cramps, heat pyrexia and heat prostration.

In fatal cases, post-mortem findings are nonspecific. The main effects remain necrosis of muscles, myocardium, DIC is usually due to cardiac arrhythmias. The following features should be noticed .

Temperature of the day

Environmental conditions

Place or occurrence

Clothing - type, colour

Skin: Prickly heat, reddened back, back of neck, urticaria in abdomen and thighs.

Brain: Cerebrum:congestion, oedema, patechial haemorrhages. Cellular changes with swollen dendrites, degenerative changes and diffuse proliferation of microglia.

Cerebellum: oedema and swelling more prominent. Oedema of purkinje layer. Disintegration of purkinje cells and gliosis. There is rarefaction of granular layer.

Thalamus and hypothalamus show oedema and degenerative changes.

Respiratory System: Trachea and bronchi may contain haemorrhagic froth. Lung parenchyma show oedema, congestion and haemoorhages.

Heart: Patechial and confluent sub epicardial and subendocardial haemorrhages. There may be degeneration of myocytes.

Kidneys: Haemoglobinic nephrosis, tubular necrosis, congestion.

Adrenals: Cortical degeneration, perivascular haemorrhages, pericapsular haemorrhages, dilated sinusoids and haemorrhages may be the prominent findings.

Blood vessels: DIC may be seen

Samples

1. Vitreous for electrolytes and glucose
2. Blood
3. Urine for catecholamines and myoglobin

Record humidity and mid day temperature of day.

Audit Sheet

Check Points	Yes	No
History		
Timings of exposure		
Day temperature		
Humidity		
Clothing		
Core Body Temperature		
Skin condition		
Eyes		
Complete external examination		
Complete Internal Examination		
Sampling –vitreous, blood and urine		
Histology – Brain, Lungs, Heart, Kidney Adrenals		
Toxicology screening if indicated		
Photography as per routine		
Conclusion		

Social Forensic Message

Cover body with light colour clothing and cover your head. Remember Saudi Dress in Summers and drink raw

mango panna preparation, lemon water and eat onion with meals.

COLD WAVE DEATHS

India has extreme cold weather from November to February months in Northern parts of country. In extreme weather conditions when temperature dips down below 10 ^{0} C, homeless people and people exposed to cold in unprotected conditions are found dead in the morning. Freezing of tissues and cells cause injury in two ways (Robbins and Crotan , 7th ed 445-446):

1. Direct effects are probably mediated by physical disruption of organelles within cells and high salt concentration incident to the crystallization of the intracellular and extracellular mater.
2. Indirect effects are exerted by circulatory changes, chilling produces vasoconstriction, increased permeability which leads to oedematous changes. Vasoconstriction also causes increased viscosity of blood which causes ischaemia, degenerative changes and infarction and ultimately produce gangrene.

Salient features in cold wave deaths, observed during postmortem are given below.

Post-mortem findings

Clothing – inappropriate and insufficient clothing and foot wears.

Head and neck – unprotected

Skin – Remarkable pinkish coloration, pink areas with blurred margins around joints elblow, knee, ankles and hips.

Face – Pinkish patches over ears, nose, cheeks, chin

Hands and feet – Swollen fingers and toes, ankle oedema, bluish, blackish

Blood – bright red colour

Stomach- acute erosion, ulceration and haemorrhages

Pancreas- fat necrosis and haemorrhages

Organs – may show micro infarcts, congestion

Lungs = congestion and microinfarcts

Brain – perivascular haemorrhages

Coronaries – Thrombosis

Sampling

Urine – Alcohol / drugs

Blood – Alcohol , drugs

Histopathology- cold effects findings in organs

Audit Sheet

Check Points	Yes	No
History		
Temperature recording		
Clothing		
Photography		
Sampling		
Complete external examination		
Complete Internal examination		
Histopathology-pancreas, lungs brain and heart		
Opinion		

EXHUMATION [14,45,95,103]

It is lawful digging out of an already buried body on order of Magistrate U/S 176 CrPC. Places of burial may be public burial grounds,- Kabristan , family burial grounds or places of surreptitious disposal in cases of concealment of death. It can also be termed as digging up, unearthing and disinterment of body. In this regard, please Punjab Police Rules25.34 [103]

Exhumation involves to take the human body or remains of a body or the coffin containing a body out of the place of burial or disposal. The procedures adopted by different religions are as:

- **Christian –** Body is laid out after washing, and clothed in a shroud or night attire. Roman Catholic faith prefers crucifix on the chest of the deceased, or that arms should be folded as cross
- **Muslim –** Body is washed by a professional , after the head has been turned towards Mecca It is then clothed in 3 pieces of white cloth 9 yards long , covering upper, middle, and lower portions of the body , Generally coffin is not used.
- **Hindu and Budhist-** Body is washed, wrapped in a shroud, covered with flowers, and cremated.
- **Jewish –** Body is laid out with the eyes closed, and the feet pointing towards the door. A purification ritual called 'Tahara 'is performed by 2 qualified Jews, and the body is then buried wrapped in a shroud.

Why is it be carried out ?

Criminal Cases which may necessitate exhumation may be :

Determination of identification, verify identification, uncover previously undocumented evidence; parties, determination of the cause of death , manner of death, cause of the accident; to collect forensic evidence

Civil cases may also require in following cases:

Identification, accidental death claim, insurance negligence, Inheritance claim, disputed identity / paternity / maternity, separation overseas and burial of wrong body.

Arrangements are made for exhumation after consulting all the involved parties:

- Relatives and other interested
- Cemetery keeper, undertaker, cemetery worker,
- Pathologist's team
- Workers, photographer, forensic toxicologist, odontologist, anthropologist as per need
- Material procurement kits
- Other necessary basic instruments
- Vehicle to carry remains to Mortuary

Plan to exhume should be prepared in consultation with involved parties and administration:

- Day and timing
- Starting early in the morning
- In presence of Magistrate, Doctor, Police, witness
- Identification team/ burial manager / relations
- Digging up team
- Sampling and documentation material
- Security of site

Time Limit: No time limit in India

On site:

- Identification of site
- Plan to dig up
- Collection of earth above and below and a control sample
- Noting entomological evidence
- Coffin
- Autopsy as the procedure adopted in other cases.

Describe place, dimensions of grave, identifying items, collect earth from above body, below the body, sides. Take out body / remains and examine at morgue in details as per the procedure for normal post-mortem examination.

Audit Sheet

Check Points	Yes	No
Magistrate Order		
Time fixation for exhumation		
Arrangements and teams to participate		
Time of departure		
Time of arrival at the burial place		
Persons identifying the place of burial		
Description of grave (L ength, Breadth covering, depth)		
Presence of Magistrate, IO and other teams members		
Description of coffin, clothing or other coverings		
Sampling of earth(500grams) liquids in coffin		
Sampling of debris/liquids in coffin for poison		
Entomology evidence		
Take out body, if skeletonised then pack after making sketch and photography		
Photography at every stage		
Videography		
Complete Autopsy as any other autopsy		
Ancillary Investigations as indicated		
Special findings should be photographed and if possible retained		
Approximate time of death		
Cause of death or other issues raised in the case		
Issues related to death resolved		

Common situation

- Consistency with previous findings if postmortem was done before
- New findings as postmortem was performed casually without opening cavities
- Inconsistency in reports
- Knowing exact cause of death if post mortem was not done

DEATH OF FOREIGN NATIONAL

With advancement travelling and job related placement, many foreigner who dies naturally or unnaturally are brought to morgue either for preservation or at times for post-mortem. The main issues remain custody, embalming, transportation. Body preservation policies are to be noted against the IATA regulations with respect to non nationals.

All centers should have display of embalming policies with procedure forms. Appropriate authorization forms and fitness certificates for airlifting and transport by all modes should be made available with pre-drafted checklist.

Post-mortem should be carried as per normal procedures as laid down, depending on type of case**.**

Audit Sheet

Check Points	Yes	No
Identity verification		
Passport details		
Information to Embassy		
Arrangement for transport		
Embalming		
Care taker undertaking /authorization by Embassy		
Police certificate /NOC		
Photography		
Cause of death		
Post mortem Certificate		

Main reasons for deaths in such cases remain as:

- Natural Deaths
- Drug Overdose
- Drug Carrier
- Poisoning (stupefying and intoxicating agents)
- Sexual Assault
- Murder
- Accident

EMBALMING SERVICES [28]

In normal practice, embalming services are required only when a body has to be transported from one place to another either by road / rail or air. It is carried out in most of the centers on official payment. The rates are nominal and varies from 2000 to 10,000 INR or as in practice .

It requires **1.** Request form, **2.**NOC from police, **3.**Cause of Death Certificate. These services are provided either by Forensic or Anatomy departments. After the embalming procedure certificate to this effect is issued as :

a. **Certificate of Embalming**

This is to certify that the dead body / Postmortem body / Autopsy body of late …… Son / Daughter/ Wife / …… aged …… Sex…….. an Indian / Foreigner ID / Passport No…….. was brought tot his Department from …… where he / she had died / where PM was done , is embalmed in the Department of Forensic Medicine /Anatomy. Embalming assures that the body is not hazardous to public health. The Death Certificate / Certificate of Postmortem and no objection certificate from the Police / Embassy / High Commission / Mission for embalming this dead body, have been seen by me , and found in order. The body after embalming , is handed over to the claimants, who brought it to this department.

Signature of Medical Officer with rank

Received the embalmed body of Late……. with Embalming

Certificate

Signature of Claimant with full particulars

— — — — — — — — — —

b. **NOC from Police** – the language of this certificate is :

No Objection Certificate for Transportation of Dead Body

This is to certify that ……. s/d/ w/ of……r/o

…….Has died

on dated …… at about …….. AM/ PM at his residence/ hospital, etc. (Name) ……His death is natural / due to illness / other reason (mention other reason) …….As per the certificate / report given by the hospital / doctor. His relative(full particulars) …….....intends to take him out of Delhi for funeral etc. We have no objection for same. Date of issue Name of officer and Seal

c. 3rd Important document is Death Certificate as used in the hospital as WHO guidelines.

AUTOPSY IN EMBALMED BODIES

There are occasions when person dying naturally or otherwise are brought for embalming and afterwards circumstances develop where death certification is required for legal and other civil purposes. The body is a well preserved and most pathogenic organisms are killed. It is also devoid of foul smells developing with time after death. If poisoning is not the issue then performing autopsy on embalmed body is a wonderful experience. It is just like performing anatomical dissection.

Advantages: Tissue is well preserved , anatomical relations are intact, lesions become more distinct , body is free from pathological organisms.

Disadvantages: It interferes with detection of poison, tissue get denatured and there is difficulty in recovery of DNA material, thrombus get dislodged, tissues get hardened and

dissection requires little force and care. All bacteria get destroyed so it interferes with identification.

Sampling in embalmed body: Vitreous humor, synovial fluid, bile are ideal samples for screening for toxicology. Besides this muscle mass from psoas and gluteal region can be preserved for toxicology . For DNA liver, spleen, bone marrow, muscles can be preserved. Although, it is a difficult process but it is possible to extract DNA from embalmed tissues. CSF from ventricles can be obtained after opening cranial cavity.

Organ dissection

All organs are good in shape and contour. These very hard in consistency. The appearance is just like half preserved tissues museum specimen. Findings are appreciated better than a normal autopsy. Major diseases and lesions can be easily diagnosed.

Photography

Femoral vessels where embalming trochar, cannula was introduced

Abdomen walls

Full body photography external as well as internal

Cause of death

Any other special findings

TIME SINCE DEATH[14,29,30 ,35,36,95]

A simplified method of estimating time since death is very important factor to guide the crime investigation. Examination by naked eye methods are listed below with their time limits in normal weather of 25-30 degrees Centigrade with average humidity. All values are approximate and time of death is based on assessment of multiple factors.

Finding seen in the body of corpse	**Time since death**	**(Noted) Yes/No**	**Estimate**
Transparent cornea, Postmortem staining is very faint, patches are not appreciated, only small streaks are visible	Within 1-2 hours		
Body surface cold postmortem staining in patches, rigor mortis is appreciated in small muscles of the body like face, lids etc	2-3 hours		
Body surface cold, PM staining well developed and fixed. Rigor mortis well developed and appreciable in upper parts of the body.	6-8 hours		
Rigor mortis appreciable in all parts of the body, well developed and fully appreciable in both limbs	Near 12 hours		
Body cold, greenish	12-24 hours		
discoloration over the right iliac fossa, eggs of common flies as small cluster may be present over natural orifices			
Rigor mortis start receding, greenish discoloration over abdomen and chest, distension of the abdomen with bloating	24-36 hours		
Whole body bloated, facial features blurred, hairs and nails easily pulled off, grown pupae, maggots all over the body	3-5 day		
Internal organs are pulpy, black and present in form of pultaceous mass	1 week		
Most of the soft tissues decomposed and present in unrecognizable form and texture, fibrous changes in prostate/uterus are identifiable	2 weeks		
Skeleton exposed, bones still attached with tendons	1=3 months		
Bones get separated but small fibers can be seen at the ends of joint bones	3-6 months		
Bones lying separately without fibers	>6-12 months		
Condition of Gastric Contents digestion and emptying (veg ot non-veg) normal dietLiquid (Water/tea /coffee) leave empty stomach Over full stomach	1-4 hours 15-20 minutes 1-2 hours		
Small Intestine Ileo-caecal junction: Hepatic Flexure: Splenic Flexure: Pelvic colon: 12-18 hours	1-8 hours within 2-4 hours 4-6 hours 9-12 hours		
Evacuation: Nothing is left in intestine after 48 hours.	18-24 hours		
Time of Death by observing **return of PM staining** to blanched area after pressing skin for 2-5 minutes with moderate pressure against skin showing PM staining. 20-25 degree centigrade	Approximate Time Since Death		
5-10 seconds 30 seconds 60-120 seconds 5-8 minutes 8-10 minutes 10-15 minutes 10-15 minutes More than 15 minutes	2 hours 4 hours 6-8 hours 10-12 hours 14-16 hours 18-24 hours 18-24 hours 24-28 hours		
Rigidity of body Primary Relaxation Face rigidity Neck rigidity	 0-1hours 0.5-2 hours 2-4 hours		

Upper limb rigidity Chest Trunk Lower Limbs Strong rigidity	4-6 hours 6-8 hours 8-10 hours 10-12 hours 12-18 hours		
Decomposition changes and Time Since Death Green discoloration iliac fossae right Fluid from mouth and protruding tongue Softening and protrusion of eye balls Loosened nails and hairs Soft tissues liquefied and absent Presence of joint ligatures Bones becomes yellow and smooth and lack vital appearance Mummification Saponification Disintegration of body More in neutral and dry soil	 18-24 hours 2-3 days 5-7 days 5-10 days 1- 3 months 3-6 months 1 year 3-6 months 3-12 months 25-100 years		
Motility of sperms[36] Weak activity can be seen up to	10 hours post death 24 hours after death		
Rectal Temperature with long thermometer Changeable factor[36] **Tem ^{0}C Changeable factor** 32 1.2 29.1-32 0.9 27.1-29 0.824.1-27 0.7 19.1-24 0.6 Less than 19 0.5	Time of death = Normal body Temp- cadaver changeable factor rectal temp x		
Electrical stimuli of muscles Positive response Weak response Irregular response	 2 hours Up to 3 hours Up to 8 hours		
Refloating of bodies to surface in drowning/ immersion in well/river/ pond/sea like water bodies Summer Hot and humid Light winter Extreme winter (below 45^{0}F)	 2-3 days 2-5 days 1-2 weeks May not surface		
Cold water immersion survival 3^{0}C 3-8^{0}C 8-28^{0}C	 3/4th hour 1.5 hour 3 hours		
Drowning (non-winter season) period of submersion Wrinkling of skin Bleaching look Soddening Degloving	 2-4 hours 12 hours 24 hours 48 hours		

Lice in scalp hair and other body parts over dead body Live Dead	 Less than 3 days Die within 3-6 days after the death of individual		
Grass colour If green grass under dead becomes yellow due to unavailability of sun rays then it means corpse is lying for more than	5 days or more		
Urine volume in normal routine 1ml/ per minute Per hour 1x60=60 ml is formed	Total volume of urine in ml – residual urine in ml= Time of Death after last voiding		
Entomology Common House fly (Garbage fly) • Small white eggs hatching • First maggot • Second Maggot • Third maggot stage **Blue Bottle (Calliphorade)** • Yellow banana eggs • Hatching time • First maggot • Second Maggot • Third maggot stage **Sarcophagidae(fruit flies)** **Summary** Fresh Body- Common House fly Blue Bottle Bloated body Liquefaction Post Decay stage Skeleton with tandons of joint Dry stage>	Any moment, average 8-12 hours 36 hours Upto 2 day Upto 3-4 days 8- 14 hours 8-14 hours 2-3 days 4-5 days 4-5 days 2-3 days 3-7 days 1-3 weeks 3-4 weeks >1 month >3-6 months (open) >1-3 years buried		
Time of death in still born Skin – reddish, fresh Vernix caseosa Skull bones appearance normal Tissues fresh Posture normal bleeding under scalp due forceps or narrow pelvis	Fresh death during labour process		
Time interval between intrauterine death and delivery[39] Skin slippage Skin blebs Skin sloughing and haemolysis, softening of organs Liquefied brain, overlapping of sutures, collapse of calvarium Laxity and dislocation of joints	 12 hours 24 hours 48 hours 5days 7days		

Intestine contents emptying, rectum contents emptying and form, urine volume, ambient temperature of atmosphere at scene, degree of DNA degradation, humidity in atmosphere, clothing layers are valuable in deciding time since death. Other circumstantial factors like newspaper piling, light on or off, TV schedule, manner of clothing, food in utensils, dish in sink, purchase receipts, phone calls, dust deposition, maggot, flies and fungus help in determining time of death. Vitreous humor electrolytes Potassium, Sodium and chloride are very helpful in first 72 hours in estimating time since death.

The features and limits as mentioned above may be seen in almost in **double time** in extreme winter season. These features show variation depending on humidity, temperature, close or open space. All factors should be given weight to make a final estimate of time since death. It is multi factorial issue rather than single criteria issue

TIME OF INJURY[37,38,66,95]
(Injury infliction time before death)

The time limits are only approximate and should not to be considered in isolation

Bleeding from injury (genital tissue, skin shows little earlier healing)			
time of injury	Few hours		
Oozing of blood	to 1 day		
Serosanguineous	2-3 days		
Serous Pus formation visible	3-7 days		
Healing	7-10 days		
	About 1.5-3 days		
Histological findings (time of injury)			
Lecukocytes	15-45 minutes		
Erythrocytes	20 minutes		
Macrophages	6 hours		
Thrombosis in small vessels	12 hours		
Hemosiderin	48 hours		
Granulation tissue	5-6 days		
Soft scar	1 month		
Firm scars	2-3 months		
Bone Callus in fractured bone			
Hemorrhage	Immediate		
Bone Necrosis	2 Days		
Organization of clot	4 Days		
Granulation tissue	5 Days		
Proliferation and infiltration of osteogenic cells	7 Days		
Fibroblastic reticulum	10 days		
Soft callus	2 weeks		
Hard Callus	6-8 weeks		
Healing of fractured bone	12-16 weeks		
Bruise colour changes			
Red	Fresh up to 6 hours		
Recent	24 hour		
Bluish, light blackish tinge	2-3 days		
Brownish/ dark bluish (hemosiderin)	3-4 days		
Greensih hue in bruise (hemotoidin)	4-6 days		
Yellowish (Bilirubin)	7 days		
Faint yellowish	7-14 days		
Healing of abrasion			
Oozing	Immediate		
Soft covering	6 hours to 1 day		
Brownish scab	2-3 days		
Black brownish	4-5 days		
Black scab shrinks at margins, start separating	6-7 days		
Hypopigmentated area	7-14 days		
Healed, unrecognizable abrasion area	2 weeks		
Healing of wound			
Fresh, bleeding with clot	Within few hours, 6 hours		
Margins swollen, red dried up blood and lymph	12-24 hours		
Capillary network, new vessels	24-36 hours		
Capillary network, fibroblasts along with vessels	48 hours		
Vessels thickened, connective tissue expands	3-5 days		
Scar formation is complete and is soft, elastic and pinkish; slough falls off;	6-7 days		
Scar with some indurations	7-9 days		
White scar with mild indurations	2-3 weeks		
White scar with small indurations < 5cm wound	4 -5weeks		
Large wounds with indurations	4-6 months		
Burn Injury			
Immediate – redness	Immediate		
Blister formation	15 minutes to 3 hours		
Swelling, oozing, bleeding	24 hours		
Pus formation and visible pus, slough formation	36-48 hours		
Thick pus formation– creamy layer	2-3 days		
Slough formation and granulation tissue	3-6 days		
Fall of superficial slough	7-8 days		
Fall of deep slough	3 weeks		
Healing of deep burns	1 month		
Scar	More than 1 month		
Contracture of joints			
Subdural Hemorrhage[38]	3 days Analytical		
Acute=Fresh, red to dark red, clotted blood, without features of organization or resolution and no membrane formation			
Subacute Subdural Hematoma =subdural haematomas that have remained undetected or unoperated for at least 3 days	More than 3 days upto 21 days		
Clot is liquefied two	2-3 weeks		
Chronic is s usually after two weeks, a neo membrane can be appreciated	More than 2-3 weeks		

DEATH CERTIFICATION [101, 102, 45]

Certification is most important exercise in medico-legal working. Death certificate is an important document and the right of next of kin to have it as it may be required for cremation , settle other legal duties and rights of the deceased individual. In every case where medico-legal is conducted a death certificate /Post-mortem Certificate is mandatory on part of autopsy surgeon. Detailed post-mortem should be given to investigating officer as post-mortem was conducted on their request. All doctors who are going to issue death certification must read Death and Birth Registration Act, India, 1969 and International Classification of Death 10 (ICD 10) issued by WHO.

Classification of causes of Death ICD 10

The 10th version of International Classification of Diseases (ICD-10) was introduced by WHO in 1993 and India adopted this in the year 2000. Accordingly, the Directors of Health Services of all States/Union Territories were advised to adopt the ICD-10 classification system for coding morbidity and mortality records. Medical certification of cause of death (MCCD) scheme is basically a part of International Statistical Classification of Diseases and health related problems (ICD) formulated by WHO. The purpose of promoting use of ICD 10 is to ensure uniform data collection and analysis.

In the structure of ICD 10, there are 3 volumes and 21 chapters. Volume 1 is the **Tabular list**, which is an alphanumeric (code) listing of diseases and disease groups, Volume 2 is **Instruction Manual** on how to use volumes 1 and 3 and Volume 3 is the **Alphabetical index** of the diseases and conditions found in the Tabular list.

Table 1: Classification of diseases in the International Classification of Diseases-10 ICD-10 Chapters with Title and three-character (code) categories (Adopted from WHO ICD-10 volume 1)

Chapter	Title	Three-character categories
I	Certain infectious and parasitic diseases	(A00-B99)
II	Neoplasms	(C00-D48)
III	Diseases of blood and blood-forming organs and certain disorders involving the immune mechanisms	(D50-D89)
IV	Endocrine, nutritional and metabolic diseases	(E00-E90)
V	Mental, behavioural disorders	(F00-F99)
VI	Diseases of the nervous system	(G00-G99)
VII	Diseases of the eye and adnexa	(H00-H59)
VIII	Diseases of the ear and mastoid process	(H60-H95)
IX	Diseases of the circulatory system	(I00-I99)
X	Diseases of the respiratory system	(J00-J99)
XI	Diseases of the digestive system	(K00-K93)
XII	Diseases of the skin and subcutaneous tissue	(L00-L99)
XIII	Diseases of the musculoskeletal system and connective tissue	(M00-M99)
XIV	Diseases of the genitourinary system	(N00-N99)
XV	Pregnancy, childbirth and the puerperium	(O00-O99)
XVI	Certain conditions originating in the perinatal period	(P00-P96)
XVII	Congenital malformations, deformations and chromosomal abnormalities	(Q00-Q99)
XVIII	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	(R00-R99)
XIX	Injury, poisoning and certain other consequences of external causes	(S00-T98)
XX	External causes of morbidity and mortality*	(V01-Y98)
XXI	Factors influencing health status and contact with health services	(Z00-Z99)

For international data comparison, the list of three-character categories is the mandatory level. The coding procedure is done at the regional level but the statistics are published by the RGI. Every cause-of-death statement is coded and tabulated in the statistical offices according to the latest revision of the International Classification of Diseases and National List prepared from ICD. Cases in which deaths are due to external causes, dual coding of both the external cause and the nature of injury is done.

ICD -10 : Chapter XX (Code IX also) ; For citing Code XX

External causes of morbidity and mortality(V01-Y98)*

This chapter permits the classification of environmental events and circumstances as the cause of injury, poisoning of environmental events and circumstances as the cause of injury, poisoning and other adverse effects.

This chapter contains the following blocks:

V01-X59 Accidents

V01-V99 Other external causes of accidental injury e.g. falls , accidental drowning, exposure to inanimate mechanical forces

X85- YO9 Assault

Y10-Y34 Event of undetermined intent

Y35-Y36 Legal intervention and operations of war

Y40- Y84 Complications of medical and surgical care

Y85-Y89 Sequelae of external causes of morbidity and mortality classified elsewhere

Example

Intentional self-harm (X60-X84)

X60	Intentional self-poisoning(ISP) by and exposure to non opiod analgesics, antipyretics and anti rheumatics e.g
	• 4- aminophenol derivatives • Nonsteroidal anti-inflammatory drugs NSAID • Pyrazolone derivatives • Salicylates
X61	ISP by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs. Not elsewhere classified
	• Antidepressants • Barbiturates • Hydantoin derivatives • Iminostilbens • Methaquualone compounds • Neuroleptics • Psychostimulants • Succinimides and oxazolidinediones • Tranquillizers
X62	ISP by and exposure to narcotics and psychodysleptics (hallucinogens), not elsewhere classified
	• Cannabis and its derivatives • Cocaine • Codeine • Lysergide (LSD) • Herion • Mescaline • Methadone • Morphine • Opium • Morphine
X63	ISP by and exposure to other drugs acting on autonomic nervous system
	Paprasympathetolytics (anticholinergics and antimuscucarinics) and spasmolytics, parasympathommetics (cholingerics) sympatholytics (antiandrenergics), sympathomimetics (adrenergics)
X64	ISP by and exposyre to other and unspecified drugs, medicaments and biological substances
	Agents primarily acting on smooth muscles and the respiratory system anaesthetics (general)/ local drugs affecting the CVS, GIT, hormones and synthetic substitute, systematic and haematological agents, systematic antibiotics and other anti- infective, therapeutic gases; topical preparations; vaccines; water balance agents and drugs affecting mineral and uric acid metabolism
X65	ISP by and exposure to alcohol
X66	ISP by and exposure to organic solvents and halogenated hydrocarbons and their vapours
	Benzene and homologues Carbon tetrachloride choloro fluorocarbons Petroleum and its derivatives
X67	ISP by and exposure to other gases and vapours
	Carbon monoxide, lacrimogenic gas, motor exhaust gas, nitrogen oxides; sulphardioxide; utility gas; Excludes metal fumes and vapours (X69)
X68	ISP by and exposure to pesticides
	fumigants; fungicides; herbicides; insecticides; rodenticides; wood preservatives; excludes :plant foods and fertilizers(x69)
X69	ISP by and exposure to other and unspecified chemicals and noxious substances
	Corrosive aromatics , acids and caustic alkalis , glues and adhesives; metals including fumes and vapours ; paints and dyes; plant foods and fertilizers; poisonous food stuffs and poisonous plants; soaps and detergents
X70	Intentional self-harm(ISH) by hanging, strangulation and suffocation
X71	ISH by drowning and submersion
X72	ISH by handgun discharge
X73	ISH by rifle, shotgun and larger firearm discharge
X74	ISH by other and unspecified firearm discharge
X75	ISH by explosive material
X76	ISH by smoke, fire and flames
X77	ISH by steam, hot vapours and hot objects
X78	ISH by sharp object
X79	ISH by blunt object
X80	ISH by jumping from a high place; includes intentional fall fromfrom one level to another
X81	ISH by jumping or lying before moving object
X82	ISH by crashing of motor vehicle; train; tram; excludes crashing of aircraft(X83)
X83	Intentional self-harm by other specified means; intentional self-harm by
	Caustic substances, except poisoning, crashing of aircraft, electrocution
X84	Intentional self- harm by unspecified means

Event of undetermined intent is classified under Y10-Y34.

ICD is worth reading document before practicing. Another important document is *'Physician's Manual on Medical Certification of Cause of Death. 5th Edition. Vital Statistics Division, Office of the Registrar General, India, Ministry of Home Affairs, New Delhi 2012.'*

In medico-legal post-mortem services, more than 90% cases are straight and there is no hindrance from law side so cause of death can be stated in clear words. This **post-mortem certificate** is to be issued in triplicate , one copy to relative / next of kin, police and one office copy. It is very helpful document and majority of people will not need detailed post-mortem report which is mainly for police and court.

1. Sample of Post-mortem Certificate
2. Sample of cause of death certificate for Municipal Corporation under Birth and Registration Act, 1969
3. Cause of death in Post-mortem report may be written as small paragraph of a few lines explaining sequences and their causation It may be one word or few logical sentences, for example hanging, strangulation, burns, firearm injury are self explanatory words. In some cases, detail is required to convey the message, it should be left to the discretion autopsy surgeon.

This should not be ambiguous, double meaning and

unrelated statement. It may reflect reason for pendency like toxicological analysis of viscera or any further requirement like histopathology or specialist advise etc. It is a legal document, any personal or administrative comment should be avoided in this document..

4. Notification to public authorities / public officer as per government notification and requirement of state and central government.

5. Photocopies of post-mortem report in murder, custody death, dowry death, encounter, bomb explosions, abetment of suicide cases etc., should be referred to police officer / court and exemption under RTI section 8(h) interfering in investigation, may be cited.

In cases of accidents, natural death cases, suicide where no abetment charge is there can be released to next of kin on written request with Photo ID proof and thumb impression to avoid any fake claim or fraud.

Actually, cause of death is public domain information while details in MLC or post-mortem details are confidential information. These details should not be made public until unless specifically exempted/ requested by court / Police to diffuse public and media pressure, exemption should be in writing; which is unlikely as no one would take responsibility so any communication beyond cause of death to public media by autopsy surgeon falls under breach of trust and is an unauthorized communication under motivation or immaturity or unprofessionalism. Autopsy surgeon should refrain from such activities.

To keep standard, checking of reports by trained people or senior people should be regular periodical exercise in the department. Organize reorientation program for those, who are not performing well.

Examples of certificates to be issued after postmortem examination by autopsy surgeon:

1. **Post-mortem Certificate**–to relatives MUST
2. **Death Certificate** –relative, corporation and police MUST
3. **Post mortem report** – Police / Magistrate as the case may be. MUST
4. **Public Media** – Cause of death (by Police PRO or PRO of hospital), if required

A. **Post mortem Certificate**

To whom it may concern

This is to certify that Post Mortem Examination was conducted on the body of …… Son/ Wife/Daughter of……..On…… …. at ……Body was brought for PM by Police Station……Through PC …….....

The deceased died due to …….....

Signature

Name

Department

B.

1. Immediate cause of death
2. Proximate cause of death
   i. Any underneath disease

International form of Medical Certification of Cause of Death

Manner of death:
How did the injuries occur?

1. Natural 2. Accidental 3. Suicidal

4. Homicidal 5. Pending investigation

If deceased was a female, was pregnancy the death associated with? 1. Yes 2. No.

If yes, was there a delivery? 1. Yes 2. No.

Name and signature of the Medical Attendant certifying the cause of death

FORM No. 4
(See Rule.7)
MEDICAL CERTIFICATE OF CAUSE OF DEATH
(For Hospital In-patients. Not to be used for Still births)
To be sent to Registrar with Form No.2 (Death Report)

Name of the Hospital_____

I hereby certify that the person whose particulars are given below died in the hospital in Ward No._____ on _____ at _____A.M./P.M.

Name of the Deceased					For use of statistical office
Gender	Age at death				
Male/ Female	If 1 year or more, age in years	If less than 1year, age in month	If less than one month, age in days	If less than one day, age in hours	
Cause of Death				**Interval between onset and death approx.**	
I. **Immediate cause:** State the disease, injury or complication which caused death, not the mode of dying such heart failure, asthenia etc. **Antecedent cause:** Morbid conditions, if any, giving rise to the above cause, stating underlying conditions last **II.** Other significant conditions contributing to the death but not related to the disease or conditions causing it	(a)……... Due to (or as a consequence of) (b)……... Due to (or as a consequence of) (c)…… …….				

Date of verification……....

(To be detached and handed over to the relative of the deceased)

Certified that Shri/smt/Kum……
S/W/D of Shri……..…….....……

R/o ……..……Was admitted to this hospital on ……..…… and expired on ….……at……AM/PM.

Doctor.……

(Medical Supdt and Name of Hospital)

Important Points –

1. **Unacceptable** cause of death-cardio-pulmonary arrest, repiratory arrest, renal failure, hepatic failure, multiorgan failure, intracranial haemorrhage or like become misleading so should be qualified by proximate cause.

Do's

- Be familiar with Birth and Death Registration Act, 1969 requirement and your duty
- Read ICD 10 of WHO
- Always be precise, concise and to the point
- Always give copy to relatives, registrar office and police

Don't

- Don't write unrelated thing in this coulumn
- Write vague words or terminology

C. **Postmortem report -** EXAMPLE OF A MODEL POST MORTEM REPORT (TYPED FORMAT)

Example

……...name of Institution …….

Department of Forensic Medicine and Toxicology

Phone……. Fax…….

POST MORTEM REPORT Police Station:

OF xyz „„„„„„„„„„„„„„„„„„„„……………..
Autopsy No: A999/2013
Registration No: 1760738 – 2013
Police Report No: 6694/2013
I.D. No: 590726 – 10 – 6537 Sex: Male
Marital Status: ………….. Age:…………………........…
Occupation: Unemployed Address……………………

We, Dr A , Dr B and Dr C carried out an autopsy examination on the body of XYZ S/O on 20/12/13 commencing at 1500 hours at the Mortuary, Name of hospital……..

The body was identified by:

1. Police:

   Rank No:

Relative Name:
I.D.No:590726 – 10 – 6537

Relationship:

History of the case

EXTERNAL EXAMINATION

The body was that of large built adult Indian male, ……… cm in length and …………kg in weight with advanced/no decomposition changes. He was wrapped in black plastic bag with no cloth found or with clothing …………………………………………………………………..

Rigor mortis was fully established. Post-mortem hypostasis was absent. There was heavy smell of decomposition noted.

His complexion was black; head hair was black, wavy and …… cm in length. Black moustache and beard were present (……….. cm). Generalized swelling of the body was noted. The face showed greenish-black discoloration and the eyes was oedematous. Multiple blisters were noted over the face and ears. Purge fluid was seen coming out from the nose and the mouth. The tongue was bitten. The upper and lower jaws had natural set of teeth except missing 2 premolar and 2 molar teeth. The abdomen was distended. Marbling and peeling of the skin was seen over the right upper abdomen. The hands were normal and fingernails were pale. Feet and toenails were normal. The external genitalia was swollen, penis was uncircumcised.

Identifying features:

1. Identification tag bearing the deceased's name was noted on the right foot.
2. No obvious scars were noted on the body.

Signs of recent medical therapy:

Nil

Injuries:

No obvious external marks of injuries identified

INTERNAL EXAMINATION

Central Nervous System:

The scalp was normal. Skull and meninges were normal. Decomposition of the brain was marked in which the brain was liquefied. The normal pattern of sulci and gyri was destroyed. The normal anatomy of the cerebral vessels could not been identified.

The upper part of the spinal cord was unremarkable. The remainder of the spinal cord was not examined.

Cardiovascular System

The pericardium was intact and of unremarkable thickness. There was no unusual collection of fluid within the pericardial cavity.

The great vessels arising from the heart showed normal anatomy. The heart (245 g) was pale of normal configuration and the chambers showed concordance. Sign of decomposition was seen. The epicardium and endocardium were unremarkable. The myocardium was unremarkable. The atria and ventricles were unremarkable. The left and right ventricular wall measured 14 mm and 4 mm, respectively. No areas of fibrosis or infarction noted.

The right coronary, left anterior descending and left circumflex arteries were patent. The aorta showed few fatty streak.

Respiratory System:

The soft tissues of the thoracic cage were intact. Ribs and sternum were normal. The pleural cavities were normal with smooth surfaces. The nasopharynx and the larynx with its surrounding structures were unremarkable. The trachea and bronchi were unremarkable. The lumen contained a small amount of secretion.

The lungs (right – 420 g, left – 300 g) were unremarkable in configuration. The pleural surfaces were normal. Cut sections showed mild congestion. The pulmonary arteries were healthy.

Alimentary System:

The peritoneal cavity was normal and no unusual effusion noted.

The tongue and oropharynx was unremarkable. The oesophagus was normal and empty. The stomach contained 100 ml of altered blood. No unusual smell noted in the gastric contents. The mucosa showed areas of superficial erosion. The external surfaces of the small and large bowel were unremarkable.

The liver (925 g) was small in size and showed macronodular cirrhosis. Cut section of the liver showed multiple nodules ranging from 0.5 cm to 3.0 cm in diameter with yellowish cut surface. No obvious tumour seen. The

gallbladder was unremarkable. Biliary tract was patent. The pancreas was autolysed.

Genito-Urinary System:

The kidneys (right - 100 g, left - 100 g) were autolysed. The normal cortico-medullary and renal pelvis was unidentifiable. The ureters were unremarkable.

The testes were examined by external palpation and showed no abnormality.

Endocrine System:

The pituitary, thyroid and adrenal glands were unremarkable showed decomposition changes.

Reticulo-endothelial System:

The spleen (165 g) was normal in size. Cut sections were normal.

There was no lymphadenopathy.

Musculoskeletal System:

Within the limits of dissection, the musculoskeletal system visualized appeared to be normal.

Time since Death

Cause of Death

Example 1

Part I

Immediate cause of death	a. Myocardial Infarction
Immediate Proximate	b. Chronic Ischaemic heart disease

Part II

Other significant conditions - Diabetes Mellitus

Example 2

Part I

Immediate cause of death	a. Acute renal failure
Immediate Proximate	b. Nephropathy
	c. Diabetes Mellitus

Part II

Other significant conditions - Chronic Ischaemic heart disease

Example

In injury cases

Immediate cause of death	a. Haemorrhagic shock
	b. Rupture live
Proximate cause of death	c. Road Traffic Accident (can add word consistent or could be seen, if you want to be guarded)

In paragraph writing method – one can express like ……..

Death in this case was due to haemorrhagic shock resulting from rupture liver caused by blunt trauma, which could be seen in RTA.

In some cases, there could be **one word cause of death also**, like hanging, strangulation, smothering, gagging etc, which are sufficient in itself and are self-explanatory. In such situations, rest of the column can be left without filling.

SUBSEQUENT OPINION IN RELATION TO POSTMORTEM

Reference …….....… Dated …..……

This has reference to application from I O…… Rank …….. Police station…… in relation postmortem no…….. conducted on ……. by me or referred to me because earlier doctor has left the institution or second opinion is required by court / investigative agency.

List of documents submitted are :

Original Postmortem report……...……

Inquest papers …….....

Photographs ……..

Viscera analysis report …….

Forensic Laboratory report……

Important observations and findings in above documents …….....

Sketch diagrams……

Photographs ……...…..

Video evaluation ……

Computer reconstruction of events……

Analysis of photographs and findings in computer …….....

Literature comparison/ review ……....

Opinion : After considering postmortem findings, scene assessment, viscera analysis report and circumstantial evidences to the best of my knowledge and belief, I am of considered opinion that ……

Enclosure returned (No…)

Signature

*Format may be modified as per need of case

PS: Queries put by Investigating seeking explanation about human acts and behavior ;

Simulation exercises and comparison with injuries present over the body are also included in this exercise.

EXHIBIT EXAMINATION

Exhibit examination is an important part of forensic examination as correlation , consideration of possibility and exclusion of possibility of involvement of particular object is projected in this procedure Weapon , photographs, clothing and other items are brought by IO for examination and corroboration with post mortem findings. A few examples where such exercise is done are mentioned here.

- Clothing examination report
- Bullet examination report
- Sharp weapon examination report
- Blunt weapon examination
- Premises inspection
- Crimes Scene Assessment
- Vehicle examination
- Water bodies Inspection
- Machinery Inspection

Steps to be taken

- Always receive in a sealed packet with seals over it
- It must be accompanied with letter
- Issue receipt and mention time for collection of report
- Always touch with gloved hands
- Always take photographs with scale
- Examine in detail
- Address the queries put up by IO
- Put identification tag by which you can identify later on
- If item recovered has blood stains then, first send it to biological division of
- FSL for blood and DNA
- Return in sealed packet with sample seal
- Obtain proper receipt

Anticipate possible questions by defence, casual approach brings embarrassment in public. Expert are identified by their reports and professional approach in the case not otherwise by tall claims.

The exhibit may be real , actual which are involved in crime like club, knife, pistol etc. or it may representative or demonstrative like photographs, replica, diagrams, maps, sketch etc.

A review of old cases of similar nature is quite helpful to beginner. A helping hand from computer animation and artist is helpful in demonstrating the event and its outcome.

A few basic things about exhibits examination:

1. Protects the evidence present over it
2. Examine in methodical manner and use magnifying lens
3. Take overall and close-up photographs
4. Preserve evidence
5. Use computer to see magnified image and compare with wounds
6. Safe guard evidences and item
7. Pack and seal properly
8. Maintain chain of custody

Social Forensic Message

What you say or present is likely to be challenged so show your objective evidence.

Your reports are self explanatory of your worth and expertise !

SUICIDE NOTE ANALYSIS [146,147]

Suicide Note Analysis is analysis of a message left by a dying person as what was his desire, aim, circumstances, mood, situation, triggers, or any abetment. Note may be in form of written text, video, email, verbal recording or message communicated to any other person.

Before committing suicide some people leave a message for those left behind what we term suicide note. Suicide note by definition is a product of person who has decided to die. Shneidman wrote 'Suicide is a human malaise and notes are penultimate act giving voice to the malaise. He proposed five possible kinds of notes

1. Thetical- Notes which assert a thesis as declarative or testimonial.
2. Antithetical- Those notes which report or deny a stated or implied thesis.
3. Synthetical- Those notes which combine the basic tenants of thesis and antithesis.
4. Athetical- A suicide note which is lacking a point of view.
5. Amphithetical-Those notes which present the simultaneous co existence of a point of view and opposite.

Preservation of suicide Note : On recovery of note either at scene, on in mail, or in pocket. First duty is to preserve the note and then make copies for record and analysis. Meanwhile send the note for hand writing confirmation to documentation division of Forensic Science.

1. Photography of Note
2. Safety of Note

3. Preservation in transparent plastic / envelope
4. Make copies of note for psychoanalysis

In hospital suicide note should be analyzed by a team constituting of Forensic Medicine Expert, Psychiatrist and clinical psychologist(optional). A simplified and modifiable format is given for convenience.

FORMAT FOR SUICIDE NOTE ANALYSIS

1. Number of notes written:

One _____More than one_____

2. Type of note : Short note (< 100 words)_____Long note (>100 words)_____
3. Time mentioned on the note:
   - Same day as suicide
   - Not the same day
   - Not mentioned
4. Place where note was found:
   - At home
   - Some other place
5. Person to whom note was addressed:
   - Not specified
   - Parents
   - Sibling
   - Friend
   - Children
   - Spouse
   - Any other
6. Whether specific instructions given like:
   - Disposal of possessions
   - Care of family
   - Financial arrangements
   - Repaying debts
   - Any other
7. Expressed affects:
   - None specified
   - Forgiveness
   - Love
   - Anger / grievance/blame
   - Low mood / hopelessness/Guilt
   - Relief / tiredness / weariness
   - Reunion
8. Difficulties mentioned:
   - Illness / pain
   - Job / financial difficulties
   - Academic problems
   - Interpersonal problems
   - Any other
9. Type of suicide note:
   - Thetical (Positive or implied, giving specific reasons)
   - Antithetical (Giving contradictory reasons)
   - Synthetical (Combination of two)
   - Athetical (Note which is lacking a point of view)
   - Amphithetical (Note which present the simultaneous co-existance of a point of view and opposite)
10. Type of Personality:
    - Logical (In physical pain)
    - Paleological (delusional and hallucinatory)
    - Thantological (Wanting suicide as mean for transition to another life for saving reputation)
    - Catalogical (Being lonely, hopeless fearful and pessimist)
11. Type of suicide note:
    - Escapist Note
    - Reactionary/Panicky Note
    - Vengeful (to punish others)
    - Manipulative (to make failure of some plan)
    - Psychotic (to fulfill delusionary call)
12. Type of suicide depending on social circumstances:
    - Anomic (Unable to adjust to social / economic condition)
    - Egoistic Suicide (Due to personal reasons)
    - Altruistic (Suicide due to social reasons)
    - Fatalistic (Suicide to escape from the situation like marital abuse, physical illness etc.)
13. Has handwriting of the note confirmed by some relative / sent for handwriting analysis?

Yes _____No _____

14. Opine whether the person (Who has committed suicide) could have been saved by proper psychological counseling or psychiatric help?

- Yes
- No

SUICIDE NOTE ANALYSIS- TRY TO FIND OUT ANSWERS FOR QUESTIONS [147]

Ques 1: What type of note is it?

Short: <100 words

Long: >100 words

Ques 2: What is the mood reflected in the note?

1. Depression alone
2. Depression with positive affect
3. Depression with hostility affect
4. Neutral affect
5. Hostility alone directed at self
6. Hostility alone-Directed at others
7. Hostility with positive affect
8. Positive affect alone
9. Combination of outward directed hostility with positive affect
10. Combination of inward directed hostility with positive affect

Ques 3. What are feeling expressed in suicide note

1. Sparing the feelings of other
2. Blaming ones self
3. Blaming others
4. Clear anger
5. Subtle anger
6. Low self esteem
7. Grief stricken
8. Feeling defeated/overwhelmed
9. Feeling hopeless/helpless
10. Unable to show feelings
11. Unworthy
12. Performance failure
13. Failed relationship
14. Feeling for self

Ques 4. Which type of personality is reflected in the suicide note?

1. Logical type: Being in physical pain
2. Paleological type: Delusional or hallucinatory
3. Thanatological type: Suicide as means of going to another world
4. Catalogical type: Hopeless, Fearful, Pessimistic

Ques 5: What are difficulties mentioned in the note?

1. Physical illness
2. Mental illness
3 Job/Financial difficulty
4. Academic pressure
5. Any other
6. No difficulty mentioned

Ques 6: Can you further specify the type of Suicide note is it:

1. Thetical: Notes asserting a thesis as declarative or testimonial
2. Antithetical: Notes that report or deny a stated or implied thesis
3. Synthetical: Notes that combine basic tenets of thesis antithesis
4. Athetical: Lacking "a point of view" and simply contain instructions or directions
5. Ambithetical: That present simultaneous existence of a point of view and opposite. Ther are close to psychological realities.

Ques 7: What is the pattern of suicide note:

1. Unbearable psychological pain-Person is in state of heightened disturbance (Perturbation)
2. Interpersonal relation-Appears to be related to unsatisfied or frustrated needs e.g achievement, affiliation, autonomy, dominance etc
3. Rejection-aggression: Appears that someone has created a situation in which death is desired partly in order to hurt or attack someone else
4. Inability to adjust: He points out that life is hard, bitter, futile and hopeless
5. Indirect expression- Person communicates ambivalence e.g., complication, contradictory feelings, attitude and trust
6. Identification-egression: There is evidence of egression with arm of termination with relief of pain he/she has been suffering
7. Ego: Person wishes to die, the suicide is accomplished due to relative weakness in the capacity for developing constructive tendencies
8. Cognitive constriction: Person appears to be intoxicated or dragged by one's overpowering emotion and constricted logic and perception

Ques 8: Describe suicide as:

Egoistic: Lack of integration of individual, taking his own life because of higher commandment

Anomic: Lack of regulation of individual by society

Altruistic:

Ques 9: What do you think that an earlier endeavour could have saved this person?

Yes

No

Ques 10: Express your opinion after going through the note:

Its a short note athetical type with catalogical personality, mood as depression, difficulty mentioned as mental illness and in my opinion an earlier endeavour could have saved this person

SECOND AUTOPSY [148-152]

At times, there are request for second postmortem examination. Although second autopsy is not very common but we do get cases off and on in forensic practice. This practice is in existence since ancient time, in one well known case in literature, Dr. William Palmar in 1856, court observed ***" It is hard to believe that such a serious exercise as a postmortem could be conducted so carelessly and unprofessionally"***[149] **.**

There are genuine apprehensions over the cursory autopsy work. The main reasons for request remain – perception of public , relatives, rampant corruption culture in the country, suspicious first postmortem, inadequate information, public out cry, false allegations, inconsistent findings, vague and ambiguous report, motivated representations, rumors, misinterpretation of findings by lay public. It is double edged weapon but it has demoralizing impact on first team as it is viewed as erosion on their credibility. As such in the law, there is no such provision about second autopsy of unburied body is carried out on administrative grounds, public complaint, apprehension, administrative jugglery, courts and police do make request for second- postmortem.

If we view this from public point of view then it is their right to get a reliable information about their love ones. In this regard NHRC of India formed a committee to frame guidelines on this issue. A Committee, headed by Dr. Justice K. Ramaswamy, set up by the Nation Human Rights Commission recommended (07-02-2001) [150] that the following rules be observed in respect of a second post-mortem:

a. This procedure, ordinarily, should not be undertaken unless either the Investigating Officer or the concerned authority or supervisory officer is of the view that the first post-mortem was wrongly done or done with a view to helping the accused to escape punishment.

b. The second post-mortem may also be ordered by the Sub-Divisional Magistrate/Additional District Magistrate of the area concerned, after looking into all the facts.

c. The second post-mortem should be conducted by a "Board" of two Forensic Medicine Specialists at a teaching institution where post-mortems are being conducted.

d. The post-mortem report of the first doctor should be made available to the Board before conducting the second post-mortem.

e. The doctor who conducts the first post-mortem should be informed about the same and be allowed to be present at the second post-mortem.

(iii) There is a need to strengthen the existing Forensic Science Laboratories by providing them with the requisite trained manpower for the examination of viscera, and by ensuring the availability of modern infra-structural facilities and equipment.

These are unavoidable so we should have a protocol for these.

In view of above, second autopsy should be carried after proper orders from concerned magistrate. These autopsies are conducted by a panel of doctors either from same hospital or different hospital under videotaping.

Ideally a list of all eligible experts should be available with administration for the above job. As a matter of convenience, magistrate usually writes to head of department to nominate the person as per availability of doctors on duty. In this regards, board constitution practices require more clear guidelines.

1. Availability of list of qualified experts with administration.
2. Choosing members of Board
3. Paper work before starting second autopsy
4. Deciding date and timings
5. Clear expectation from Board
6. Ensure following before starting case
   - PM report of first PM
   - Crime Scene evaluation report
   - Photographs or video available
   - Inquest papers of first PM
   - Ancillary facilities
   - FSL toxicology and biological facilities
   - Photography
   - Video-taping
   - Histopathology facilities
   - Back up biological material

Second Autopsy is a specialized job and people with experience should be involved by the department.

Audit Sheet

Before Autopsy

Check Points	Yes	No
Authority Letter		
First Postmortem Report		
Photographs of first PM		
Video if available		
Common meeting to brief of facts		
Plan discussion for second autopsy		
Special Investigation if any		
Viscera preserved report		

During and after Autopsy

Check Points	Yes	No
Preparation made		
Photography arranged		
Video-taping arranged		
Complete Photography and videotaping		
Complete external examination		
Complete internal examination		
Special examination of any system		
Histopathology, if required		
Toxicology, if required		
Answers to the query of IO		
Opinion		
Back up /Spare biological material for future use if required		

Common outcomes

1. Agreement over first and second autopsy
2. Disagreement in opinion of first and second autopsy
3. New findings in second autopsy
4. Interference by artefacts, decomposition , previous removal and dissection of viscera.

Common Observations

1. Incomplete Autopsy in form of
   a. non-dissection of internal viscera, only superficial incision is given
   b. Head is not opened
   c. Organ is missing due to previous preservation
   d. Dissection of affected is not done like neck dissection in asphyxia deaths, pelvic organs in abortion case etc.
2. **Incomplete workout of the case** – cursory autopsy, not using x-ray, HP
3. Cause of death misinterpreted or not detected

D. Disposal of viscera of other cases

E. Important findings missed

Classical mistakes in autopsy work as pointed out Mortiz [151] remain – unclear objective, incomplete autopsy, embalming before autopsy, decomposed body, misinterpretation of postmortem changes, poor evaluation of scene and photographs, premature conclusion and over enthusiastic novice.

In pediatric autopsies, Sturner WO[152] expressed 10 categories of potential and actual errors. He emphasized on scene investigation data, complete medical reports, all macroscopic findings, evaluation of microscopic slides, toxicology and other relevant clinical investigation reduce errors of both omission and commission.

DAILY INSPECTION REPORT OF MORTUARY

Every big postmortem centre (1000 PM/year) is expected to have minimum three/four postmortem tables. This requires a daily watch on cleaning and functioning of centre. A simplified way is given here to guide**.**

Mortuary Technician MO/ Mortuary Incharge

Any other problem of the day ……

DISPOSAL OF MORTUARY WASTE MATERIAL

Disposal of waste material is very important area in mortuary services as human bodies are brought in different conditions. In highly decomposed cases whole vicinity is vitiated due to strong smell emanating from human remains. There are different sources of waste in mortuary complex and these require cleaning on daily basis. A brief account of these wastes is discussed here. Close supervision and strict adherence to clean habits is very important in mortuary. Majority of the hospital are engaging contract services for cleaning and waste disposal.

Sources of waste in mortuary services

A. From dead bodies brought to the mortuary

B. From Health professionals working in the mortuary

C. From public visiting the mortuary to receive dead

D. From Police personnel

Follow international guideline for disposal of items as per universal guidelines

Container Colour	Items to be discarded	Final recommended disposal
Yellow Small	Discarded needles, blades, instruments.	Incineration
Yellow Large	Tissue waste, bone, specimen, HP waste after trimming	Incineration
Green	Organic waste	
Red	Infected and soiled linen, plaster, bandages, plastic, plastic gloves caps, shoe cover	Incineration
Blue	Surgical gowns	Recycle if cotton surgical gowns other send for disposal

Number of postmortem conducted	Postmortem certificate issued	Postmortem report issued	Pending reports	Observation/ remarks
Cleaning of Instrument	Table 1	Table 2	Table 3	
Person responsible for cleaning				
Mortuary Hall cleaning	Hall 1	Hall 2	Common area	Tissue Trimming
Person responsible for cleaning				
Premises cleaning	Office and Clinical forensic other and premises	Toilets	Office Tables	Doors
Person responsible				
Number of bodies in cold storage	MLC	Non MLC	Unclaimed	
Cold storage Temperatur e	Cold Storage 1	Cold Storage 2	Storage 3	A/C of Mortuary OT
Morgue Attendant on duty	8am to 2 pm	2 pm to 8 pm	8pm to 8am	General Duty
Name of MA				
Viscera preserved PM no				
Night Autopsy				

Other material

All material originating from human body are highly infectious material so precaution and prevention are in the best interest of staff

ACKNOWLEDGEMENT

In the preparation of these guidelines, we got valuable information from the following sources.

We acknowledge them with gratitude and appreciate their role in quality forensic services

1. Quality assurance review of the Victorian Institute of Forensic Medicine, Department of Forensic Medicine, Monash University.
2. Minimum Standards adopted by the Victorian Institute of Forensic Medicine, Department of Forensic Medicine, Monash University.
3. MRCPath Part II Examination, Autopsy Module, Guidelines for Examiners and Candidates. The Royal College of Pathologists, Great Britain.
4. Dayapala A, Murty O.P. Operational Guidelines for Postmortem Examination. Journal of Forensic medicine and Toxicology, 2006;26 (1):9-39
5. Infant Autopsy Protocol, New York State Department of Health, Bureau of Child and Adolescent Health, New York.
6. Clinical Practice Guidelines for Perinatal Mortality Audit, The Perinatal Society of Australia and New Zealand.
7. Murty OP, Bhootra BL. Auditing of Medico-legal Work-Part 1 and II Journal of Forensic Medicine and Toxicology 2003;20(2):1-14.
8. Guidelines on Management of Avian Influenza in PPUM, Pusat Perubatan Universiti Malaya, Kuala Lumpur. March 2006.
9. Forensic Pathology, Bernard Knight, 3rd edition London. Arnold 2003.
10. Franklin CA,editor. Modi's textbook of Medical Jurisprudence and Toxicology, 21st edn, N M Tripathi Pvt.Ltd , Mumbai,1988
11. Garry F Peterson, Steven C Clark. Forensic Autopsy Performance Standards. National Association of Medical Examiners, 2005.
12. The Royal College of pathologist , UK . Guidelines on autopsy practice. In: Report of Working group of The Royal College of Pathologists , 2002.
13. Postmortem Procedures. G.A. Gresham & A.F.Turner. London. Wolfe Medical Publications. 1979.
14. Pillay VV. Modern Medical Toxicology, 4th edn, Jaypee, New Delhi 2013.
15. Reddy KSN. In: The Essentials of Forensic Medicine and Toxicology, 31st edn,, Hyderabad, 2012.
16. Journal of Forensic Medicine and Toxicology ISSN 071-1929.
17. International of Medical Toxicology and Legal Medicine ISSN 0972-0448
18. Google Inc.
19. RNKarmarkar.In:Forensic Medicine and Toxicology,Academic Press, Kolkatta WB,2010.
20. Krishan Vij.In: Textbook of Forensic Medicine and Toxicology:Principles and Practice,4th ed. Elsevier,2008.

WORKSHOP ORGANIZING TEAM OPERATIONAL GUIDELINES FOR POSTMORTEM WORK IN INDIA

Chief Coordinator & Composer of this document

Dr. O.P. Murty, Additional Professor, Forensic Medicine and Toxicology, All India Institute of Medical Sciences, New Delhi-110029

Email: dropmurty@yahoo.co.in;

Phone: 0091 11- 26593274/9868397155

Group Leader

Dr. Anil Kohli, Reader, Forensic Medicine and Toxicology, University College of Medical Sciences, New Delhi-110095
Phone 0091 11 22592979

Reviewers

First Round – Prof SK Verma , Dr Sudipta Ranjan Singh , Dr. Karthik Krishna, Dr. Akhilesh Raj Jhamad, Dr. Asit Kumar Sikary, Dr. SK Sharma - held on 4th May, 2012

Second Round -Prof. SK Verma, Dr. Shahsank Pooniya, Dr. Thejawi H T, Dr. Vinod Ranga, Dr.Asit Kumar Sikary &Dr. SK Sharma.- held on 7th Nov.,2102.

Third Round - Prof SK Verma , Professor Hareesh Reddy , Prof KK Banerjee , Prof Tapas Kumar Bose , Dr. SK Sharma ,Dr. Tabin Millo, Dr. Mukta Rani, Dr.C Behera, Dr Seema Sutay, Dr.Yogendar Malik, Dr. Asit Kumar Sikary, Prof Partha Pratim Mukhopadhyay, Prof Mandar Karmarkar – **4-6th May, 2013**

Final Reviewers

Final review Committee – Dr.Anil Kohli, Prof SK Verma, Dr. Mukta Rani, Prof KK Banerjee **,** Dr SKSharma, Dr. Tabin Millo, Dr. Seema Sutay, Dr. Asit Kumar Sikary, Dr CB Jani, Dr. Andre Fernandes, Prof RS Bangal, Dr Anu Sasidharan

Thanks for Inputs and Contributions

Special thanks to Dr. Anil Kohli (Group Leader , contributor and Co-Chairman of Workshops), Dr. Mukta Rani(Group leader , reviewer and contributor), ProfSK Verma (Chief Reviewer and chairman of Workshops), Dr. Shalini Girdhar

(Contribution on Suicide Note Analysis), Dr. Asit Kumar Sikary (Contribution and editing), Dr.Asha Ram Gorchiya (Contribution on death certification), Prof P Mukhopadhyay (Contribution on snake bites), Prof KK Banerjerjee(Review and suggestions), Dr Seema Sutay (Review), Prof CB Jani (review and suggestions) and Ms Supriya Krishna (editing), Dr Anu Sasidharan (Review).

SOP is ready for field test

Dr. O.P.Murty

Chief Coordinator, composer and Organizing Secretary

Quality Forensic Services and Teaching

0091 11 26593274 / 0091 9868397155

dropmurty2008@gmail.com;
workshopsopmt2012aiims@gmail.com

Citation can be done as;

Murty OP, Kohli Anil, Millo T, , Rani Mukta, Verma SK, Asit K Sikary, Girdhar Shalini,Banerjee KK , Sharma SK, Sampath Kumar P. Uniform Guidelines for Postmortem Work in India: Faculty Development Workshop, *J For Med Tox2013*;30(1): 1-150.

RESOURCES

1. **Saukko P, Knight B**. In: Knight's Forensic Pathology. 3th ed. London: Arnold 2004; 1-4;,541; 617
2. **Gresham G.A.**, Turner A.F. In Post-Mortem Procedures.1st ed. London: Wolfe 1979; 16-121,139-144.
3. Guidelines on Management of Avian Influenza in Pusat Perubatan, Universiti Malaya, March 2006; 29
4. Recommendation No. R (99) 3 of the committee of Ministers to Member States of Council of Europe on the Harmonization of Medico-legal Autopsy Rules.*Forensic Science International. Vol.III Nos 1-3, July 2000.*
5. Quality Assurance Review. Victorian Institute of Forensic Medicine, Monash University. http;// www.vifm.org. (Courtesy Prof. S. Cordner.)
6. Minimum Standard, Victorian Institute of Forensic Medicine, Monash University.http://www.vifm.org. (Courtesy Prof. S. Cordner)
7. **Murty O.P., Bhootra B.L.** Auditing of Medico-Legal Work – Part 1& II. *Journal of Forensic Medicine and Toxicology* 2003;20:7-14.
8. Infant Autopsy Protocol, New York State Dept. of Health, Bureau of Child and Adolescent Health, New York. http//www. health. state, NY ,US.
9. Clinical Practice Guidelines for Perinatal Mortality Audit . The Perinatal Society of Australia and New Zealand. http//www.psanzpnms.org./doc.
10. MRCPath Part II Examination. Autopsy Module, Guidelines for Examiners and Candidates, The Royal College of Pathologist, Great Britain. http// www.rcpath.org / recourse /pdf
11. **Dayapala A, Murty OP**. Operational Guidelines for Postmortem. *J For Med Tox*,2006;26(1): 9-39.
12. **Vij K**. In: Textbook of Forensic Medicine and Toxicology Principles and Practice. 5th ed. Elsevier.2011; 302-304.
13. **Parikh CK.** In: Medico legal postmortems in India. Medical publications.1985:11-13
14. **Reddy KSN.** The Essentials of Forensic Medicine and Toxicology, 21st Edition, Hyderabad, India.2002;229-230;284;300-301;481-489.
15. Jurgen Ludwig.In: Handbook of Autopsy Practice. 3rd ed,2003. Humana Press. p30-31;26-28.
16. Jurgen Ludwig. In: Handbook of Autopsy Practice. 3rd ed2003. Humana Press. p26-28
17. **Michael T Sheaff, Deborah J Hopster**. Post Mortem Technique Handbook.2000: p100-104
18. **Bharati S, Lev M**. The anatomy and histology of conduction system. In: Chung EK (ed) : Artificial Cardiac Pacing : Practical Approach, 2nd ed. Baltimore, MD, William & Wilkins, 1984: p12.
19. **Lev M, Watne AL**. Method for routine histopathologic study of SA node. *Arch Pathol*. 1954; 57: 168.
20. **Wildran J, Lev M**. The dissection of human AV node, bundle and branches. *Circulation*. 1951; 4: 863.
21. Lev M, Bharati S. Age related changes in the cardiac conduction system. *Internal medicine for specialist*. 1981; 2: 19.
23. **Toger D Start, Simon S Cross**. Pathological investigation of deaths following surgery , anaesthesi, and medical procedures. Best Practice No 155. *J Clin Pathol*1990;52:640-652.
24. **MK Heat ley**. Dissection and reporting of he organs of the organs of the female genital tract. *J Cl Pathol* 2008;61:241-257.
25. **Michel Philip Burke, Ken Opeskin**. Audit in Forensic Pathology . *The Am J For Med Path* .2000;21(3):230-236.
26. Guidelines for Good Clinical Laboratory Practices (GCLP). *Indian Council of Medical Research* , New Delhi 2008.
27. **Dutta. A , Arora RC , Sarmah PC**. Analysis of Problems related to Forensic Examination in offences against Human body and Need for Auditing . *Indian Police Journal*2011; July –Sept, 2011; LVIII.No3 :4-37
28. **Murty O.P.** General Aspects of Forensic Medicine and Toxicology in Indian –setup : Working arrangement and Problems of Medico-Legal Work. *J For Med Tox2010*(2):1-28.
29. **Pillay VV**. In: Handbook of Forensic Medicine and Toxicology ,13rd edition, Paras Publications ,

Hyderabd . 2003: 93.

30. **Jayapalan VK**. Practical Manual of Forensic Medicine by Indian Academy of Forensic Medicine , 1984.
31. **VV Pillay**. Modern Medical Toxicology, 4th ed. Jaypee, New Delhi , 2013.
32. **DWK Cotton, SS Cross**. Hospital Autopsy , Jaypee, New Delhi.
33. *WHO. In: Sexual Violence Research Initiative by Janice Du Mont and D White, 2007:10.*
34. Guidelines to promote safe working conditions In. Managing Health and safety risks 'in New Zealand Mortuaries.
35. Bernard Knight .In: Time Since Death. Arnold
36. **Noffel H., Umran K**. Time since Death from PM Staining and other different methods In: Forensic Medicine for Medical Students :A clinical Approach, Syria,2008*:12-38.*
37. **Murty OP**. In : Manual for Rehabilitation of Torture survivors, 2010,SORCT , New Delhi:64-69.
38. **Leestma Jan E, Kirkpatrik Joel B**. In: Forensic Neuropthology, Raven Press:200-205;343-346.
39. Michel T, Shaeff, Deborah. In : Postmortem Technique Hand Book, 2nd Edn, Springer, 2009:365.
40. **Kinght LD , Presnell SE**. Death by sewer gas: case report of double fatality and review of literature. *Am J For Med Path*,2005;26(2):181-195.
41. **Kage S, Takekawa, Kursaki K, Imamura T**. The usefulness of thio-sulphate as an indicator of hydrogen sulphide poisoning.Br I Ind Med 1999;47(4):283-285.
42. **Murty OP.** Maid Abuse- case report and review. *J For Leg Med*.2009;16:290-296.
43. **Greenhill JP.** In: Obstetrics edn 1965, WB Saunders. Philadelphia and London:129-135;467-474.
44. **Karmarkar RN**. In:Forensic Medicine and Toxicology. 3rd edn.,2010,Academic Publishers, India:432-440;104-110.
45. **Franklin CA**. In: Modi's Textbook of Medical Jurisprudence and Toxicology, 21sr edn.,1988: 365-367;165-168;416-418.
46. **White, Julian.** Snake bite and spider bite: management guidelines South Australia, Aldelade, 2006:21-23.
47. **Pillay VV**. In: Modern Medical Toxicology,4th edn.,*Jaypee, India*,2013:138-150.
48. **Regan DB, Longmire AW**. Hydrogen Sulphide exposure as a cause of sudden occupational Death – Letter to editor. *Arch Pathol Lab Med*,2010;134:1105.
49. **Raghuvendra Kumar Vidua**. How safe are our elders in South Delhi ? . *J For Med Tox,* 2012;29(2): 113-116.
50. **Variend S.** Fetal , perinatal and infant autopsies . In: The Hospital Autopsy by DWK Cotton & SS Cross, Jaypee, 1994: 99-109;50-51.
51. **Mukhopadhyay Partha Pratim, Ghosh Sulekha, Ghosh Tapan Kumar**. Forensic diagnosis and classification of snakebite (neurotoxic and haemotoxic) from renal changes at autopsy: morphological and histological determinants using a semi-quantitative method. *Med Sci Law* 2010; 50(3): 140-44.
52. **Lalwani S, Agnihotr AK , Talareja AK, Murty O P.** Pattern of injuries in fatal cases of fall from height. *J For Med Toxicol* .1999;16(2);38-46.
53. **Agnihotri Ak , Lalwani S , Talareja A , Murty O P.** Fatal Firearms – 3 years review . *J Fo r Med Toxicol* . 1999;16(2):47-51.
54. **Murty O P**. Medicolegal aspects of transfusion reaction and status of blood programme in India. *Romamanian Journal of Legal Medicine* , 1998;6(2):163-170.
55. GA Sunil Kumar**,** Murty O P**,** Dogra TD. Study of Ligature marks in Asphyxial deaths of hanging and strangulation. *Int. J Med. Tox. and Legal Medicine 2002;* 4 (2) :21-24.
56. **Rautji Ravi, Rudra A , Behera C, Murty O P.** Snakes identification and medico-legal aspect, . *Int. J Med. Tox. and Legal Medicine*, 2003;6(1):1-6.
57. **Murty OP, Chung BSK, Yin LY, Loo TC , Nurul Imam P**. Pattern of injuries in fatal accidents of construction workers: A retrospective study of 10 years. The *Malaysian J For Path and Sciences*.2005 ;1(1): 44-57.
58. **Pramanik P, Sharma SK , Murty O P.** Effect of DNA sample collection , storage and transportation on DNA fingerprinting: An overview. *Int J Med Toxicol leg Med* . 2006;8(2): 7-10.
59. **Millo T, Murty OP.** Female victims of violent crimes and abuses: An over view of Indian Scenerio. *Int J Med Toxicol leg Med* . 2006;8(2): 18-24.
60. **Murty O P, Ming Chin Jia , Ezami Mohd Asyraf, Poh Kim Yan, The Chee Yong**. Physical Injuries in fatal and non-fatal child abuse cases : A review of 16 years with hands on experience of 2 years in Malaysia. *Int J Med Toxicol leg Med* . 2006;9(1):33- 43
61. **Murty OP, Agarwal A.** Sudden Cardiac deaths due to Myocardial Infarction and ethnicity: A Malaysian perspective. Int J Med Tox and Leg Med 2008 ; 10(2): 45-54.
62. **Murty OP, Agarwal A, Kanageshwari, Nuruzawani AR**. Nor Syuhada, Kamarul Ariffin. Sudden Death during sport activities: A Malaysian perspective. *J Ind Academy Forensic Medicine* 2007; 29(4):115-124.

63. **Murty O P,** Siti Nor binti Abdul Rahamn, Jasminah Begam, Binti Kader Mydin, Nor Hakimah binti Hussain, Sharul Rizan bin Ilias. Pattern of injuries in Drivers and other occupants of four wheel vehicles in fatal accidents- A Malaysian study. *J Forensic Med Toxicol*. 2006;23(2):33-43.

64. **Murty O P, Auin Izzati bt Arshad, Lim Teck Siang Nurhidyau bt Smail Kassim, Syed Iqbal Al- Idrus B, Syed Rosli**. Pattern of Injuries in fatal motorcuclist accidents and their correlation with drugs , alcohol and road safety measures. *Int J Med Toxicol leg Med* 2005;8(1): 22-28.

65. **Murty OP, Singh H N, Kalra R, Paul George , Dogra TD**.Electrocution accidents – Pathophysiology treatment with eight years review of fatalities in South Delhi area. *Journal of Forensic Medicine and Toxicology,1997;14(1):14-22.*

66. **Paul George, Murty OP**. Bride Burning and Burns **.** *Journal of Forensic Medicine and Toxicology, 1995;12(3&4):13-29.*

67. **Sharma SK, Murty O P.** Mysteries of Firearm injuries and scientific tricks of the experts , *CBI Bulletin* , 1993;7:20-29.

68. **Mukhopadhyay P P, Ghosh S, Ghosh T.K.** "Pattern of Renal Pathology in Fatal Envenomation by Indian Cobra (Naja naja)" *J Indian Acad Forensic Med* 2010; 32 (2): 132-33.

69. **Mukhopadhyay P.P., Ghosh S, Ghosh T.K Konar (Sanyal) K.** Pattern of renal pathology in fatal viper bite (Daboia russelli): a mortuary based study. *Journal of Forensic Medicine & Toxicology* 2010; 27(2): 40-43.

70. **Cotton DWK, Cross SS**. The hospital Autopsy. Jaypee Brothers, New Delhi, 1st Ed, 1993: 50-52.

71. **Snashall David C**. Injury an death in the construction industry. In: The Pathology of trauma edited by KK Mason, Edward Arnold, 1993: 269-276.

72. **Dankert, Mann, Northrop**. Hours of work, New York: Harper and Row;1965.

73. **Vanezes P, Busutill A**. editors. Suspicious Scene Investigation . 1996, Arnold:168-171.

74. **Reddy KSN.** In: The Essentials of Forensic Medicine and Toxicology, 31st edn,, Hyderabad, 2012:254-256.

75. American Association of Forensic Odontologist. Available at : www. AFOS.org

76. **Murty O P.** Forensic Photography. *Int J Med Tox Leg Med* , 2000;2(2):36-42

77. **Murty OP.** Opinion in Poisoning cases in Forensic Practice *, J Ind Acad of For M*ed ,202;24(3):91-97.

78. **Murty OP.** Dowry Crimes Scene Investigation. *Int. J Med. Tox. and Legal Medicine* 2002; 4 :2 -10.

79. **Murty OP.** Medico-Legal responsibilities of aging individuals. *In J of Geriatircs,* 2004

80. **Haslam DW, James WP.** Obesity. *Lancet*, 2005;366:1197-1209.

81. **Brush D Erick.** Marine Envenomations. In : Goldfrank Energency Toxicology : 1629

82. **Schmidt ME, Abdelzaki, Tu AT**. Nphrotoxic action of rattlesnake and sea snake venoms: An electron-microscopic study. *J Pathol* 1976;118:75-81.

83. **Jagannatha SR, Pradeep Kumar MV, Naveen Kumar T , Ananda K, Venkatesha VI**. Injuries due to fall from height: A retrospective study. *J For Med Tox* 2010;27(1):47-50.

84. **Kohli A , Banerjee KK.** Pattern of injuries in fatal falls from buildings. *Med Sci Law*2006;46(4):335-41.

85. **Baljit Singh, Nariender Singh, Rahat Kumar**. Sewer Gas Poisoning. *J for Med Tox Legal Med*, 2002;5(1):25-26.

86. **Chandrashekhar TN**. A study of incidence of suicide during different phases of menstrual cycle. *Int J Med Tox Leg Med* 2001;3(2):30-32.

87. Agnihotri AK, Chaudhary EH, Millo T, Murty OP. Sharp force fatalities: 3 years review. *Int J Med Tox Leg Med* 2001;3(2):18-21.

88. **Murty O P, Mohd Arif Bin Muhmad Rasat, Lim Lay Ang, Wu Chee San, Nurul H Hamzah Huhmad Rasat**. Retrospective study of natural causes of death in last 10 years at UMMC. *J For Med Tox.*2005; 22(2):8-28.

89. **Sarkar Shymal, Murty OP, Bhardwaj DN, Sharma RK, Dogra TD**. Sexual offenders and victims in south Delhi . *Mal J For Path Sc*i 2008;3 (1):1-44.

90. CEHAT available at . http://www.cehat.org Accessed on 23/4/2013

91. **Nadesan kashinath**. Carbon Monoxide Poisoning – suicidal inhalation of car exhaust fumes. *J For Med Tox* ,1995;15:53-56.

92. **Murty OP, Lau Hong Khai, Siti Rohana Mohd, Norhazlina Yahaya, Siti Sairah binti Zahir**. Demographic pattern of Carbon Monoxide Poisoning fatlities in Malaysia. *Mal J For Path Sci* 2010;5(3): 35-52.

93. **Patro BK, Behera C, Millo T, and Murty OP**. Management of human remains following disaster- A public health approach. *J Forensic Med Toxicol* 2007; 24(2):66-73.

94. **Murty O.P.**, et al. A ten year retrospective study on poisoning cases in two major cities of Malaysia and India. *The Journal of Indian Society of Toxicology*;2008;4(1):6-11.

95. **K S N Reddy, Murty O. P.** In: Nayayalya Chiktsa Vigyan ki Roop Rekha- A Textbook of Forensic Medicine and Toxicology , first edition- 2007 (Hindi Version) . K Sugna Devi Publication, Hyderabad, India

96. **Murty O.P.** Lightning fatality with blast, flame, heat and current effects: A macroscopic and microscopic view. *J For Leg Med.*2008:

97. **Murty O P.** Dramatic lightning injury with exit wound. *Journal of Forensic and Legal Medicine* .2007;14(4): 225-227.

98. **Kohli Anil , Aggarwal NK, Murty O P.** Role of Medical Ethics in torture cases with two illustrations. *J For Med Toxicol,1997;14(2):41-46.*

99. **Murty O P.** Medicolegal Investigation into medical negligence cases. *Journal of Karnataka Medicolegal Society*,1998;7(2):12-19.

100. **Murty OP, Rautji Ravi.** Investigation of bomb explosion. *J Ind Acd For Med.*2003; 4 :150-154.

101. **Asha Ram Gorchiya, Sikary Asit, Murty OP.** In: Faculty Development Workshop on Quality Forensic Services and Modular Teaching at AIIMS New Delhi, 4-6th, May,2013.

102. Physician's Manual on Medical Certification of Cause of Death. 5thEdition. Vital Statistics Division, Office of the Registrar General, India, Ministry of Home Affairs, New Delhi 2012.

103. **Chanana Ashok, Chaudhary Rajeev Kumar**. Exhumation. *J For Med Tox 2011;*28(2):6-9.

104. **Verma SK**. Hazards & Bio-safety in autopsy facilties. *J Ind Acd For Med.*2003; 16-21.

105. **Shahrom Aw, Siew SF, Noorazma S, Aznool HA**. Forensic Investigation of mutilated remains. *Mal J For Path Sci* 2007,2(2):66-76.

106. Jenifer Hughes, Johnson David. Marine Poisoning and envenomation, 2006.

107. **Weisman R**. Marine Envenomations. In:Goldfrank's Toxicologic emergencies,7th edn, 2002:1592-1598.

108. **Iscan MY, Mc Cabe BQ**. Animal effects on human remains. In: Seigel J A (Chief Ed): Encyclopedia of Forensic Sciences, Academic Press, London,2000 Vol 1: 198-206.

109. **Memchaubi Ph, Momon chand A**. Killed by a boar. *Int J Med Tox Leg Med*, 2002; 5(1):10.

110. **Momonchand A**. Deaths due to animal attack. *J For Med Tox* ,2005;22(2):31-33.

111. **Murty OP, Rozama Lal, Singh Deepak, Paul George.** Dog bites in Forensic Practice – A case report . *Journal of Forensic Medicine and Toxicology* , 1996;13(1&2):18-19.

112. **Murty O P, Millo T**. Camel Bite – a case report . *Journal of Forensic Medicine and Toxicology,* 1998;15(1):48-49.

113. **Peetinder Singh, Aggarwal AD,Agarwal KK,Oberoi, Bhullar DS, Walia DS**. Unidentified Human Cadavers:An unaddressed issue. *J For Med Tox*,2012; 299(2):107-110.

114. **Ravi N,Chandrasekhar TN**. Medico-Legal Importance of Placenta. *J For Med Tox* .2012;29(1):45-47.

115. **Chaudhary BL,Yadav Pradeep, Kumar Mukesh, Band Rahul M**. Medico-legal deaths in homeless population of central Delhi. *J For Med Tox* .2012;29(1):33-37.

116. **Dode CR. Mohanty AC**. Suicides in relation to menstruation. *Int J Med Tox Leg Med*. 1999;1(2):12-16.

117. **Karmarkar MD, Ghadge MR**. Autopsy in a case of Kidney transplant: A case report. *J For Med Tox* , 2004;21(2):31-33.

118. **Knight Bernard**. In: The post mortem Technician's Handbook: A manual of mortuary practice, Black Well Scientific Publications, Oxford1984:150-153.

119. **Noorama S, Shahrom AW, Suhani MN**. Identification of perpetrator by metric analysis of bite marks: A case report. *J For med Tox* .2006;23(2):29-32.

120. **Setia Puneet, Bansal YS, Singh Dalbir**. Triad of injuries produced due to blast effect: Acase report. J *For Med Tox* 2006;23(2):27-28.

121. **Steven G**. Mechanism of injury- Approach to evaluating patients with blast related Polytrauma. *J Am Osteopath Assoc* 2006;106(5):265-270.

122. College of American Pathologists. Practice Guidelines for examination of placenta, *Archives of Pathology and laboratory Medicine*1997;121.

123. College of American Pathologists. The examination of the placenta: Patient care and risk management. *Aechives of Pathology and Laboratory Medicine*,1991:115.

124. **Falconer B, Rajs J**. Postmortem findings of cardiac lesions in epileptics: a preliminary report. *J For Sci1* 976;8:63-71.

125. **Neild PJ D, Syndercombe Court, WR Keatinge**, et al. Cold-induced increase in erythrocyte count, plasma cholesterol and plasma fibrinogen of elderly people without a comparable rise in protein C or factor X. Clin Sci 1994;86:43-48.

126. **Clair M Lathers, Paul L Schraeder, Michael W Bungo, Jan E Leestma**. Editors: In: Sudden Death in Epilepsy: *Forensic and Clinical issues, CRC Press*, 2011:115-118.

127. UGC, India. The University Grants Commission vide its letter no F.1-16/2007 (CPP-II) dated June 17, 2009.

128. **Mishell DR**. Ectopic pregnancy etiology, pathology, diagnosis, management, fertility prognosis. In: Stenchever MA, Droegmueller W, Herbst AL, editors. Comprehensive Gynaecology,4th ed. St Loius (MO): Mosby;2001.

129. Centers for Disease Control and Prevention. Ectopic pregnancy surveillance, United States, 1970-1987. MMWR CDC Surveil Summ 1990; 39(SS-4):9-17.

130. **Tuomivara L, Kauppila A, Puolakka J**. Ectopic Pregnancy – An analysis of the etiology, diagnosis and treatment in 552 cases. *Archives of Gynecology and Obstetrics* . 1986; 237(3):135-147.

131. **Randall S**. Ectopic Pregnancy. *IPPF Med Bull*, 1986 Dec; 20(6):1-2.

132. **Hankins GD, Clark SL, Cunningham FG, Gilstrap LC**. Ectopic Pregnancy. In: Operative Obstetrics. Norwalk, Conn: Appleton &Lange, 1995:437-56.

133. **Frank WJ Anderson, Joanne G Hogan, Ansbacher Rudi**. Sudden Death: Ectopic Pregnancy Mortality .*Obstetric and Gynaecology*, 2004; 103(6):1218-1223.

134. **Dutta DC**. In: Text Book Of Obstetrics including Perinatology and Contraception. New Central Book Agency(P) Ltd , Kolkata , India, 1995: 196-198.

135. **Ackerman R, Deutsh S, Krumbloz B**. Levels of Human Chorionic Gonadotropin in Unruptured and Ruptured ectopic pregnancies. *Obstet Gynaecol,1982;60:13-14*

136. **Marshall JR, Hammond CB** et al . Plasma and urinary HCG during early pregnancy. *Obstet Gynaecol,* 1968; 32:760-764.

137. **Murty OP**. Ectopic Pregnancy- Double Missed: Nissed Diagnosis or Medical Negligence. *J For Med Tox* 2008;

138. **Myerburg RJ, Castellanos A**. Cardiac arrest and sudden cardiac death. In: Braunwald E, Ed: Heart Disease: A Textbook of Cardiovascular Medicine, 4th edition. Philadelphia, PA, WB Saunders Co; 1992:756-789.

139. **Maron BJ, Roberts WC, McAllister HA**, et al. Sudden death in young athletes. *Circulation* 1980;62:218-229.

140. American Heart Association. Statement on exercise: benefits and recommendations for physical activity programs for all Americans; a statement for health professionals by the committee on exercise and cardiac rehabilitation of the Council on Clinical Cardiology, American Heart Association (position statement). *Circulation* 1992; 86, 340-344.

141. **Fuller CM, MacNulty C, Spring DA, Arger KM, Bruce SS,Chrsoss B,Drummer EM**. Prospective Screening of 5615 High School atheletes for Sudden Cardiac Deaths. *Medicine & Science in Sports & Exercise* 1997;29:1131-1138.

142. **A. Thomas.** Non accidental injury in children. In: M. M. Stark (Ed), a physician' A guide to clinical forensic medicine. *New Jersey: Human Press*. 2000: 117-134.

143. **C. J. Hobbs, H. G. I. Hanks and J. M. Wynne**. (1999). Child abuse and neglect a clinician's handbook (2nd Ed.). UK: Churchill Livingstone.

144. **Cantwell H B, Rosenberg D A.** 1990 Child neglect. National Council of Juvenile and Family Court Judges, University of Nevada, Reno, Nevada.

145. Working Together 1991 Working together under the Children Act 1989. A guide to arrangements for interagency co-operation for the protection of children from abuse. HMSO, London.

146. **Shalini Girdhar**. In: Suicide Note Analysis - A MD thesis AIIMS, New Delhi, 2003.

147. **Shalini Girdhar, Mukta Rani**. Modular Teaching Workshop on Suicide Note Analysis, 4-6th May, 2013 at AIIMS, New Delhi.

148. **Murty OP**. Second Autopsy / opinion: An Indian Experience. Mal J For Path. 2006; 1(1):1-14.

149. Postmortem and inquest verdict on cook. Available at : URL:http//www. STAFSPASTTRACK.ORG.UK/ EXHIBIT.PALMER/INQUEST.

150. National Human Rights Commission, Delhi . Recommendation for second Autopsy Guidelines. 2001.

151. **Mortiz AR.** Classical Mistakes in Forensic Pathology. *Am J For Med Path,*1981;2(4):299-308.

152. **Sturner WO**. Common errors in Forensic Pathology. *Am J For Med Path,*1988;19(4):317-20.

153. **Davies MJ**. The Investigations of Sudden Cardiac Death. *Histopathology* 1999;34:93-98.

154. **Love S.** Review. Post-mortem sampling of the brain and other tissues in neurodegenerative disease. *Histopathology*2004;44:309-317.

155. **Black M, Graham DI**. Sudden Death in epilepsy. *Current Diagnostic Pathology* 2002;8:365-372

156. **Edson E, Hage – Hamsten M**. Beta Tryptase measurement in postmortem in anaphylactic deaths and in controls. *For Sc Int* 1998;93:135-142.

157. **PumpheryRSH, Robers ISD**. Autopsy findings following fatal anaphylactic reactions. *J Clin Path* 2000;53:273-276.

158. **Kumar, Abbas and Fausto**. In: Robbins and Cotran Pathologic Basis of Disease, 7th edn,2006.209-211.

159. **Abhishek Yadav, Anil Kohli, NK Aggarwal**. Study of correlation between intracranial hemorrhages and skull fractures. *J For Med Tox* 2008;25(2):42-45.

160. **Roger D Start, Simon S Cross**. Pathological investigation of deaths following surgery, anaesthesia and medical procedures. Best Practice No155.*J Clin Pathol* 1999;52:640-652.

161. **Henry C Lee, Timothy Palmbach, Marilyn T Miller**. In: Henry Lee's Crime Scene Handbook, Academic Press, 2001: 271.

162. **Chaudhari MK**. In: An Essential Guide to Pathology, Central Book Agency, Kolkata, 1998:84-85.

163. **Sugar NF, Fine DN, Eckert LO**. Physical Injury after sexual assault: Findings of a large case series. *Am J Obs & Gynae* 2004;190:71-76.

164. **Marilyn Sawyer Sommers.** Defining patterns of genital injury from sexual assault: A Review. *Trauma*

Violence and Abuse 2007;8 (3):270-280.

165. **Heger AH, McConnell, Ticson Lynne, Guera Lisa, Lister Julie, Zaragoza Toni**. Healing Patterns in Anogenital Injuries: A longitudinal study of inuries associated with sexual abuse, accidental injuries, or genital surgery in preadolescent child. *Paediatrics* 2003;112(4):829-837.
166. **RN Karmakar**. Editor: In : JB Mukherjee's Forensic Medicine and Toxicology, 3rd edition , Academic Press, Kolkata 2007:839-846.
167. WHO. Janice Du Mont, Deborah White. In: The uses and impacts of medico-legal evidence in sexual assault cases: A global review, 2007:10.
168. **McEndre B**. Clinical application of vaginal maturation index. Nurse Pract 1999 Sept;24(9):48,51-2,55-6.
169. **Meisels A**. The maturation value. Acta Cytol 1967;11(4):249.