

Dr. C. B. JANI

M.D. (Pathology)

M.D. (Forensic Medicine)

D.N.B. (Forensic Medicine)

JIAFM 2007 29 (1) ISSN: 0971-0973

Journal of Indian Academy of Forensic Medicine (JIAFM)

A Peer-reviewed Journal by

Dr. R.K. Gorea
Professor & Head, Department of Forensic Medicine
Govt. Medical College, Patiala, Punjab.

Dr. V.V. Pillay
Professor & Head, Department of Forensic Medicine
Amrita Institute of Medical Science, Cochin.

Dr. O.P. Jasuja,
Professor, Deptt. Of Forensic Sciences, Patiala University

Dr. A.K. Srivastava
Professor & Head, Department of Forensic Medicine
Subharti Medical College, Meerut, U.P.

Dr. B.R. Sharma
Reader, Department of Forensic Medicine
Govt. Medical College, Chandigarh

International Advisory Board

Dr. Patrick Besant-Mathews, USA
Dr. E.N. Michalodimitrakis, Greece
Prof. (Dr.) P. Sema Aka, Turkey
Mr. Nirman Arora, Belgium
Ms. Virginia Lynch, USA

Dr. Ahmet Sadi Cagdir
Prof. (Dr.) F.W. Rosing, Germany
Dr. Z.G. Standing Bear, USA
Prof. (Dr.) Calin Scripcau, Romania
Dr. Parikh C.K., USA

Advisory Board

Aggrawal B.B.L., New Delhi
Dogra T.D., New Delhi
Sharma G.K., New Delhi
Murty O.P., New Delhi
Verma S.K., New Delhi
Kumar Adarsh, New Delhi
Singh Dalbir, Chandigarh

Thind A.S. Faridkot
Aggarwal Akash, Ambala
Kumar Pradjeep, Manglore
Kaur Balbir, SrinagarGupta
Thakur S.D., Jammu
Kumar Shantha, Tamilnadu
Manju Nath K.H, Banglore

Das Sanjoy, Dehradoun
Chandraprakash, Haldwani
Ray Inderjit, Kolkota
Mahtoo Tuls, Ranchi
Gupta R.K., Kanpur
K. Ravindran, Pandicherry
Jani C.B., Anand

(Official Publication of Indian Academy of Forensic Medicine)



Editor-in-Chief

Dr. Mukesh Yadav
Professor & HOD
Dept. of Forensic Medicine & Toxicology,
Muzaffarnagar Medical College
Muzaffarnagar

Residence

No. D-67, Samrat Palace
Garh Road, Meerut, U.P.
Mobile No. 094114-80753
Email: drmukesh65@yahoo.co.in



Joint Editor

Dr. D.S. Bhullar
Registrar-cum-Chief Medical Officer (G)
Dept. of Forensic Medicine & Toxicology
G.G.S. Medical College, Faridkot, Punjab.

Residence

Khokhar House-767/A, Top Khana Road
Patiala (Punjab)-147001
Ph. No. 0175-2219249, 5546393
Mobile No. 098145-43131
Email: bhullar_ds@yahoo.com

Subscription Information

- Members of IAFM will receive the free of cost.
- Non Members and Institutions (Annual Subscription rates)
- Personal: In India, Rs. 1000/ (Rest of the world: US\$ 200/ or equivalent)
- Institutions: In India, Rs. 2000/ (Rest of the world: US\$ 400/ or equivalent)

Subscription orders and payments should be made in favour of

“Editor, Journal of IAFM, Payable at Meerut”

We Accept: Bank Cheque / Demand Drafts (Add Rs. 50/- for outstation Cheques)

The Journal is published quarterly.

The Scope of the Journal covers all aspects of Forensic Medicine and allied fields, research and applied.

Claims for missing issue:

A copy will be sent free to the member / subscriber provided the claim is made within 2 months of publication of the issue & self addressed envelop of the size 9" x 12" is sent to the Editor. who want the journals to be dispatched by Registered Post must affix Rs.100/ worth postage stamps).

JIAFM

A Quarterly Publication
Volume 29, Number 1, January to March 2007
Meerut



Editor-in-Chief
Dr. Mukesh Yadav

From Editor's Desk

I feel immense pleasure to present before you the first issue of JIAFM 2007. I assure you about the quality of research papers and quality of printing in future issues. Your valuable suggestions are always encouraging me and I heartily welcome for future suggestions. behalf of Executive Committee of IAFM for the years 2006-2008 I took resolution to further improve the quality and status of our Journal. We always learn from mistakes and try to improve upon these. I am thankful to the advertisers who have provided additional financial resources for improving the quality of this issue.

Journal, Indian Academy of Forensic Medicine

Volume 29, Number 1, January to March 2007

Contents

Page No.

- From Editor's Desk.....
 - Editorial: **Duty to Treat HIV/AIDS Patients**
- Papers:
1. **Post Intubation Trauma: A Prospective Autopsy Study** 1-6
Dr Mahabalesh Shetty, Dr Nagesh Kumar G. Rao
 2. **'Bolam Test'** 7-8
Dr. Prateek Rastogi, MD, PGDMLE
 3. **Awareness of Today's Interns about Ethics in Medical Practice** 9-11
Dr. Madhav G Rajee
 4. **Aluminium Phosphide Fatalities: A 24 years Experience** 12-16
Dr Dalbir Singh, Mrs Seema Tyagi, Dr. Yoginder Singh Bansal, Dr. S. P. Mandal, Dr. A S Thind
 5. **Revenge by the Bites** 17-20
Gorea R K, Jasuja O P, Aggarwal A D, Narula R
 6. **Dealing with Unclaimed Dead Bodies: An Issue of Ethics, Law and Human Rights** 21-24
Dr. Mukesh Yadav
 7. **Demographic Study of Fatal Cranio-Cerebral Road Traffic Injuries in North Bengal Region** 25-27 ✓
Dr.Saibal Gupta, Dr.Prabir Kumar Deb, Dr.Rumi Moitra, Dr.Dibyakar Chhetri
 8. **Role of Chemical Examination in Formation of Opinion as to Cause of Death Following Poisoning** 28-31
Dr.Sobhan Kr. Das
 9. **Determination of Age in living by closure of Cranial Sutures: A Radiological Study** 32-34
Lt. Col. (Dr.) V. B. Gaur, Dr. V. B. Sahai, Dr (Brig) Amarjit Singh, Dr Amit Kharat
 10. **Reconstruction of body injuries leads to unraveling mystery behind unidentified mutilated skeletonised human remains** 35-37
Dr. S. P. Garg
 11. **A Study of Crime Against Women: Role of Forensic Medicine** 38-41
Dr. T.K.K. Naidu, Dr. Mukesh Yadav
 12. **Handedness in Skeletal Remains** 42-43
Tanuj Kanchan, T. S. Mohan Kumar, G. Pradeep Kumar, K. Yoganarasimha

Copy Right: No part of this publication may be reprinted or republished without the prior permission of IAFM. Submission of all papers to the journal is understood to imply that it is not being considered for publication elsewhere. Submission of multi-authored paper implies that the consent of each author has been obtained. In this journal, every effort has been made not to publish any inaccurate or misleading information. However, the Editor, Joint Editor and Editorial Board accept no liability in consequences of such statements.

All requests for reprint or further information relating to any article may please be made with author and in case of multi-author, please communicate to the first author

Printed and published by: **Dr. Mukesh Yadav and Dr. D.S. Bhullar** on behalf of
Indian Academy of Forensic Medicine

Editorial

Duty to Treat HIV/AIDS Patients

A duty is cast upon a physician to uphold the dignity and honour of his profession. The prime object of the medical profession is to render service to humanity; reward or financial gain is a subordinate consideration. Whosoever chooses his profession, assumes the obligation to conduct himself in accordance with its ideals. Physician should merit the confidence of patients entrusted to their care, rendering to each a full measure of devotion. The honoured ideals of medical profession imply that the responsibilities of the physician extend not only to individuals but also to society.

Though a physician is not bound to treat each and every one asking his services except emergencies for the sake of humanity and the noble traditions of the profession, he should not only be ever ready to respond to the calls of the sick and injured, but should be mindful of the high character of his mission and the responsibility he incurs in the discharge of his professional duties. In his ministrations, he should never forget that the health and lives of those entrusted to his care depend on his skill and attention.

A physician advising a patient to seek service of another physician is acceptable; however, in case of emergency a physician must treat the patient. No physician shall arbitrarily refuse treatment to a patient. However, for good reason, when a patient is suffering from ailment, which is not within the range of experience of the treating physician, the physician may refuse treatment and refer the patient to another physician.

Patient suffering from HIV/AIDS could be treated by any ordinary physician in initial stages and later on can be referred to Government ART Centres for further treatment. The physician should neither exaggerate nor minimize the gravity of a patient's condition. He should assure himself that the patient, his relatives or his friends have such knowledge of the patient's condition as will serve the best interests of the patient and the family.

The physician should not neglect the patient once having undertaken a case, nor should he withdraw from the case that to after knowing his positive HIV status, without giving adequate notice to the patient and his family. No registered medical practitioner shall willfully commit an act of negligence that may deprive his patient or patients from necessary medical care. Physicians as good citizens, possessed of special training should be expected to disseminate advice on public health issues. Even when an epidemic occurs, a physician should not abandon his duty for fear of contacting the disease himself.

News appearing in news papers regarding refusal of treatment to HIV Positive patient that to by the Government Hospitals are disgraceful for whole medical fraternity of the India. Like "**Kolkata hospital denies admission to AIDS patient**", in **The Times of India, May 24, 2007**, "**HIV+ patient alleges harassment**" in **Hindustan Times, February 10, 2007**, and "**RML turns away HIV + child**", in the **Hindustan Times, dated April 12, 2007**, eleven year-old female patient (HIV positive), went to the Ram Manohar Lohia Hospital complaining of abdominal pain. She was diagnosed with appendicitis but not operated upon. Patient was denied treatment and her family alleges it was due to her HIV status. She is the latest to be turned away by doctors because of her status.

This patient and 30 other Naz residents are registered at the hospital's ART Clinic for constant care. "Despite registering with them, our in-house doctor had to treat her. After this incident we decided to move to AIMS because our children were not being given proper care at RML.

"We do not refuse treatment to anyone. I can't comment unless I speak to the doctor in question," defended by one of the hospital administrator of the Ram Manohar Lohia Hospital, Delhi.

It has been seven years since NACO received a report of a doctor infected with HIV while treating a patient. That is the only documented case of occupational exposure so far. Though instances of "workplace infections" and refusal of treatment to HIV-positive patients have been numerous, these cases largely remain unreported and no action can be taken.

If HIV patients are refused treatment, it is because doctors think they are putting themselves at risk by treating them. In many cases, hospital staff contract HIV while caring for infected patients due to lack of knowledge.

There is a **need to educate health care personnel** so that they do not refuse treatment to HIV patients. NACO will soon begin mandatory training for healthcare personnel in reducing risks while caring for HIV positive patients.

In private hospitals, accident forms are filled if employees are injured while working. If there are any accidental cuts during treatment of patient, the employees have to fill a Form. His blood sample is taken immediately to check for any infection. This will not only help in documenting the incident but also help in correlating the chances of HIV infection in this way.

Mukesh Yadav
Editor-In-Chief

Post Intubation Trauma: A Prospective Autopsy Study

*Dr Mahabalesh Shetty, **Dr Nagesh Kumar G. Rao

*Assistant Professor

**Professor

Department of Forensic Medicine and Toxicology, Kasturba Medical College, Mangalore-575001, India.

Tel:09448130574, Fax:0824-2428183, E-Mail: drmabs@yahoo.co.in

Abstract

Prolonged intubation of the trachea in the treatment of acute respiratory failure has become common in intensive care units during last two decades. Although intubation of the trachea confers great advantage, lesions of the larynx and the trachea may result and are severe on occasions. Hence, it is important that, our knowledge regarding the effects of intubation on the respiratory tract needs to be expanded with all available means of study. This at times can be a challenging issue in routine medicolegal work, as they are of potential nature for misinterpretation and needs caution in interpreting.

Key Words: Intubation Injuries, Artefactual Injuries, Tracheal Injuries. Laryngeal Injuries.

Introduction:

In recent years there has been an increased use of endotracheal intubation. Endotracheal intubation requires passage of a semirigid tube through the larynx, thus exposing this delicate structure to serious insult. Larynx is prone to injury at the time of insertion of the tube and remains vulnerable throughout the duration of intubation. Prolonged intubation of the trachea in the treatment of acute respiratory failure has become common in intensive care units during last two decades. The intubation of the trachea is often performed and is a safe procedure with a low complication rate. Although intubation of the trachea confers great advantage, lesions of the larynx and the trachea may result and are severe on occasions. Provided there are no anatomical difficulties, serious lesions occur rarely if the patient is well relaxed. Nevertheless, such lesions are not so uncommon that they can be disregarded. The hazards of intubation have been well documented since the birth of endotracheal anesthesia over a century ago. [1] One-fourth of all intubated and ventilated ICU patients require ventilator support for more than one week and 10% require it for more than two weeks. [2] The danger of intubation begins with the insertion of the laryngoscope, tube, and include broken teeth, mucosal abrasions, soft tissue swelling, ulcerations and lacerations of and larynx and trachea. Cricoarytenoid dislocation, esophageal perforation, tracheal rupture and retropharyngeal abscess formation have been well documented. [1, 3] Hence, it is important that, our knowledge regarding the effects of intubation on the respiratory tract needs to be expanded with all available means of study.

Although there are several reports in the clinical literature regarding intubation injury, references in the forensic literature are meager. [4] However, endotracheal intubation injuries are also considered

as iatrogenic artefactual injuries, which may mimic inflicted injuries caused by neck compression as in cases of manual strangulation. This at times can be a challenging issue in routine medicolegal work, as they are of potential nature for misinterpretation and needs caution in interpreting. [4]

An attempt has been made in the present autopsy study to observe the different changes of therapeutic endotracheal intubation in the victims of unnatural deaths intubated prior to death.

Materials and Methods:

Material for the study comprised of autopsy specimens of larynx and trachea collected from 65 cases of unnatural deaths (Table II), referred for medicolegal autopsy to the department of Forensic Medicine, Kasturba Medical College, Manipal, during the period extending from April 1, 2001 to February 28, 2002. Each of these cases was of medicolegal nature, brought to the casualty, Kasturba Hospital, Manipal in a state of critically ill condition and died while on treatment. Certain selection criteria were adopted for inclusion of a case in the study, and are listed below:

1. The deceased must have been intubated with endotracheal tube prior to death.
2. The endotracheal tube used must be a polyvinyl chloride (PVC), high volume, low-pressure and cuffed tube.
3. The intubation must have been performed either orally or nasally, by duty doctors and confirmed by details given in the case sheet of the deceased obtained from the hospital.

The cases in which there were obvious injuries to the neck, tracheostomy wound or alleged to have died of throttling, strangulation or hanging were excluded from the study. Period of intubation, description of the tube, route of intubation, resuscitation related injuries, clinical causes of death and police history were obtained from the Medical

Records Department of Kasturba Hospital, Manipal and inquest report and requisition forms by the police, respectively, constituted additional information.

Methodology:

Methodology constituted of routine 'I' incision followed by removal enblock of tongue, epiglottis, larynx and trachea by dissecting and mobilizing them down and severing the trachea at the level of carina. The specimen collected so was then opened along the midline posteriorly by blunt tip scissors with great care, preventing postmortem artefacts or damage. A detailed examination of the larynx, trachea and epiglottis were then performed by naked eye and magnifying lens (if necessary) and all the injuries were recorded, using the standard protocol (proforma) with line drawings. Each of the specimen were then fixed in 10% formalin for 24-48 hours and tissues were then collected from posterior larynx, anterior wall of the trachea and epiglottis from each case from the site presenting gross changes noticed at autopsy. They were then subjected to routine processing for histopathological examination with haematoxylin and eosin (H&E) staining in the Department of Pathology, KMC, Manipal and reported accordingly, and subjected for statistical analysis by SPSS package of Microsoft Windows.

Results and Observation:

A total number of 124 medicolegal autopsies were undertaken in the Department of Forensic Medicine, Kasturba Medical College, Manipal, between April 1, 2001 and February 28, 2002

Table-I presents breakdown analysis of different types of cases, which were brought to the Casualty of the hospital, requiring endotracheal intubation as an emergency measure. It is evident from the table-I, that 29 (44.61%) cases were of road traffic accident origin, followed by 17 (26.13%) cases of burns and 13 (20.00%) cases of poisoning in the order of frequency.

It is evident from Table-II that intubation was required in all cases with different age group with a higher incidence of 21 (32.20%) cases in the age group of 21-30 years, lower incidence of intubation was noticed in extremes of ages i.e. two (3.07%) cases in age group of <10 years and one (1.35%) case in age group of >81 years. Considering the sex incidence it is again evident from the Table-II that 42 were males and 23 were females with male female ratio of 5:3 in the present study.

It is obvious from Table-III that the 57 cases (87.70%) had oral intubation in present study as against 8 (12.30%) cases representing nasal intubation route, convinces the fact that oral intubation is the most common intubation route

opted in our hospital and is prone for laryngotracheal trauma.

Table-IV illustrates the distribution of cases depending on duration of survival after intubation in hours. According to the table-IV, minimum duration required for intubation trauma was 1 hour in two cases, while in another 2 cases the intubation time was 240 hrs (10 days) maximum. It is also evident that 32 (49.23%) cases in the present study succumbed within 24 hours i.e. 1 day of intubation. Considering all 65 cases mean intubation survival time in present study was calculated to be 54.04 hours i.e. 2-3 days.

The facts in Table-V, presents the anatomical distribution of gross changes noticed in epiglottis, larynx and trachea in the study populations. Each of these changes were confirmed by histopathological examination. Among the gross changes, ulcerations (Fig.1 & 5) were frequently observed in 22 (33.84%) cases with larynx being the common site 15 (23.08%) cases followed by trachea 5 (7.69%) cases and least in epiglottis 2 (3.07%) cases. Mucosal erosions/abrasions (Fig.2&6) and oedema/swelling (Fig.3&7) was noticed in 13 (20%) cases, each, though equal in number, trachea presented maximum changes 10 (15.38%) cases of erosions/abrasions, while edematous changes predominated in larynx 6 (9.23%), as against 4 and 3 (6.15% and 4.6%) cases in epiglottis and trachea respectively. Larynx also showed contusions (Fig. 4) in 4 (6.15%) cases as against 1 (1.53%) case in epiglottis and absence of contusion in trachea. Thus considering all gross changes of intubation trauma, it is evident from the Table-V that larynx is the most vulnerable structure to endotracheal tube, followed by trachea and epiglottis in order of frequency. Table-IV also highlights the mean duration of intubation in development of these changes. Accordingly contusions were the earliest change (24.4 hrs) followed by oedema and swelling (26.4 hrs) erosion/abrasion (55.6 hrs) and ulceration (79.6 hrs) changes. Thus it may be noticed here that as the duration of intubation increased more severe are the changes observed.

Type of intubation injuries observed microscopically in the present study varied from subepithelial haemorrhage, erosions, inflammation and ulcerations. As the histopathological examination was done obtaining tissue samples from epiglottis, larynx and trachea, distribution of different changes observed were also tabulated in the same order and presented in Table-VI. From the facts in Table-VI, it is obvious that on microscopy, ulcers (Fig.5) were the commonest post intubation trauma noticed in 20 (30.76%) cases out of 65 study samples. Majority of these were seen over the laryngeal mucosa in 12

(18.46%) cases. The next commonest microscopic change observed in the study was subepithelial haemorrhage among 14 (21.53%) cases, with higher frequency in larynx in 8 (12.30%) cases as against low frequency in 2 (3.07%) cases. Tracheal erosions (Fig.6) were though noticed in 13 (20%) cases in present study groups, majority of them were seen in the trachea in 10 (15.38%) cases as against 2 (3.07%) cases in larynx and 1 (1.53%) case in epiglottis. It is strikingly noticeable in the same table that only 13 (20%) out of 65 cases presented in combination of any two or more post intubation trauma changes, where in again larynx predominated this observation in 6 (9.23%) cases.

Discussion:

Endotracheal intubation is a routine mode of management protocol for treating ventilatory failure in patients without acute airway obstruction. The degree of trauma depends upon many factors. The size, shape, and stiffness of the tube are considered to be the potent factors as is the duration of intubation. The larger and stiffer the tube, longer the tissues are subjected to pressure, greater is the trauma. The position of the head and movement between tube and tissues are also the other potent factors. Further the pressure from the tongue and attachments at one end and the anterior tracheal wall at the other end tend to straighten the curved tube or bend it backwards with resultant pressure on laryngeal structures. Thus the pressure resulting from such hard tissue is no doubt greater than that offered by resilient cartilage.

From Table II it is evident that intubation was required in all cases with different age groups with higher incidence in 21 (32.20%) cases, in the age group of 21-30 years. Laryngotracheal lesions and age though revealed no correlation on statistical analysis, the observation made concurred with other studies. [1, 5, 6, 7] Tonkin et al reported a greater incidence of complication in females. According to him, this was due to the use of larger tubes in the females than one would use in adult males; because of the smaller larynx in females. In addition, it is a well known fact that the mucosa covering the cartilage is thinner in females. However in the present study, men outnumbered women (Table II) in the ratio of 5:3.

There is a difference of opinion among anesthesiologists as to whether nasotracheal or orotracheal tube is less likely to cause laryngotracheal damage. From Table III it is evident that 57 (87.70%) cases had oral intubation in the present study as against 8 (12.30%) cases representing nasal intubation route. This convinces the fact that oral intubation is the most commonly used route in our study and is held responsible for

the laryngotracheal trauma in the study subjects. Similar observations were also reported in the literature. [9,10] Markham and his colleagues reported that nasotracheal intubation is a useful technique in children especially in short-term management of many respiratory problems. However they also reported that nasotracheal intubation can lead to post intubation hoarseness, severe subglottic odema, subglottic web formation, subglottic cicatricial narrowing and subepiglottic stenosis.[11] According to Stauffer et al oral intubation tends to cause more fatal laryngeal injury than nasal intubation in their study. They also reported that posterior glottic ulcers were significantly more with oral intubation than nasal route. It is also reported by him that necrosis of nasal alae, nasal septa were common with nasotracheal intubation in comatose patients, promotes the preference to use orotracheal intubation route. [9] Since majority of the subjects in present study were road traffic accident victims (44.61%) (Table I), who were brought to the hospital in comatose condition, oral intubation route was preferred. According to Hedden et al, the oral tubes are much safer because it is less fixed and thus free to move within the passage.[12]

Of all the factors, the major factor leading to laryngotracheal trauma is the duration of intubation. Table- IV highlights the duration of intubation in the present study, which ranged from 1-240 hrs with mean intubation period of 54.04 hrs. Ulcerations were noticed grossly in 22 (32.84%) cases at autopsy with mean duration of 79.6 hrs (Table V), whereas microscopically it was noticed in 20 (30.76%) cases with mean duration of 81.39 hrs (Table VI). Thus it is evident from Table VI that severity of mucosal injury is directly proportional to the duration of intubation. This correlates with the reports by Harrison et al.[8] It is also obvious from the same table that the mean duration of intubation required for laryngotracheal inflammation/oedema and subepithelial hemorrhages are 27.4 hrs and 31.6 hrs (i.e. more than one day and less than 2 days) respectively. Although it is well known that longer the duration of intubation more marked the complication. From the present study, it appears that some changes are more frequently due to the introduction of the tube itself, rather than the duration and also that the changes are more readily produced within a shorter period of time, than was previously thought. The present study also indicates that the morphological alterations were marked in the first 24 hrs (Table V), thereafter the changes increased in severity upto 240 hrs (10 days) resulting in ulcers. Table V and VI presents the

anatomical distribution of gross and microscopical findings in epiglottis,

larynx and trachea. They include contusion, erosion, oedema and ulceration, with microscopical evidence of subepithelial hemorrhage, erosions, inflammation and ulcerations; observed individually or in combination. Similar observation were reported by many authors. [10, 13, 14]

All the gross and microscopical changes were seen maximum in larynx following trachea and epiglottis (Table VI) with higher preponderance for ulcerative lesions. Mucosal changes such as oedema, inflammation and subepithelial hemorrhage were seen in the medial aspect of the vocal process and bodies of arytenoids and inner posterolateral aspect of cricoid cartilage on either side of the midline in the larynx (Fig.1). Likewise the morphological changes of intubation trauma were seen in the anterior wall of trachea at the level of 3rd to 10th tracheal rings in some of the specimens, trauma was nearly or completely annular representing trauma due to the cuff. While in few specimens, intubation trauma changes were seen at the lower end of the trachea due to the trauma by the tube tip (Fig.3). Similar findings have been reported by Stein et al [7], Stauffer et al. [9] Gaynor et al [13]

Thus the morphological alterations in larynx and trachea in the present study included gross observation of congestion, oedema, haemorrhage, and ulceration and these gross changes were verified histologically and most of these changes were found as features of laryngotracheitis. Although ulcerations result from traumatic introduction of the tube itself, virtually significant ulcerative changes in present study were confined to larynx (Table VI). This accounts for the fact that characteristically the site for the most frequent, most severe, most serious trauma is in the posterior larynx.

Conclusion:

The present prospective study comprised of 65 medicolegal cases died with endotracheal intubation trauma, reported from Kasturba Hospital, admitted for treatment in critically ill stage, and autopsied in the Department of Forensic Medicine, KMC, Manipal, during study period extending from April 1, 2001 to February 28, 2002.

- Almost all patients who died after the use of artificial airway had laryngotracheal injury at autopsy.
- Ulceration of the postero-lateral surface of the larynx and anterior wall of the trachea was the striking feature.
- Endotracheal intubation can produce frequent and severe complications despite the use of

soft, flexible tube having high volume, low pressure cuffs.

- The mechanism of laryngo-tracheal injury following endotracheal intubation is complex and multifactorial.
- There was no correlation of the morphologic changes to age, sex, route of intubation and co-existing medical problems.
- The severity of the lesions increased sharply with the duration of intubation.
- Present study observations are though consistent with the literature available, further study is essential, as literature on endotracheal intubation are meager from Indian context.

Table-I: Breakdown analysis of present study group

Cases	Number	Percentage
Road traffic accident	29	44.61%
Burns	17	26.13%
Fall from height	2	3.10%
Electrocution	1	1.53%
Assault	1	1.53%
Wall collapsed	2	3.10%
Poisoning	13	20.00%
Total	65	100%

Table-III: Distribution of cases according to route of intubation

Route of Intubation	Number of Cases	Percentage
Oral	57	87.70
Nasal	8	12.30
Total	65	100

Table-II: Age and sex wise distribution of endotracheal intubation trauma in 65 cases of study sample.

Age (in years)	Sex		No.	%age
	Male	Female		
<10	1	1	2	3.07
11 – 20	3	3	6	9.23
21 – 30	13	7	21	32.30
31 – 40	11	3	14	21.50
41 – 50	4	1	8	12.30
51 – 60	6	4	9	13.84
61 – 70	2	3	2	3.07
71 – 80	2	-	2	3.07
>81	-	1	1	1.53
Total	42	23	65	100

Table-IV: Distribution of cases according to the duration of survival after intubation

Duration of Intubation (hrs)	No. of Cases	Total (n=65)	
<24 hrs (1 day)	1	2	32 (49.23 %)
	4	4	
	8	2	
	16	1	
	18	2	
	20	2	
	21	1	
	22	4	
	24	14	

24-48 hrs (2 days)	36	1	16 (24.61 %)
	40	2	
	42	1	
	46	5	
48-72 hrs (3 days)	48	7	2 (3.07 %)
	72	2	
72-96 hrs (4 days)	90	1	5 (7.69 %)
	92	1	
	96	3	
>96 hrs (>4 days)	120	2	8 (12.30 %)
	140	2	
	144	1	
	192	1	
	200	1	
	232	1	
10 days	240	2	2 (3.07 %)

Table-V: Distribution of gross autopsy changes of post intubation trauma in epiglottis, larynx and Trachea in the study subject (n=65)

Gross Changes	Contusion	Abrasion (Erosions)	Oedema	Ulceration	Combination	Total
Epiglottis	1 (1.53%)	1 (1.53%)	4 (6.15%)	2 (3.07%)	2 (3.07%)	10 (15.38%)
Larynx	4 (6.15%)	2 (3.07%)	6 (9.23%)	15 (23.07%)	6 (9.23%)	33 (50.76%)
Trachea	-	10 (15.38%)	3 (4.61%)	5 (7.69%)	4 (6.15%)	22 (33.84%)
Total	5 (7.69%)	13 (20%)	13 (20%)	22 (33.84%)	12 (18.46%)	65 (100%)
Mean duration of intubation	24.4	55.6	26.4	79.6	46.9	-

Table-VI: Distribution of microscopic (histopathological) changes in intubated subjects of present study (n=65).

Microscopic changes Site observed	Subepithelial haemorrhage	Erosion changes	Inflammation / Oedema	Ulceration changes	Combination of changes	Total (%)
Epiglottis	4 (6.15 %)	1 (1.53 %)	2 (3.07 %)	2 (3.07 %)	3 (4.61 %)	12 (18.46 %)
Larynx	8 (12.30 %)	2 (3.07 %)	2 (3.07 %)	12 (18.46 %)	6 (9.23 %)	30 (46.15 %)
Trachea	2 (3.07 %)	10 (15.38 %)	1 (1.53 %)	6 (9.23 %)	4 (6.15 %)	23 (35.38 %)
Total	14	13	5	20	13	65
Duration of intubation trauma	31.6	59.19	26.6	81.39	53.90	100%

Fig. 1) Shows ulceration in the Larynx in the arytenoids and cricoid area. Ulceration in anterior wall of Trachea.



Fig (2) mucosal erosions in Trachea.

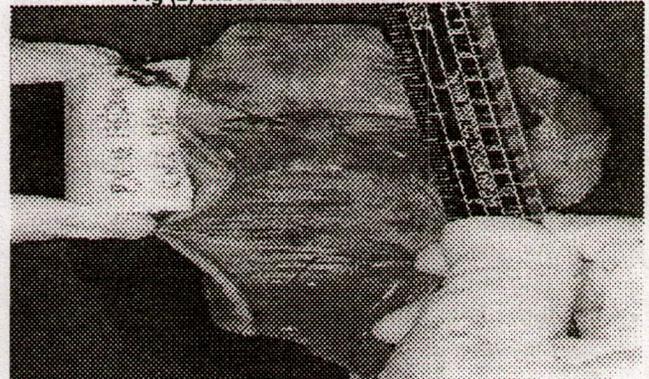


Fig. (3) Gross swelling of Epiglottis, Larynx and Trachea.

Ulcerations in Trachea

- (a) Due to cuff of the endotracheal tube,
- (b) Due to tip of endotracheal tube.

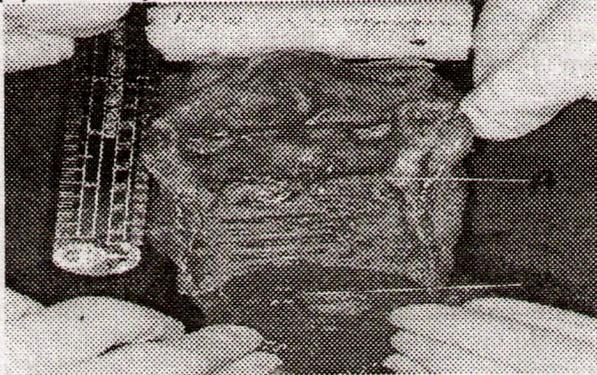


Fig (4) Shows contusion in larynx.

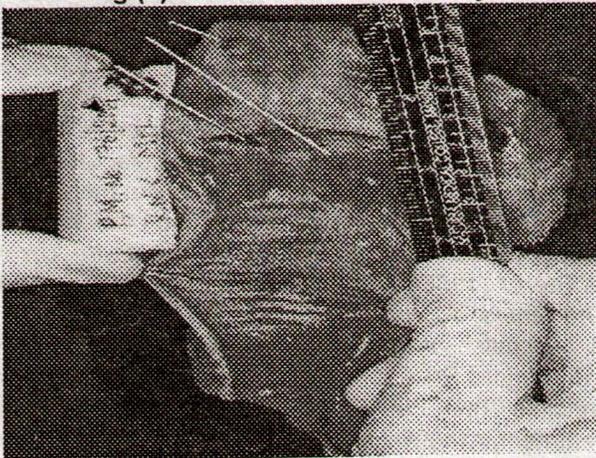


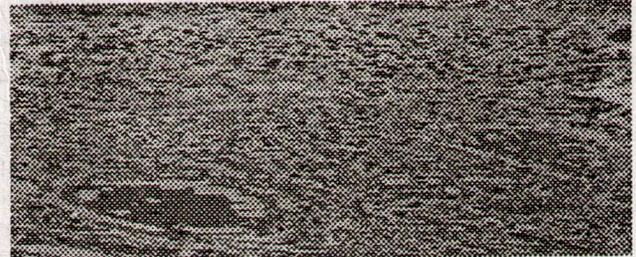
Fig (5) Tracheal section shows ulcer overlying granulation tissue. Regenerating epithelium is observed on either side if the Ulcer (H&EX200)



Fig (6) Section of trachea showing surface epithelial erosion. (H&EX200)



Fig (7) Larynx shows two congested vessels, interstitial oedema and Inflammation (H&EX200)



References:

1. Peppard S and Dickens J. Laryngeal injury following short-term intubation. *Ann Otol Rhinol Laryngol* 92: 327-330, 1983.
2. David Volpi et al. Risk factors for intubation injury of the larynx. *Ann Otol Rhinol Laryngol* 96: 684-686, 1987.
3. Frank R Lewis, Richard M Schlobohm and Arthur N Thomas. Prevention of complications from prolonged tracheal intubation. *Am J Surg* 135: 452, March 1978.
4. Raven KP et al. Artfactual injuries of the larynx produced by resuscitative intubation. *Am J Foren Med Pathol* 20(1): 31-36, 1999.
5. Lindholm CE. Prolonged endotracheal intubation. *Acta Anaesthesiol Scand* 33(suppl): 1-131, 1969.
6. McDonald IH and Stocks JG. Prolonged nasotracheal intubation. *Br J Anaesth* 37: 161-172, 1965.
7. Stein AA, Quebral, Boba Antonio and Landmesser. A post-mortem evaluation of laryngotracheal alterations associated with intubation. *Ann Surg* 151: 130-138, January 1960.
8. Harrison GA, Tonkin JP. Prolonged (therapeutic) endotracheal intubation. *Br J Anaesth* 40: 241-249, 1968.
9. Stauffer JL, Olsen DE, Petty TL. Complications and consequences of endotracheal intubation and tracheostomy. *Am J Med* 70: 65-76, 1981.
10. McGovern FH et al. The hazards of endotracheal intubation. *Ann Otol* 80: 556-565, 1971.
11. Bishop J Michael et al. Laryngeal effects of prolonged intubation. *Anaesth Analog* 63: 335-42, 1984.
12. Hidden M, Ersoz CJ, Donnelly WH et al. Laryngotracheal damages after prolonged use of orotracheal tubes in adults. *JAMA* 207(4): 703, 1969.
13. Gaynor EB, Greenberg SB. Untoward sequelae of prolonged intubation. *Laryngoscope* 95: 1461-62, 1985.
14. Hilding AC and Duluth Minn. Laryngo-tracheal damage during intra-tracheal anaesthesia. *Ann Otol* 80: 565-581, 1971.

‘Bolam Test’

Dr. Prateek Rastogi, MD, PGDMLE

Assistant Professor, Department of Forensic Medicine, Kasturba Medical College, Mangalore - 575001, Karnataka, India.

Abstract

The issue of medical negligence is always debated in any medical or legal forum. There are multiple criteria to term a medical professional as negligent and one amongst them is Bolam test. In present paper the applicability of this test is discussed.

Key Words: Medical Negligence, Bolam Test, Prudent Patient Test.

The Bolam Test:

The judgment given by Mr. Justice Mc Nair in **Bolam vs. Frien hospital management committee (1957)** is a landmark decision in deciding cases of medical negligence and is known as the “**Bolam test**”. It says, “The test is the standard of the ordinary skilled man exercising and professing to have that special skill. A man need not possess the highest expert skill, it is well established law that it is sufficient if he exercises the ordinary skill of an ordinary competent man exercising that particular art (a health care professional), is not guilty of negligence if he has acted in accordance with a practice accepted as proper by a responsible body of medical man skilled in the particular act”. [1]

Negligence in law means failure to do, which a reasonable man in the circumstances would do, or doing something, which a reasonable man in the circumstances would not do. [2] Actions of doctors are to be judged by actions of other doctors skilled in that particular art under similar circumstances and at a material time. The famous quote “**Ship surgeon’s duty to be judged on fair play and not by Harley street standards**” suggests that the actions of a doctor in primary health centre cannot be compared to one in a tertiary care hospital i.e. a proper sense of proportion requires us to have regard to the conditions in which hospital and doctors have to work. [3, 4] Also as said by Lord Denning in **Roe vs. ministry of health (1954) 2 All E.R.131** “**We must not look at 1947 event with 1954 spectacles**” as in both these cases the facilities and knowledge are not comparable. [1, 3] Moreover, skills and degree of care shown by a MBBS doctor cannot be compared with that of a specialist. So for comparison two doctors possessing similar qualifications, acting under similar circumstances and at same period of time should be considered.

In Bolam’s case, it was also held that a doctor does not merit criticism if, when dealing with a mentally ill person and having a strong belief that his only hope of cure is a particular treatment, he does not disclose to the patient the dangers which he believes to be minimal. [1, 3] In such cases he cannot be held

negligent, as even if both the situations were explained to him he would not have been in position to decide upon (provided no legal guardian is available). Thus, if a doctor is acting in best interests of the patient then due consideration should be given to his actions before terming him negligent. In present scenario the scope of test is widened to covers even normal patients.

Another issue is that, when there are two or more bodies of opinion regarding a mode of treatment then what a doctor should do? In such cases a doctor is not held liable if he acts in accordance with a practice accepted as proper by a responsible body of medical man skilled in a particular form of treatment in question, merely because there is a body of competent professional opinion which might adopt a different technique as said in **Urray vs. Bierer (1955) The Times, 16 March, on appeal The Times, 15 July**. [4]

In a Scottish case **Hunter vs. Henley (1955) SLT 213** the lord President stated the reason behind this principle that “in the realm of diagnosis and treatment, there is ample scope for genuine difference of opinions”. [3] In **Vancouver general hospital vs. McDaniel 1934 WN 171** an infant suffering from diphtheria was kept on same floor as small pox patients and was attended by same nurse. With the result, she contracted small pox. Courts held that as it was a usual practice to keep patients in same wards so hospital and doctors cannot be held negligent. [3]

Thus if a medical man charged with negligence has followed a practice or a method followed by a section of medical man but disapproved by another section of medical man, then he cannot be charged negligent, simply because some mishap occurred. Decided cases show that judicial notice is taken of the fact that genuine differences of opinion and different practices and methods exist in the medical world. But a doctor cannot adopt any practice just because he thinks it to be better; he should act in accordance with a widely accepted method. It is negligence to continue an outdated and rejected practice. Thus, a doctor should always keep himself

update about new technique and opinions. At the same time a doctor is not negligent if he failed to read a particular article but a series of warnings in medical press would perhaps be negligence. [5]

Discussion

Bolam test says that to term the act of doctor as negligent we should consider the act of another doctor in the similar circumstances and facilities as existed with the treating doctor. Also the professional knowledge and skill of the treating doctor should be compared with another doctor having same educational background. Courts in a multiple number of cases have very well settled these issues worldwide.

The second part of test has given rise to certain discussions. What does the "responsible body" means and what all are the issues, which this body can decide? The issue of accepting a prevalent practice of medicine or a practice approved by "responsible body" appears to be simple while thinking and choosing between two or more lines of treatment. The issue complicates when the decision has to be made about discretionary powers of individual patients. Some experts says that if the acceptable practice is not to disclose every risk to patients then "Bolam Test " can be applied and few facts hidden.

With advancement of patient's rights concept and with increasing effect of human right activists on society, it is now argued that all facts are to be disclosed to patients in relation to his treatment,

however insignificant they may appear. This was held in **Roger vs Whitaker (1993)** where failure to disclose a 1 in 14,000 risk of damage to patient's eye was held negligent. The court held that a prudent patient in the position of actual patient would have wanted to know the risk, given all circumstances of the patient in question. [1] This concept is known as "Prudent Patient Test".

Many courts in Australia and few other countries have retained Bolam test for diagnosis and treatment decisions and have abandoned it for disclosure issues where it has been replaced by a more reasonable and patient oriented prudent patient test. However this change does not scrape the concept of 'Threapeutic Privilege', which allows medical professionals to withhold information, which is potentially harmful to the patient.

References:

1. Laurie GT. Civil Litigation following injury and death from trauma: The health care professional in jeopardy. In: Mason JK, Purdue BN. The Pathology of Trauma. 3rd ed. London: Arnold, 2000:488-503.
2. Reddy KSN. Medical Law and Ethics. In: The Essentials of Forensic Medicine and Toxicology. 24th ed. Hyderabad: K. Suguna Devi, 2005:19-46.
3. Mehta HS. Medical Negligence and Civil Liability. In: Textbook of Medical Law and Ethics in India. 1st ed. Bombay: The Bombay Samachar Pvt. Ltd, 1963:170-212.
4. Addison PH. Laws relating to Medical Practice. In: Mant AK. Taylor's Principles and Practice of Medical Jurisprudence. 13th Ed. New Delhi: 2000:39-64.
5. Vij K. Medical Negligence. In: Text Book of Forensic Medicine and Toxicology. 1st Ed. New Delhi: B I Churchill Livingstone Pvt Ltd, 2001: 700-721.

Awareness of Today's Interns about Ethics in Medical Practice

Dr. Madhav G Raje,
 MD (Forensic Medicine), Dip. Family Medicine
 Professor, Forensic Medicine, NKP Salve Institute of Medical Sciences, Nagpur.
 171, Kartik Apartment, Nelco Society, Subhash Nagar, Nagpur.
 Ph. No. 9822947102 / 0712-5667452.

Abstract

Growing awareness of public, snarling C.P.A., skyrocketing competition, changing personal & public life scenario, have all transformed or set to transform rules of medical practice. Practice of Ethics in medicine could be a "value addition". **Aims:** To study the awareness of today's Interns about medical ethics. **Study design:** Cross sectional. **Participants:** Interns of four Medical Colleges of Nagpur. **Analysis:** Simple percentage. **Results:** All Interns passed the test. (i) AIDS & Ethics: All Interns revealed positive reaction towards Emergency treatment of AIDS' patients. (ii) Issue of certificate & Ethics: 65% interns aware. (iii) Treating complications & Ethics: 67.5% aware. (iv) Diagnosis & ethics: 92% aware. (v) Awareness & Ethics: 90.5% aware. **Conclusion:** Awareness of Interns seems theoretical, but adequate. Practical issues like: to issue certificate & to treat complications through the perspective of ethics reveal less awareness & knowledge. So practical issues need to be addressed considering the perspective of ethics in medicine while teaching.

Key Words: Awareness, Intern, Ethics, Medical Practice, Medical College.

Introduction:

"When you sow bountifully; you reap bountifully.

When you sow sparingly; you reap sparingly".

If Ethics is incorporated in Intern's training, then more medical professionals will surely practice ethics. [1] Practice of ethics has become an integral part & need of health care services in today's high-tech world. [2] Not only because of C.P.A., greater awareness of public about duties of doctors, but also because of greater competition among medical professionals, over national & international scenario. Inclusion of medical ethics will only be a 'value addition' in health care services. [3]

This is a new concept; that ethics be added; to draw 'silver lining' in medical practice. Many doctors in past were/ are not very sensitive to the concept of ethics. [3] But doctors & students of newer generation have realized the importance of inclusion of ethics in education as well as in practice.

Numbers of medical graduates in India who have undergone formal training in Ethics are very few. [4] So; need of spread of awareness about ethics is huge. So to assess (& spread) awareness of interns about ethics, this study is undertaken. Mere awareness about ethics may not be enough to be tested. So in this study finer details regarding ethics were also tested through MCQ.

Objective: To study awareness of Today's Interns about medical ethics.

Material & Method:

This was a cross sectional study carried out in the city of Nagpur in the month of Feb. 2006. Four medical colleges of the city were visited. Interns from three MBBS degree & one BHMS degree

Homeopathy Medical College were examined. Informed; Oral Consent was obtained. Ethical Committee of one Medical College has reviewed the study design, questionnaire.

Total numbers of interns tested were 248. Questionnaire; MCQ type was given to Interns to solve. Approximately one minute was allotted for each question. All Interns available were seated in one hall of respective college, & were tested in their respective colleges. Interns were asked to tick correct option. Discipline was strictly maintained. Questionnaires were immediately taken back after having been solved.

Questions were grouped under four areas; as per shown in Table No. 1.

Table No. 1

Areas of Information: Title	Concerns
AIDS & Ethics	Reaction of Interns towards dying patients of AIDS.
Issue of Certificate & Ethics	Ethical Decision. Adding values to medical practice.
Treating Complications & Ethics.	To pursue ethical behavior When confronted by treatment complications. Problem solving ethical behavior; under conditions of crisis was assessed.
Diagnosis & ethics	After having diagnosed critical illness what should be ethical behavior of doctor; if to reveal or not to reveal.
Awareness & ethics	How many Interns are aware that they are scanned under the lenses of ethics & moral values in life; by patients at large.

Results:

None of the Interns scored less than 50% marks in the test. Meaning; all Interns had passed the test. Interns were adequately aware about medical ethics. However, finer details when scrutinized revealed a different picture. This discrepancy or higher % of passing the test could be because of MCQ pattern of test. MCQ facilitates the students to pass the test even if they lack adequate knowledge to practice or to treat patients safely. [8]

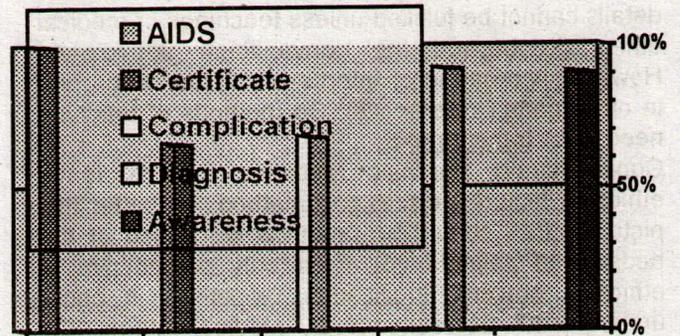
All Interns showed awareness & positive response to treat dying patient of AIDS before referring appropriately. 174 out of 248 Interns gave desired or appropriate answer to question of issuing death certificate appropriately & ethically. It comes to approximately 70% of ethically correct answers. 146 out of 248 Interns are not willing to issue 'false certificates'. It is approx. 60% of Interns are willing to exercise ethics in practice, in respect of issue of true or false certificate. 185 out of 248 knew about how to handle a situation 'ethically' if they meet complication while treating a patient. That comes to almost 75% of Interns knew ethical behavior in the face of treatment complications. 147 out of 248 knew how to brave complications but ethically; encountered while treating. That's 60 % ; so in this case almost 15% interns could not meet the ethical criteria of handling complication. Reasons not explored. Speculations could be anything, may be; lack of practical knowledge & exposure, lack of exposure to 'ethics' objective structured clinical examination, (ethics OSCE) (6). 233 out of 248 answered correctly ethically; when asked about ethical action in view of routine diagnosis. That's 94% were correct. However; when confronted with slightly serious & non-routine diagnosis & ethical action, 222 out of 248 succeeded; that's 90% were ethically correct. 209 out of 248 were aware of ethical issues; that comes to 85 % awareness. In another question, 238 out of 248 answered correctly in the area of awareness, revealing 94 % awareness!

Table No. 2 n= 248.

Ethics and ---	Ethically correct %	No. of interns' correct answers in	
		Q 1.	Q2.
AIDS -	100 %	248	
Certificate -	65 %	174	146
Treating Complications	67.5 %	185	147
Diagnosis -	92 %	233	222
Awareness -	90.5 %	209	238

(Table showing percentage-wise correct answers)

Table No. 3.
Bar Diagram depicting percentage of areas of information.



Discussion:

"Catch them young", was the concept behind this venture. In order to inculcate awareness of medical ethics & values among medical professionals; none other than Interns could have been better opted for. Ethical Awareness of all Interns regarding treatment of dying patients of AIDS was found to be 100 %. It reflects that Interns are no more afraid of treating patients of AIDS, secondly; it also reflects that ethically & compassionately (Empathically) Interns are very responsible doctors. [9]

If to issue certificate or not can be a great dilemma in front of young doctor like Interns. However average 65 % Interns were clear in their thoughts; that they will follow ethical rules when it comes to issue a certificate. Even then in order achieve 100% ethical behavior; it's imperative to focus teachings on issues to be dealt with; in day-to-day life, like if to write a 'false' certificate. [7] 67 % Interns were aware of ethical action if confront complications while treating patients. This is quite in contrast to house officers in surgery wards of hospitals in Karachi; Pakistan. [1] Ethical awareness in view of complications is found extremely poor not only among doctors of Karachi, but more or less similar at other places too. 92 % Interns knew how to act ethically when it is a matter of patient education or mere disclosing information regarding their illness. This shows that general awareness of Nagpur's Interns is quite high, may be because of plenty of educational activities; which keep occurring in & around the city. 90 % Interns are aware

about ethics in medical practice. This is in contrast to that of studies in Northwestern University, Illinois, USA. This is because medical ethics is a part of curriculum at UG level in India. But of course; this study depicts better picture of mere awareness of ethics among Interns.

Conclusion:

Awareness of Interns seems adequate theoretically in this region; but practical need of knowing finer details cannot be fulfilled unless teachings of medical ethics go beyond the conventional boundaries. However knowledge of Interns is not found so good in other parts,(references). So methods of teaching need to be transformed.

Conventionally Forensic Medicine Experts teach ethics by lecture - discussion method. To better this picture ethics should be taught & discussed at the bedside of patients. [5] Then only perspective of ethics & practical implications of ethics is better understood & accredited [6] by medical Interns. [7]

References:

1. Medical Ethics in surgical wards. Shiraz B.; Shamim M S; Ahmed A. Indian J. Med. Ethics 2005 Jul- Sept.; 2(3); 94-6.
2. Developing an ethics curriculum for an internal medicine residency program. Wayne W B; Muir J C; Da Rosa D A. Teach Learn med. 2004 spring; 16(2) 197-201.
3. Attitude of medical students to medical ethics in their curriculum. Olukoya A. A; Med.Edu.1983 mar; 17(2): 83-6.
4. Opinion survey of physicians on ethical issues in medical research. Sriram T G ; Chattergy S; Jain S; et al, J Indian Med. Assoc 1991 Jul 89 (7); 187-90.
5. Ethics Education for Medical House Officers. Sulmasy D P; Marx E S. J Med. Ethics 1997 Oct. 23(5) 328.
6. The Ethics Objective structured clinical examination (Ethics OSCE). Singer P A; Cohen R; et al. J Gen Internal Med. 1994Dec; 9(12) 709-10.
7. Medical Ethics Teaching in Canadian physical medicine & Rehabilitation residency program. Blackmer JANN. R Coll.Physician Surg.Can.2002 Dec.; 35(8 Suppl) 574-8.
8. <http://home.abssurgery.org/xfer/ABSTestGuide.pdf> -- 2006.
9. www.bram.org/internship.html -- Interns are entrusted for clinical responsibility.

Aluminium Phosphide Fatalities: A 24 years Experience

*Dr Dalbir Singh, ***Mrs Seema Tyagi, **Dr. Yoginder Singh Bansal, **Dr. S. P. Mandal, ****Dr. A S Thind

*Professor

**Assistant Professor

***Medical Technologist

****Secretary, Punjab Medical Council, Chandigarh

Corresponding author:

Dr Dalbir Singh

Department of Forensic Medicine, PGIMER, Chandigarh

Fax: (91-0172) 2744401, 2745078

Tel. No. (91-0172) 2700181, 2706041

E-mail: drdalbirsingh@hotmail.com;

drdalbirsingh@rediffmail.com

Abstract

A 24 years autopsy study (1982-2006) of acute poisoning deaths owing to aluminium phosphide from a tertiary care hospital of Northern India (Postgraduate Institute of Medical Education and Research, Chandigarh) revealed that mortality due to acute poisoning constituted 12.6% of the total unnatural fatalities and out of which 51.3% were because of this fumigant insecticide. The first victim reported in 1982 and its proportion, which was 20% in years 1982 to 86, increased to 73% between the years 1994- 98 and then decreased to 49% of the total acute poisoning fatalities in 2002-06. Peak incidence was observed in the age group of 21-25 years (31%) and least in the age group of beyond 65 years (3%). The proportion of suicidal deaths increased from 20% to 54% between these periods. Sales workers / businessmen (15%), office workers (10.7%) followed by student (10.4%), among the males and domestic workers (23%), students (10.4%) in females were the main victims of suicidal poisoning. 53% male victims were married whereas 59.4% female victims were unmarried. 52.4% were from the urban areas.

Key Words: Aluminium Phosphide, Fatalities, Poisoning, Profile, Autopsy.

Introduction:

Morbidity and mortality due to acute poisoning is a vogue since millennia. Last few decades, owing to tremendous advances in the fields of agriculture, medical pharmacology and industrial technologies there is a remarkable change in the profile of acute poisoning, where new poisonous substances have come to the forefront. In the developed world, household chemical agents and prescribed drugs have been the most common poisoning agents, whereas in the developing countries, agro-chemicals, in spite of their invaluable contribution in increasing the food production and pest control, are the most common offenders. [1-21] The WHO figures suggest an alarming mortality rate due to the toxicity of these compounds in developing countries owing to their easy availability, widespread use and absence of adequate/ appropriate protective equipment, leading to occupational exposures. [22]

Though the reports from different toxicological laboratories from India have shown change in the profile in acute poisoning particularly with the aluminium phosphide, no nationwide study has been carried out so far. The present study based on 24 years autopsy experience of poisoning cases is an attempt to quantify the problem of aluminium phosphide poisoning in Chandigarh zone of India with following objectives:

1. To analyze the incidence of aluminium phosphide poisoning as observed in a tertiary care hospital of Northern India.
2. To study the various factors influencing its incidence.
3. To provide a base line data to policy makers to equip the health care institutions of the area(s) accordingly.

Material and Methods:

Present study is the retrospective analysis of autopsy records of 1103 (742 males, 361 females) poisoning fatalities that occurred at Postgraduate Institute of Medical Education and Research, (PGIMER), Chandigarh from 25th October 1982 (i.e. the day on which first mortality due to aluminium phosphide poisoning was reported) to 24th October 2006. PGIMER, Chandigarh provides tertiary health care to the people of more than half a dozen states of north India but the subjects in the present study belonged only to Chandigarh zone of India consisting of states of Punjab, Haryana, Himachal Pradesh and Union territory (U.T) of Chandigarh. During the study period this zone did not witness any significant natural or man made calamity or any other factor, which could have influenced the profile of the acute poisoning. Information regarding age, gender, demographics, socioeconomic status, and type and manner of poisoning consumed was recorded from the

postmortem and hospital records, which also had further confirmation regarding manner of poisoning derived from the reports of the victim's relatives, friends and the police. Type of poison consumed was also verified from the chemical examiner's reports, for which various specimens from these subjects were sent for analysis. For the purpose of analysis, study period (1982 to 2006) was divided into 6 blocks of four years each i.e. 1982-86, 1986-90, 1990-94, 1994-1998, 1998-2002 and 2002-2006 and similarly the subjects were divided into eleven age groups: <13, 14-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-65 and >65 years. X^2 test was used for analysis.

Results:

Trends and Zonal Distribution:

Mortality because of acute poisoning constituted 12.6% of total unnatural deaths and out of which 51.34% were because of aluminium phosphide poisoning. Since the first death of a female from urban area of the state of Haryana was reported, mortality due to this insecticide increased many fold i.e. 5 cases in 1982-86 to 40 cases in 1986 to 90 and was 181 cases in last four years of the study constituting, 51.34% of total acute poisoning deaths during these years (Fig. 1).

A geographic distribution of the aluminium phosphide mortality was as follows: 253 cases (43%) from the state of Haryana, 239 cases (40%) from the state of Punjab, 76 cases (13%) from U.T of Chandigarh and 27 cases (4%) from the state of Himachal Pradesh. The number of aluminium phosphide mortality which was 60% in the state of Punjab and 40% in the state of Haryana in 1982 to 86 and 15% in U.T of Chandigarh in 1986 to 90 decreased to 28%, 31% and 10% respectively in 2002 to 06. Whereas in the state of Himachal Pradesh it increased from 2.5% in 1986-90 to 9% in the corresponding period (Fig. 2).

Age and Gender:

Mean age of fatal and aluminium phosphide poisoning cases was 23.1 years (range 1.2 years to 79 years). Peak incidence was observed in the age group of 21-25 years (186 cases, 31%) followed by the age group of 14-20 years (151 cases, 25.4%) and least in the age group of beyond 65 years (8 cases, 3%). Out of total 595 victims, 356 (60%) subjects were between the ages of 14-30 years. The male female ratio was 1.7:1. This male preponderance was seen in all the age groups except in the age group of 51-55 years. In the age groups of 21-25 years and 31-35 years, this preponderance was more pronounced (2.2:1). Peak incidence of female deaths was in the age groups of

14-20 years (66 cases, 30%) and least in the age group >56 years (Fig-3).

Marital Status and Mode of poisoning

Out of 185 male & 114 female suicidal and 148 male & 77 female accidental deaths, majority i.e. 99 males & 77 females and 83 males & 43 females respectively were unmarried. Whereas in the subjects in which mode of death was undetermined, majority (23 males & 15 females) were married.

Occupation:

Sales workers / businessmen (45 cases, 15%), office workers (32 cases, 10.7%) followed by student (31 cases, 10.4%), among the males and domestic workers (69 cases, 23%), students (31 cases, 10.4%) in females were the main victims of suicidal poisoning. Where as in accidental poisoning deaths; among males, agriculture workers (23 cases, 10.2%) and Office workers (23 cases, 10.2%) followed by students and unemployed (19 cases each, 8.4%) and in females, domestic workers (34 cases, 15.5%) followed by students (25 cases, 11.1%) were the main victims (fig-4). All the Agriculture workers, skilled industry workers, sales executive/businessmen were the males whereas in domestic workers and students female preponderance was more pronounced.

Areas of Residence:

The proportion of aluminium phosphide poisoning mortality was slightly more (52.4%) from the urban areas. In the initial year's i.e. 1982 to 86 to 90; 60% & 65% victims respectively were from the rural areas, but this trend changed and in the years between 1990 to 1994 to 98 more victims were from urban areas i.e. 59.2% and 57.1% respectively. This trend again reversed and 52% victims of aluminium phosphide poisoning were from the rural areas in the last four years of this study (Fig-5).

Changing pattern in proportion and mode of aluminium phosphide poisoning:

Suicides by ingestion of aluminium phosphide (40%) were the most common followed by accidental (35%) and Homicidal (1%) poisoning. In 12% instances, mode of poisoning was undetermined. The proportion of suicidal deaths increased from 20% in 1982 to 86 to 54% in 2002 to 06. Whereas in the incidence of accidental deaths there was a slight decline i.e. 40% to 38% during the same period (fig-6).

The proportion of mortality because this fumigant insecticide was 20% of the total acute poisoning fatality in the initial years i.e. 1982 to 86 of this study. Other common poisons during this period were organophosphates/ carbamate (46%), corrosives (12%), alcohol (6%), zinc phosphide (6%),

barbiturates (3%) etc. Proportion of aluminium phosphide poisoning then increased to 73% in the years 1994- 98. Since then its incidence is showing the decreasing trend and was 49% of the total acute poisoning deaths in the last block year of 2002-06 of this study.

Discussion:

The extent of poisoning morbidity and mortality in a society reflects the socio-economic as well as the mental state of that society. One of the reasons for higher proportion of poisoning deaths in the present study due to this easily available fumigant insecticide with no antidote most probably was that the exact mechanism by which phosphine in a aluminium phosphide poisoning setting acts is not clear. Nakakita [23] et al. reported the inhibition of mitochondrial oxygen uptake in isolated rat liver and the inhibition of ADP uncoupler and ion stimulated respiration but exact target site was not identified. Later on Chefurka et al [24] reported that it acted to be a strong inhibitor of mitochondrial respiration in active state (state-3) then in resting state (state-4) in mouse liver, housefly flight muscles and beef hearts. It was found to inhibit uncoupled site and ion pumping state affecting pyruvate, malate, succinate, glycerophosphate and ascorbic cytochrome substrates. The effect was maximum on liver mitochondria while on beef heart was of intermediate nature. This inhibition could not be reversed by uncouplers suggesting that it is due to direct effect on electron transport which is an important electrochemical link between respiration and phosphorylation in mitochondria. In a recent study by Singh et al. [25] a significant inhibition of platelet cytochrome-C- oxidase has been reported. However exact mechanism of action of phosphine still to be distinctly defined and till then it is presumed that this fumigant will remain in the existing proportion.

The observations of present study that aluminium phosphide poisoning is a nearly endemic proportion are in accordance with various reports from several parts of India [1-13] and other parts of the Asian continent. [14-18] Besides its notorious existence in cow belt of India aluminium phosphide is also emerging as a major intentional poison in countries like Iran [17] and Jordan [18]. Whereas in Sri Lanka, [14] Taiwan, [15] Japan [15] and Zimbabwe, [16] organophosphorus compounds were reported to be one of the major causes of unnatural deaths including the suicidal.

More fatalities due to aluminium phosphide poisoning among the males between the ages of 14-30 years in the present series and also as reported by others, [1-21] may be because of the macro social changes, the society in this part of the country is undergoing due to

significant advancement in the various technologies during these years. It is an age where a person is mostly working, more active/mobile and faces the challenges of life more vigorously. This makes him more susceptible to anxiety, depression and cognitive impairments, which precipitate modes of behavior leading to suicides/homicides or accidents. [1-4] above this age perhaps, it was the midlife crises, which took its toll. In the fast paced modern society men are often trying to driven to prove themselves, when they approach the middle age, some of them are not able to withstand the stress both inside and outside their home and are forced to commit suicide by ingesting this easily available and effective fumicide. In their home, the children are approaching the adolescence, not meeting to their expectations and are often seen as a problem. Where as outside they face stiff competition and carrier problems. It has been reported that social changes even positive produce alteration in social setup, lack of social regulation, social isolation and stress resulting in increase not only in the rate of what Durkheim called "egoistic suicide" but also in anomic suicide. [26-28] Increase in female deaths as observed in present study could be attributed to the changing social status of the women. More and more women in this part of the country are now coming out of the safe territory of their homes for education & employment and thus exposing themselves like males to related causes and circumstances leading to intentional deaths [1-4]. Cross-cultural studies [26-30] have revealed that the suicidal deaths rate in a society was significantly related to the women employment rates. Increasing incidence of deaths due to aluminium phosphide poisoning in females was most probably due to the increasing frustration among women and their maladjustment to the present socio-economic conditions of the society. [1] The pattern of increase in number of intentional deaths as seen the present study indicates that possibly it was the early-married life, which was stressful for females. In the present Indian society, it is widely known that her in-laws for various reasons often subject the newly married women to harassment, sometimes pushing the helpless woman to take the extreme step to commit suicide (? dowry death). However downward trends in such deaths were reported in last few years the study especially in accidental and most probably was due more awareness regarding its handling and packaging.

More fatalities due to aluminium phosphide poisoning from the States of Haryana and Himachal Pradesh can attributed to changes brought more rapid pace of developmental work in these two

states after their trifurcation carved out from erstwhile combined state of Punjab [1] and was in agreement with the various reports from other developing countries that suicidal risk increase with the improvement of the quality of life in a given society. [29] Increasing number of sales worker / businessmen, office workers deaths most probably reflect the increasing stress because of competition/career problems. It however, needs further in depth study. It has also been reported that in India, occasional crop failures despite the use of high-tech agriculture, often resulted in dejected farmers committing intentional deaths ironically by using the same pesticides, which they purchased for better crop yield. [1, 31] In western countries, however, hanging followed by firearms and pharmacological agents were reported to be the common methods employed for accomplished suicides. [19-20]

Conclusion:

Until the exact mechanism of action of phosphine in a aluminium phosphide poisoning setting is established and an effective antidote is not found, active involvement of the manufacturing and agricultural industries in safe and unbreakable packages dispensing; also in educating the people regarding its handling and strict vigilance by international agencies v.i.z: world Health Organisation etc. may help in reducing the proportion of the fatalities due to this fumicide.

Acknowledgement:

Authors are thankful to late Prof. I. J. Dewan, Professor Emeritus Anatomy for his encouragement, valuable suggestions and help at various stages in the preparation of this manuscript and Mr. Ravinder Sharma, personal assistant for secretarial help.

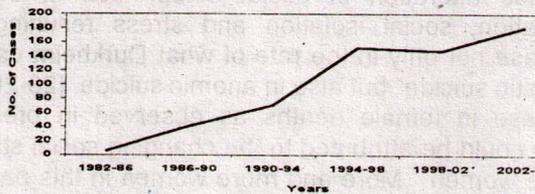


Fig. 1 : Temporal Distribution of ALP Mortality

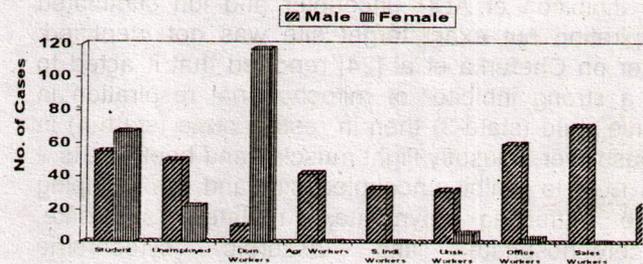


Fig. 4 : Correlation of Aluminium Phosphide Mortality & Occu

The category others includes transport workers, retired government servants, profession category Sales workers, also include the business executives. S. Indl. Workers = Skilled I workers, Unsk workers = Unskilled workers, Dom. Workers = Domestic workers, Agr. Wor Agriculture workers.

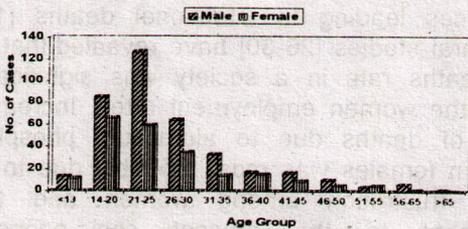


Fig. 3 : Age & Gender wise Distribution in Aluminium Phosphide mortality

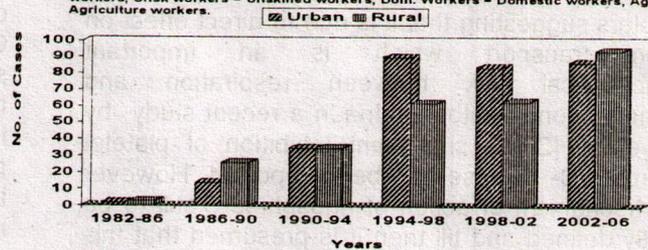


Fig.5 : Urban-Rural Distribution of Aluminium Phosphide Fatalities

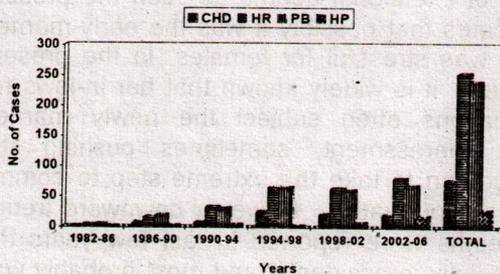


Fig. 2 : State Distribution of Aluminium Phosphide Deaths

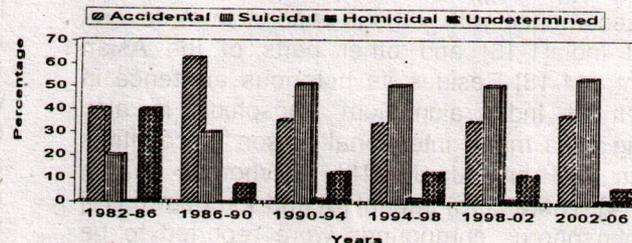


Fig. 6 : Changing Trend in Mode of Aluminium Phosphide Mo

Table 1: Marital Status and Mode of Poisoning

Mode of Poisoning	MALE			FEMALE		
	Unmarried	Married	Total	Unmarried	Married	Total
Accidental	83 (51%)	65 (44%)	148	43 (55.8%)	34 (44.2%)	77
Homicidal	2 (50%)	2 (50%)	4	1 (25%)	3 (75%)	4
Suicidal	99 (53.5%)	86 (46.5%)	185	77 (67.5%)	37 (32.5%)	114
Undetermined	16 (41%)	23 (59%)	39	9 (37.5%)	15 (62.5%)	24
Total	176 (47%)	200 (53%)	376	130 (59.4%)	89 (40.6%)	219

References:

- Singh D, Jit I, Tyagi S. Changing trends in acute poisoning in Chandigarh Zone: a 25-year autopsy experience from a tertiary care hospital in north India. *American Journal of Forensic Med. Pathol.* 1999 Jun; 20(2): 203-210.
- Singh D, Dewan I J, Vasishta R K, Tyagi S. Aluminium phosphide poisoning-autopsy and Histopathological findings. *J Forensic Med Toxicol.* 1995;12(2):16-20.
- Singh S, Singh D, Wig N, Jit I, Sharma B K. Aluminium phosphide Ingestion – a clinico-pathologic study. *Clin Toxicol.* 1996; 34(6):703-706.
- Singh S, Balakrishnan, Singh S, Vinod Malhotra V, Parathion poisoning in Punjab. A clinical and electrocardiography study of 20 cases. *Journal of Association of Physicians of India* 1969; 17: 181-18710.
- Siwach SB, Gupta. The profile of acute poisoning in Haryana – Rohtak Study. *J. Assoc. of Physicians of India.* 1995; 13: 756-59.
- Gupta PK. Pesticide exposure – Indian Scene. *Toxicology*, 2001; May 20; 198(1-3): 83-90.
- Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world. *Q.J. Med.* 2000; 93: 715-731.
- Aggarwal SB. A clinical biochemical, neurobehavioural and sociopsychological study of 191 patients admitted to hospital a result of acute organophosphorous poisoning. *Environ. Research* 1993; 62: 63-70.
- Adlakha A, Philip PJ, Dhar KL. Organophosphorous and carbamate poisoning in Punjab. *J. Assoc. Physicians of India* 1988; 36: 210-12.
- Thomas M, Anandan S, Kuruvilla PJ, Singh PR, David S. Profile of hospital admissions following acute poisoning – experiences from a major teaching hospital in South India. *Adverse drug React. Toxicol. Rev.* 2000; 19: 343-17.
- Mohanty MK, Kumar V, Bastia BK, Arun M. An analysis of poisoning deaths in Manipal, India. *Vet. Hum. Toxicol.* 2004; 46: 208-09.
- Lall SB, Peshin SS, Seth SD. Acute poisoning – a ten years retrospective study. *Ann. Natl. Acad. Med. Sci. (India)* 1994; 30: 35-44
- Sagar M S, Sharma R K, Dogra T D. Analysis of changing patterns of unnatural fatalities in south Delhi (Comparative study of 1977-1980 and 1988-1991). *J Forensic Med Toxicol.* 1993; X (2): 21-25.
- Hattiarachij, Kodithuwankku CS. Pattern of poisoning in rural Sri Lanka. *Int.J Epidemiol* 1989;18:418-422.
- Satoh T, Hosokawa M. Organophosphorus and their impact on global environment. *Neurotoxicology* 2000;1 (1-2):223-227.
- Kasilo OM, Nhachi CF. A pattern of acute poisoning in children in urban Zimbabwe: ten years experience. *Hum Exp Toxicol.* 1992; 11(5): 335-40.
- Shadnia S, Rahimi M, Pajoumand A, Rasouli MH, Abdullahi M. Successful treatment of acute aluminium phosphide poisoning: possible benefit of coconut oil. *Hum. Exp. Toxicol.* 2005; 24: 215-8.
- Abder-Rahman HA, Battah AH, Ibraheem YM, Shomaf MS, Elbatainch N. Aluminium phosphide fatalities; new local experience. *Med Sci Law* 2000; 40:164-8.
- Fuller GH, Rea AJ, Payne JF et al. Parasuicides in central London 1984-1988. *J R Soc Med* 1989; 82: 653-656.
- Lawson AH, Mitchell I. Patient with acute poisoning in general medical unit (1960-71). *BMJ.* 1972; 4: 153-156.
- Ynne H, Bateman DN, Hassanyeh F et al. Age and self poisoning: the epidemiology in New Castle upon tyne in the 1980s. *Hum Toxicol.* 1987;6:511-515.
- World Health Organization. *World Report on Poisoning prevention.* Geneva. WHO. 2004: 3-4.
- Nakakita H, Katsumata Y, Ozawa T. The effect of phosphine on the respiration of rat liver mitochondria. *J. Biochem.* 1971; 68: 589-593.
- Chefurkaw, Kashi KP, Bond EJ. The effect of phosphine on electron transport in mitochondria. *Pesticide Biochem Physio.* 1976; 6: 65-84.
- Singh S, Bhalla A, Verma SK, Kaur A, Gill KD. Cytochrome-c oxidase inhibition in 26 aluminium phosphide patients. *Clin Toxicol (Phila).* 2006; 44:155-58.
- Yang, B., Lester, D. (1995). Suicidal behavior and unemployment. In S.S. Canetto & D. Lester (Eds.), *Women and suicidal behavior*, Ch. 7 (pp. 97–108). New York: Springer Publishing Company.
- Pope, W. (1982). *Durkheim's suicide: A classic analyzed.* Chicago: University of Chicago.
- Durkheim, E. (1951). *Suicide: A study in sociology.* Glencoe, IL: Free Press.
- Targosz D, Sancewicz-Pach K, Szkolnicka B, Mitrus M, Klys M. Frequency and pattern of poisoning in adults and adolescent Krakow population in 2003 and 1983. *Przegl Lek.* 2005; 62 (8): 446-52.
- Tartaro C, Lester D. An application of Durkheim's theory of suicide to prison suicide rates in United States. *Death Stud.* 2005; 29 (5): 413-22.
- Ramakrishana S. AP farmer's suicide exposes peril of pesticides. *The Indian Express Chandigarh* 1998; 113 (1146): 5.

Revenge by the Bites

*Gorea R K, M.D., **Jasuja O P, Ph.D, ***Aggarwal A D, M.D., ****Narula R, M.D.S.

*Professor and Head, Forensic Medicine, Gian Sagar Medical College, Ram Nagar (Banur), Patiala

**Professor, Forensic Science, Punjabi University, Patiala

***Assistant Professor, Forensic Medicine, MM Medical College, Mulana.

****Assistant Professor, Oral & Maxillofacial Surgery, G.N.D. Dental College, Sunam

Abstract

Bite marks are important evidences, which are most often ignored by the investigating officers in India. Sometimes due to lack of this knowledge, let the culprit go Scot-free. Bite marks help to link the culprit with the crime. It is important scientific evidence, which if properly collected and analyzed can help, in successful prosecution of the case. Analysis of a case of bite marks is presented here by which culprit could be identified.

Key Words: Forensic, Odontology, Bite marks, Overlay Technique.

Introduction:

Bite marks are found quite commonly on the crime scene mostly related with sexual offences and burglaries. They may be present on the skin of the victim or various eatables like fruits, cheese etc.

Earlier, they were not easily accepted as evidence in the courts, even in the advanced countries, but gradually bite marks analysis made their impact. Pitluck (1997) in his article mentioned more than 260 cases in which bite marks were used as evidence in various judicial proceedings. [1]

Main problem with the bite mark analysis is that this evidence is extremely subtle and unless the investigating officer takes extreme care, its value may be lost permanently. Harvesting of these bite marks and later comparing them with that of suspect's teeth may solve the crime in many cases by either comparatively easy, exclusionary path or slightly difficult, inclusionary path. Forensic odontologist has to answer the queries whether the bite mark is human, whether it is individual, does the bite mark predates the crime or is associated with the crime and is the bite mark consistent with the crime.

To answer the queries, forensic dentist has to first photograph the bite mark and then make it to the life size. A dental cast is made of the suspect and from the dental cast a transparency is made, which is then superimposed to see the similarities or dissimilarities and suspect is excluded or identified. [2] In recent times, hand-drawn acetate overlays have given way to computer assisted analytical techniques. The most recent development in the field is that of 3D/CAD supported photogrammetry (FPHG) based on tooth-to-tooth and arch-to-arch comparison. [3] Examination of the bite marks by virtue of simple visual description, stereo-photography, stereo-metric graphic plotting and reflex microscopy has also been reported. [4, 5] These methods can be used depending upon the facilities present at a particular centre. In

underdeveloped and developing countries, even simple methods of comparison may be very useful.

The bite mark analysis is based upon two assumptions i.e. human teeth are unique and sufficient details are transformed to biting surface, which aids in identification. [6] However, the validity of bite mark evidence has been challenged over the years, consequently, a healthy scientific skepticism surrounding bite marks have developed. [7,8,9]

Computer assisted bite mark analysis first came into being when it was used for establishing the dental "uniqueness", even in case of identical twins. [10,11,12]

Case History:

In this case, a person was alleged to have bitten a woman to take revenge for the misbehavior, which the husband of the woman had done, to his wife sometime back. One night when woman was napping outdoors, the culprit came and bit the woman on face and arms.

A doctor medicolegally examined her and the police for collection of relevant samples and analysis for bite marks referred this case to the medical college.

On questioning, the culprit alleged that the husband of the woman made these marks and he is being falsely implicated due to some property dispute.

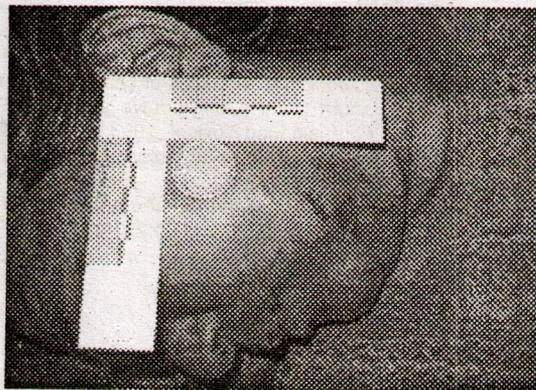


Figure 1: Bitemark on cheek with ABFO scal

Examination and Analysis:

For the purpose of thorough analysis of any physical evidence, proper collection of the bite marks plays an important role in the investigation of the case. Bite marks on the cheek and forearm of the woman were photographed with a digital camera (Canon Power Shot A70) keeping the ABFO No.2 scale in the view field, which is now universally adopted by the forensic dentists and professionals; for photographing bite marks. [13] Studies have recommended the use of rigid ruler for scale, proper camera positioning in relation to scale and proper light arrangements. [14] These were made to the life size and prints were taken in colour and gray scale. Swabs were taken from the each bite mark individually for determining the blood group in the saliva, if present. Blood samples of the victim, her husband and alleged culprit were taken for blood grouping.

Dental casts of the alleged culprit and husband of the woman were prepared using Alginate powder. Dental casts were scanned (with HP psc1200) and transparencies were printed for matching with the bite marks.

Hand-drawn transparencies were also prepared from the dental casts for overlaying and matching. Individual details of the teeth were recorded. From the casts, bite marks were taken on the plasticine material and were photographed. Impressions of the dental casts on the skin of a volunteer (one of the authors) were also taken and pattern of the impression was compared with the bite mark. Casts were also directly overlaid over the photograph of the bite marks.



Figure 2: Gray-scale photo of bite mark

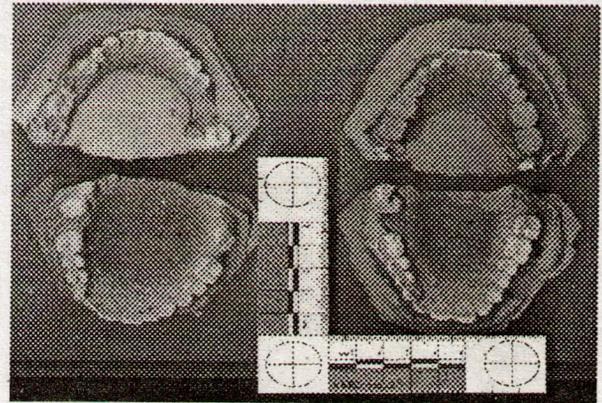


Figure 3: Scanned dental casts

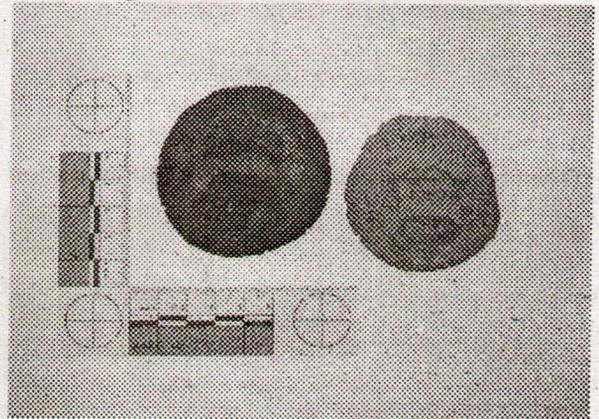


Figure 4:

Experimental bite marks from casts on clay

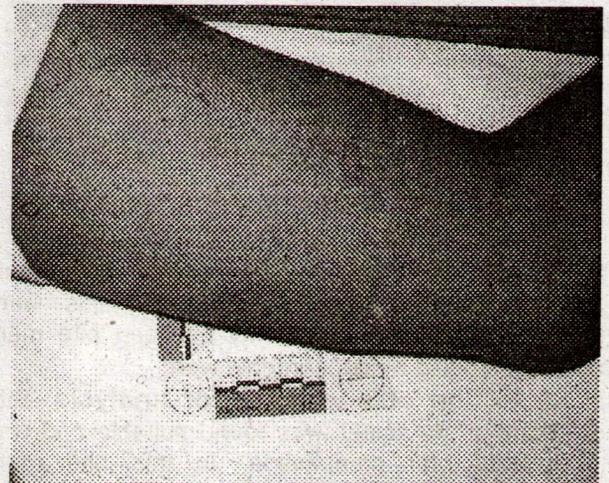


Figure 5:

Experimental bite marks from casts on skin

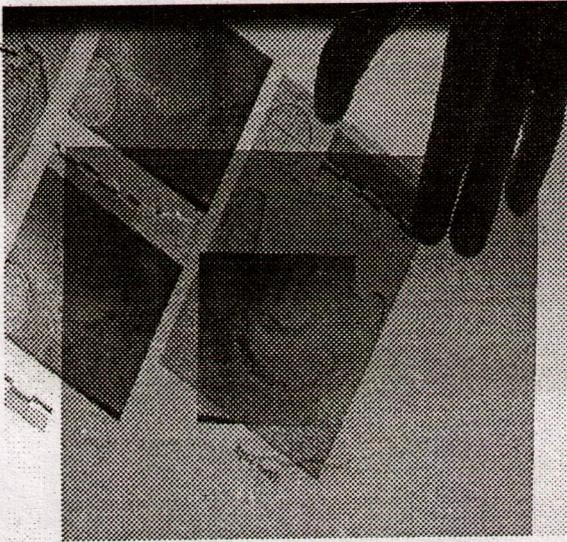


Figure 6:

Overlaying technique using trans-illumination

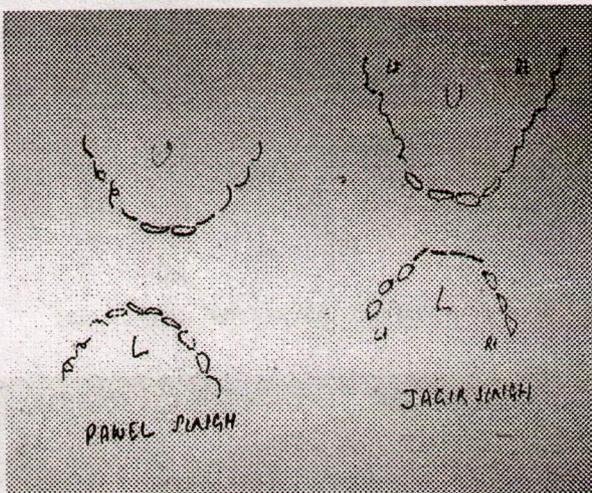


Figure 7: Hand-drawn transparency

Observations:

The swabs were examined scientifically at Forensic Science Laboratory and no saliva stains were detected. Features of similarity between bite mark and cast studied by experiments were:

- i. **Selection of bite mark for analysis:** Bite mark on the cheek was found suitable and was selected for comparison. In this bite mark impression of lower teeth were better with maximum identifiable features, and was further selected for comparison.
- ii. **Curvature:** Three anterior teeth of the husband were in a straight line, but the bite was in a curve, so husband of the woman

could be excluded. Arc of the teeth was comparable to the teeth of the alleged culprit, because transparency exactly matched in overlay technique.

- iii. **Number of teeth impressions:** The bite mark had five teeth impressions clearly identifiable and one irregular impression. The four middle marks matched with incisors while the lateral ones matched with canines.
- iv. **Spacing and individual features of teeth:** In the alleged culprit, all four incisors were not in a straight line, but at some angle to each other, which corresponded to the bite mark photograph. Right canine was prominent and it produced its own mark. Left canine was showing attrition and had more than one prominent areas and this explained bizarre broad mark on left of bite mark. The distance between two canines also corresponded with the distance between two canine teeth on the casts.
- v. **Prominence and attrition of canines:** Husband had canines at lower level than incisors and did not participate in bite on experimentation, so the husband could be excluded, whereas the right canine of the accused was prominent and the left canine was showing attrition, corresponding to the features in the bitemark.
- vi. **Experimentation:** Experimentation with plasticine and human skin of the volunteer, by dental cast of the alleged culprit also produced impression similar to the bite mark photograph. Impression produced by dental cast of the husband on plasticine and skin of the volunteer were dissimilar to the photograph of the bitemarks on the victim.

It was opined with reasonable medical certainty that bitemarks on face of victim matched with the dental casts of accused.

Discussion:

Sorup (1924) inked the plaster models of teeth and put impressions on the transparent sheet, which was later superimposed on the bite mark. [15] Humble (1933) used the transparencies for bite marks comparison. [16] Franklin and Curtis (2001) have described in detail the method of bite mark overlay technique. [17] Bernstein (1983) has described in detail about the application of photography in forensic dentistry. [18] Whittaker and MacDonald (1989) emphasizes that bite mark analysis starts with the examination of the wound. [19] Sweet (1995) is of the view that no two human bite marks can be identical. [20] Sheasby and MacDonald (2001) have described in detail about the primary

and secondary distortions in the bite marks. [21] Richard (2001) has written that unique characteristics of biter's teeth are compared with that of the bite mark on skin and which will help in identification. [22]

Conclusion:

It was observed that direct comparison of the casts was more helpful in reaching the conclusion and transparency overlay confirmed this. In comparing direct and indirect method of match, indirect comparison method remains inconclusive, but the direct comparison method tends to match. More study is required to find out if direct method is more sensitive than indirect comparison method [23]. Maximum help was by getting dental impression on the skin of the volunteer and second best was by biting on the plasticine material.

Direct comparison of the photograph with dental cast was more helpful than overlaying technique. Printing the photograph on thin paper or transparency helped in better comparison. Where there is a doubt noting the individual features of the teeth, provided best help and imagining and experimenting with that particular feature.

Positively, as the science continues to evolve with more precise and demonstrative methods of performing the investigations and development of research data on the individuality of human dentition, the value of bite mark analysis in legal system will continue to increase. [24] Bite mark evidence has become accepted as powerful tool in investigation of crime, and a new level of court interest is brimming, but it is most likely that forensic scientists will have to refine all the scientific techniques, presently available in the field.

Reference:

1. H.M. Pitluck, Bite Marks Citations, In: P.G. Stimson, C.A. Mertz (Eds): Forensic Dentistry, Boca Raton, Florida, CRC Press, 1997, pp.269 – 276.
2. D.K. Whittaker, Bite marks - the criminal's calling cards, Br Dent J., 196 (2004) 237
3. M.J. Thali, M. Braun, T.H. Markwalder, W. Brueschweiler, U. Zollinger, N.J. Malik, K. Yen, R. Dirnhofer, Bite mark documentation and analysis: the forensic 3D/CAD supported photogrammetry approach. Forensic science international, 135 (2003) 115-12.

4. G. Bang, Analysis of tooth marks in homicide case, Acta Odontol Scand, 34 (1976) 1-11.
5. A.J. Ligthelm, W.J. Coetzee, P.J. VanNiekerk, The identification of bitemarks using the reflex microscope, J Forensic Odontol, 5 (1987) 1-8.
6. I.A. Pretty, M.D. Turnbull, Lack of dental uniqueness between two bitemark suspects, J Forensic Sci., 46 (2001) 1487-1491.
7. R.W. Fearnhead, Facilities for forensic Odontology, Med Sci Law, 1 (1960) 273-277.
8. J. Furness, A new method for the identification of teeth marks in case of assault and homicide, Br Dent Journal, 124 (1968) 261-267.
9. C.O. Jonason, K.O. Frykholm, A. Frykholm, Three-dimensional measurement of tooth impression of criminological investigation, Int J For Dent, 2 (1974) 70-78.
10. R.F. Sognnaes, R.D. Rawson, B.M. Gratt, N.B. Nguyen, Computer comparison of bitemark patterns in identical twins, JADA, 105 (1982) 449-451.
11. A.S. Naru, E. Dykes, The use of digital imaging technique to Aid bite mark analysis, Science and Justice, 36 (1996) 47-50.
12. D. Sweet, M. Parhar, R.E. Wood, Computer based production of bitemark comparison overlays, J Forensic Sci., 43 (1998) 1050-1055.
13. W.G. Hyzer, T.G. Krauss, The bite mark standard reference scale – ABFO No.2, Journal of forensic science, 33 (1988) 498-506.
14. T.C. Krauss, Photographic techniques of concern in metric bitemark analysis, J Forensic Sci., 29 (1982) 633-638.
15. A. Sorup, Odontoskopie: ein Beitrag zur gerichtlichen Medizin vischer, Zahnheilk, 40 (1924) 385.
16. B.E. Humble, Identification by means of Teeth, British Dental Journal, 54 (1933) 528.
17. D.W. Franklin, D.J. Curtis, Bitemark Overlay Technique: Photocopy Technique, The Dental clinics of North America, Forensic Odontology, W.B. Saunders Company, Philadelphia, 2001, pp.395 – 397.
18. M.L. Bernstein, The Application of Photography in Forensic Dentistry, Dent Clin North Am, 27 (1983) 151.
19. D.K. Whittaker, D.G. McDonald, Bite Marks and Flesh, A Color Atlas of Forensic Dentistry, 4th edition, Wolfe Medical Publication, 1989, p.108.
20. H.F. Richard, The Dental Clinics of North America, Forensic Odontology, W.B.Saunders Company, Philadelphia, 2001, p.366.
21. D.J. Sweet, Bitemark evidence, In: C.M. Bowers, G.L. Bell, (Eds): Manual of Forensic Odontology, Colorado, ASFO, 1995.
22. D.R. Sheasby, D.G. MacDonald, A Forensic Classification of distortion in Human Bite Marks, Forensic Sci. Int., 12 (2001) 75-78.
23. R.K. Gorea, M. Jha, O.P. Jasuja, K. Vasudeva, A.D. Aggarwal, Marvelous Tools of Identification – Bite Marks, Medico-Legal Update, 5 (2005) 61-64.
24. F.D. Wright, J.C. Dailey, Human bite marks in forensic dentistry, Dent Clin North Am., 45 (2001) 365-397.

Dealing with Unclaimed Dead Bodies: An Issue of Ethics, Law and Human Rights

Dr. Mukesh Yadav, B.Sc., M.B.B.S., M.D., LL.B., PGDHR
Prof. & HOD, Muzaffarnagar Medical College
Muzaffarnagar, U.P.
Email: drmukesh65@yahoo.co.in

Abstract

Privatization, consumerism and economic liberalization in India brought many good things for common men, but it also leads to many legal, ethical and human rights problems. Privatization of medical education leading to mushrooming of medical and dental colleges in India which results in the violation of many laws, not able to keep pace with the changing scenario. Many types of crimes are reported by the media, one of them is related to the illegal human dead body organ trading, which is in violation of Article 21 of the Indian Constitution, the Transplantation of Human Organ Act, 1994, the U.P. Anatomy Act, 1956, etc. this paper deals with critical review of these violations and suggested remedies for preventing human rights as well as ethical and legal violations.

Key Words: Human Rights, Anatomy, Act, Ethics, Law, Organ, Medical, Dental, Unclaimed, Dead Bodies.

Introduction:

The Agra police in U.P. have stepped up their investigations in to the alleged human organs trading racket exposed by a TV Channel on January 14, 2007. A local TV Channel, which carried out the sting operation, showed a private lab owner allegedly dealing in human parts. Agra police however, has claimed of recovery of only human bones at initial investigation. Retired Professor, Dr. A.K. Agarwal of S.N. Medical College, Agra, along with wild life experts has been asked to assist in investigation. [1] Grisly murder of children and women and recovery of skeletal remains along with human flash at Nithari, Noida is still horrifying a common man. [2]

Medical Council of India (MCI) and Dental Council of India (DCI) in its requirements criteria mention about the use of 'soft human tissue specimens' and bones for study in many departments like: Anatomy, Pathology, Forensic Medicine, etc., dissection of human body is required by the MBBS Students in their first year of study. To facilitate elaborate teaching of human anatomy, dead bodies are required by the Anatomy department. The Anatomy Act was aimed at enabling the use of unclaimed dead bodies required by medical institutes. [3]

Health and law being the State Subjects the U.P. Government has enacted in the Seventh Year of the Republic of India, the U.P. Anatomy Act, 1956 to provide for the supply of unclaimed dead bodies of deceased persons to teaching medical institution for the purpose of anatomical examination and dissection. Whereas, it is expedient to provide for supply of unclaimed dead bodies of deceased persons to teaching medical institutions for the purpose of anatomical examination and dissection. The Act is aimed at enabling the use of unclaimed dead bodies required for medical institutes. It extends to the whole of the U.P. [4, 5]

The right to life which is the most fundamental of all rights is also the most difficult to define. Certainly it cannot be conferred to a guarantee against the taking away of life; it must have a wider application. With reference to a corresponding provision in the 5th and 14th amendments of the U.S. Constitution, which says that no person shall be deprived of his "life, liberty or property without due process of law", in a case [6] Field, J. spoke of the right to life in the following words:

"By the term 'life' as here used something more is meant than mere animal existence. The inhibition against its deprivation extends to all those limbs and faculties by which life is enjoyed. The provision equally prohibits the mutilation of the body by the amputation of an arm or leg, or the putting out of an eye, or the destruction of any other organ of the body through which the soul communicates with the outer world".

The statement, which has been repeatedly quoted with approval by our Supreme Court [7, 8, 9] has been further expanded in another case [10] by the statement **"that any act which damages or injures or interferes with the use of any limb or faculty of a person, either permanently or temporarily, would be within the inhibition of Article 21"**. This right extends to the death and dignified disposal of the dead body also.

At the time of enactment of Act there were no privatizations of medical education. This Act does not mention of the authorized person clearly (designation, department, etc.) to deal with the issue of use of unclaimed dead bodies. This situation leading to confusion and apprehension among the medical doctors about the legal complexities involved. The Act recognizes only **"medical institutions"**, means a hospital or medical or teaching institution established, maintained or

recognized as such by notification in the Official Gazette by the state government to carry on anatomical examination or dissection, or both (**Section 2(1) (b)**) [5] It needs mention that private medical and dental colleges unless and until recognized and notified in the Official Gazette by the concerned State Government to carry on anatomical examination or dissection, or both, can not take the privilege of the Anatomy Act. But Essentiality Certificate for permitting to open medical or dental college given by the State Government as 'No Objection Certificate' can be presumed recognition of the State Government. It has not mentioned about the position of Dental Colleges of India private or government.

Issue of Claimants:

The Act [5] also mentions of term "relative" as per the **Indian Succession Act, 1925**, but this Act of 1925 is already amended subsequently in 1926, 1927, 1929, 1939, 1950, 1951, 1952, 1962, 1964, 1983, 1991 and most recently in 2002 (**Act 26 of 2002**). [**Section 2 (1)** (i, ii, iii)] [11] Thus, this provision needs amendment as per the new provisions of the amended Act. This Act [11] was come into force on **June 17, 1956**. It mentions of the terms "full blood", "half blood", and "uterine blood", and "heir".

"**Relatives**" means any person related to the deceased as wife, husband, parent, son, daughter, brother or sister and includes any other person related to the deceased:

- By **lineal consanguinity** within six degrees or by **collateral consanguinity** within twelve degrees; or
- By marriage with any of the relatives specifically mentioned in this clause or with any other relative with the aforesaid degree; or
- As preceptor or disciple within three degree.

Explanation: The expression 'lineal and collateral consanguinity' shall have the meaning assigned to them in the Act [**Section 1 (a) (b) (c)**] [11]

Collateral Consanguinity: Collateral are descendant in parallel lines, from a common ancestor or ancestress. For instance, brother is collateral, so is sister. Similarly, paternal uncle and paternal aunt and their children, maternal uncle and maternal aunt and their children are **collaterals**.

[**Section 3**]

Lineal Consanguinity: it means descendents and ascendants. **Descendants** mean the offspring of a person. Immediate descendants of a person are his sons and daughters. The children of sons and daughters and their children, and so on, are also descendants. A person may have descendant through

his sons and daughters up to any degree of descent. Similarly ancestors of a person are known as Ascendants. Immediate ascendants of a person are his father and mother. The father and mother of his father and mother are also his ascendants, and so are their parents up to any degree of ascent.

There is need for further clarification of the position. Again the Act [5] does not mention about the position of unclaimed body when it belongs to other religions (Muslim, Christians, etc.)

Body of A deceased person shall deemed to be unclaimed if such person has no relatives, or if it has not been claimed by any of his relatives, friends or servants within such period as may be prescribed in that behalf [**Section 2**] [5]

The Act defines "**Unclaimed Human Dead Body**" means body of a deceased person, if such person has no relatives, or if it is not claimed by any of his relatives or friends or servants within 48 hours of his death. [**Section 2 (2) & Rule 1 (b)**] [5]

Disputed claims:

Doubt or dispute as to relative:

Where any doubt or dispute arises whether person is a relative of the deceased, such **the matter shall be referred to officer** as may be appointed in this behalf by the State Government and **his decision** thereon shall be **final and conclusion**, and **pending such decision, the unclaimed dead body shall be preserved from decay** in such manner as may be prescribed. [**Section 6**]

On reference made under Section 6 of the Act, an officer appointed there under by the State Government shall immediately **fix a date for hearing within two days of the receipt of such reference and inform the parties accordingly**. [**Section 5 (1), Rules**]

After hearing the parties concerned the Officer appointed by the State Government under Section 6 of the Act, may make such inquiry as he may think proper and fit to dispose of the case and shall give the decision on the date of hearing and his decision shall be final and conclusive. [**Section 5 (2), Rules**]

Regarding the disposal of dead body the Act mentions that disposal of dead body is to be done in the manner provided thereof, in **Section 104**. [12] Here again it is important to point out that this Act of 1898 [12] is also repealed and replaced by the new Code of 1973, [13] which came into force on **April 1, 1974**. [Page 1] Section 174 and 176 Cr. P.C. provides for the inquiry by the police officer and magistrate when any unnatural death occurs or where there is any suspicion about the cause of the death. [13] The State Governments too made a

large number of amendments to the Code of 1898. [14]

Duty of police and other officials to assists in obtaining possession of unclaimed dead bodies:

Any authority of officer empowered by under this Act [5] shall, in the discharge of their duties, be given such assistance and help as he may reasonably required by all the officers and servants of the departments of police, medical, public health and of the local bodies. [Section 8]

Protection of persons acting under this Act:

No suit, prosecution or other legal proceedings shall lie against any person for anything which is in good faith done or intended to be done under this Act. [Section 9]

Officers to be Public Servants: [Section 10]

All Officers appointed or authorized to act under this Act shall be deemed to be Public Servants within the meaning of Section 21 IPC. [15]

Procedure:

The authority in charge of a hospital (Principal/M.S.) (or prison) immediately give information of the fact of death of a destitute or a person alone died in the hospital to the nearest police station. The concerned police officer on receiving the information in the case of unclaimed dead body of a person:

- Dying in a hospital (or prison); or
- In a public place, not being place of his residence; or
- Who after having dedicated in writing his dead body for the purpose of anatomical examination or dissection

Take possession of the unclaimed dead body and after recording relevant information for fixing identity letter on (height, age, sex, religion, belongings, photograph, etc) after waiting period of 48 hours (preferably 72 hours) hand it over to a government recognized medical institution; requesting it for anatomical examination or dissection or both.

In case of unclaimed dead body where deceased died in a hospital or a prison or in a public place, not being his place of residence and where a relative is known to be alive but has for reason beyond his control failed to claim the body within 48 hours period, police officer hand over the body to religious or public institutions belonging to the same religion of the deceased for final disposal as per the rites and rituals. [Sec. 5 (1) (a) (b)] [5]

But in cases where deceased (unclaimed dead body)

person who has prior to his death specifically declared

that his dead body shall not be subject to anatomical examination or dissection or both, shall be handed over by the police officer to religious or public institutions belonging to the same religion of the deceased for final disposal as per the rites and rituals. [Section 5 (2)] [5]

Principal / M.S. of a medical institution on the requisition of the HOD Anatomy forward or send fresh requisition in writing to the concerned police station (a copy to SSP/DM) mentioning reference of the Anatomy Act and Rules thereof [Section 2 of Rules] [16] that institution requires number of dead bodies for the purpose of the anatomical examination or dissection or both by the end of June every year.

Similarly, if any body intends to dedicate his dead body for purpose of anatomical examination and dissection make a letter in writing to the SSP/DM.

Methods of disposal of unclaimed dead body: [Paragraph 135-A, Police Regulations] [17]

The police officer in case of doubt as to the cause of death of the deceased and in any other case in his opinion it is expedient so to do, dispose of the unclaimed dead body in the manner as provided in Section 104 [12][Section 5 (3) (a)] but after the repealing of this Act of 1898 by the new Act of 1973, [13] the procedure should be as per Section 174. [14] Rules must clearly mention about disposal of dead body in the scenario in which unclaimed dead body is not required by the authority in charge of a medical institution for anatomical examination or dissection.

Rules must also mention about the period after which the medical institution for prolonged preservation and use for anatomical examination and dissection may use the unclaimed dead body. Preferably this period should be within 72 hours after the death in ordinary case.

Paragraph 135-A read as "when a corpse recovered by the police is unclaimed or cannot be identified the police officer making enquiry under Section 174 [14], shall arrange to give the fact of discovery the widest possible publicity with a view to its identification as also to the tracing out of the deceased's relations, friends or acquaintances to whom it can be made over for disposal. In rural areas such publicity shall be made by beat of drum and in urban areas the police officer may also take the help of the local press, broadcasting station, if any, and voluntary organizations like the Sewa Samiti.

The police officer making the enquiry shall also, as for as possible endeavors to ascertain correctly the faith to which the deceased belong in order to

ensure proper disposal, if eventually necessary, of the corpse according to the customary rites of the faith to which the deceased belonged. With this end in view the officer concerned shall, besides making other enquiries, carefully examine the corpse to see if it has got any distinguishing features, such as might held to establish the deceased, denomination and make an entry to this effect in the general diary and the inquest report.

If after due publicity a dead body remains unclaimed the Superintendent of Police of the district may hand it over to recognized Medical College for the purposes of anatomical examination and dissection at their own expense. The officer-in-charge of such college shall furnish to the Superintendent of Police a certificate to the effect that after anatomical examination and dissection the corpse was disposed of according to the customary rites of the faith to which the deceased belonged. [Paragraph 135-A] [17]

Dealing with the Dead in a Medical College:

Attending medical officer should be present at the bedside in the case of dying patients. He will pronounce the patient as dead and give death report only after laps of an hour of pronouncing death.

All cases of unclaimed dead bodies and in which death occurs suddenly under suspicious circumstances or in which death is directly or indirectly due to an accident must be reported to the local police authorities and the permission sought before releasing the body. [18]

Preparation of the dead body:

Recommendations:

A website should be launched by the government to display detailed particulars of missing persons and unclaimed dead body any where in India, to help the relatives to search for missing persons and to avoid any legal complication or criminal activity.

Summary and Conclusions:

In the changed scenario of privatization of medical education it become necessary to amend the Anatomy Act, 1956 to keep pace with the amended related Acts like The Hindu Succession Act, 1929, the Code of Criminal Procedure, 1888 and other

laws and most importantly to prevent human rights violations of the deceased, protected under the Article 21 of the Constitution of the India.

Similar situation may be prevalent in other States of the India. That is why it is imperative to make a concerted effort at all India level by MCI, DCI, National Human Rights Commission (NHRC), all the State's Human Rights Commissions to look into the matter and prevent human rights violations of the deceased in public interest. Continued Medical Education (CME) / Workshops should be organized by the concerned medical colleges for doctors, police and others law enforcement agencies to prevent this unethical and illegal act of human rights violations. The term medical institution should also be qualified to cover the Dental Colleges for the purpose of this Act. There is need to amend the present Act.

References:

1. Hemendra Chaturvedi, "Organ Trade Racket in Agra, Private Lab Owner Arrested", Hindustan Times, New Delhi, Monday, January 15, 2007: 3.
2. Nithari Killings
3. The Minimum Standard Requirements of MCI for the Establishment of 50, 100, 150 Admissions, 1999.
4. For elaborate discussion on the subject, please refer to U.P. Gazette, Extraordinary, dated August 29, 1956.
5. The U.P. Anatomy Act, 1956 (U.P. Act No. VI of 1957).
6. Munn v. Illinois (94 U.S. 111).
7. Kharak Singh v. State of U.P., AIR 1963 SC 1295, 1301, 1305.
8. Sunil Batra v. Delhi Administration, (1978) 4 SCC 494.
9. Olga Tellis v. Bombay Municipal Corporation, (1985) 3 SCC 545: AIR 1986 SC 180, 194.
10. Francis Coralie v. Union Territory of Delhi (1981) 1 SCC 608: AIR 1981 SC 746.
11. The Indian Succession Act, 1925 (Act No. 39 of 1925).
12. The Criminal Procedure Code, 1898 (Act No. V of 1898)
13. The Criminal Procedure Code, 1973 (Act No. 2 of 1974)
14. Ratanlal & Dhirajlal. The Code of Criminal Procedure, 15th Edition-2000: 51, 272- 275.
15. Ratanlal & Dhirajlal. The Indian Penal Code, 1860 (Act XLV of 1860), 28th Edition-2000: 14, 15.
16. The U.P. Anatomy Rules, 1959, Notification No. 2037 (iii) A/-507-57, dated April 3, 1959.
17. Mishra, RN. Commentaries on U.P. Police Regulations with allied Laws. Hind Publishing House, Allahabad, 10th Edition-2006: 65.
18. Hospital Administration Manual, Chapter 4 and Casualty
19. The Transplantation of Human Organ Act, 1994.
20. Singh, Mahendra P., V.N. Shukla's, Constitution of India. 10th Edition-2001, Eastern Book Company, Lucknow: 165.

Demographic Study of Fatal Cranio-Cerebral Road Traffic Injuries in North Bengal Region

*Dr.Saibal Gupta, **Dr.Prabir Kumar Deb, ***Dr.Rumi Moitra, ***Dr.Dibyakar Chhetri

*Prof. & Head

**Asstt. Prof.

***Demonstrator

Deptt. Of Forensic Medicine, North Bengal Medical College, Distt. Darjling, West Bengal

Abstract

Introduction:

North Bengal being a vital link to not only bordering states like Sikkim and Assam, is also linked to Asian countries like Nepal, Bhutan and Bangladesh. Siliguri being not only the main trading centre in entire North Bengal is also the gateway to tourism industry of the entire Himalayan belt. The traffic density in Siliguri and adjoining towns has increased by nearly ten times in last five years. There is a proportionate increase in the number of Road Traffic Accidents as seen in North Bengal region.

The present study deals with the different demographic Profiles of victims of fatal Cranio-Cerebral Road Traffic Accidents during a span of five months (August 2003 to December 2003). This period has been especially chosen because we find that the post monsoon period where road conditions are any motorist's nightmare and road accidents due to bad roads is common. Another reason is during the Puja season, there is a big rush of tourists, both domestic and international to this part of the state. This naturally causes an increased traffic density throughout North Bengal region.

Information regarding the age, sex, type of victim, the nature of vehicle involved, the survival time of the victim etc., were taken from the Police Inquest Report and by queries made to the relatives of the deceased. Detailed Post Mortem Examinations were carried out in the Department of Forensic Medicine Mortuary at North Bengal Medical College in which external and internal injuries were carefully recorded, analyses and compiled in the study.

Observation :

Out of the 100 victims of Road Traffic Accidents, our study shows 88 cases were Males and 12 were females. The Male to Female Sex Ratio is 7.3: 1. The study shows the incidence of fatality was found to be maximum in the Age group 21 – 30 years (23%) followed by the Age group 31 – 40 years (19%). The lowest incidence was found in the Age group above 70 years (2%).

In our study, Pedestrians were found to be the commonest group of victims comprising of 44% of the total cases. Next in the series were riders of Motorcycle and Scooter (19%), followed by

Cyclists(15%), Truck and Bus Passengers (7%) and car passengers (3%).

The survival period of the victims showed that majority died either on the spot without any medical aid (22%) or within 24 hours of the accident (36%). The number of victims who died after 48 hours was 25%.

The maximum numbers of fatal accidents (30%) were reported between 0600 to 1200 hours followed by the time interval 1800 to 2400 hours (27%). The least number of cases (8%) occurred between 0000 to 6000 hours in the morning.

Out of the total cases died due to cranio-cerebral injuries as a result of Road Traffic Accidents, 25% of the cases had Cranio-Cerebral Injury without any significant injury to other parts of the body. 75% of the cases had Cranio-Cerebral injury associated with other major injuries to other body parts.

Of the Cranio-Cerebral Injuries, fracture of the skull was found to be present in 66% of the cases, fracture of the vault of skull was more common than the base of the skull (13.2: 1). The incidences of fracture of various skull bones was, Temporal: 30 cases (45%), Parietal: 26 cases (39.3%), Frontal: 5 cases (7.5%), Occipital: 4 cases (6.06%). Fissure type of fracture was the commonest type followed by depressed comminuted fracture.

The commonest type of intracranial haemorrhage found was Subdural haemorrhage (68%) followed by Extradural haemorrhage (28%) and Intracerebral haemorrhage (8%) was the least common.

The cases of Subdural haemorrhage and Subarachnoid haemorrhage could not be differentiated in our study due to lack of facility for microscopical examination. Contusion of brain was present in 7% of the cases and laceration of the brain was present in 9% of the cases.

Discussion:

According to the information given by the Institute of Road Traffic Education, New Delhi, 85% of the road accident deaths occur in developing countries and nearly half in the Asia-Pacific region. India accounts for 10% of the road accident fatalities worldwide. [1] An estimated 1,275,000 persons are grievously injured on the road every year. [1] In the study conducted by Banerjee et al [2], on head injury victims in fatal road traffic accidents in

Delhi, 31% were victims of head injury in vehicular accidents. The Male: Female sex ratio in our study was 7.3: 1 where 88% were males. In the study conducted by Tirpude B.H., Naik R.S., Anjankar A.J., Khajuria B.K. 3 In 1998, at Sevagram, Wardha, Maharashtra the Male: Female sex ratio was 4.4: 1. Agnihotri A.K., Joshi H.S., Tsmilshina N [4], in their study of Craniofacial trauma in Western Nepal in 2003 noted that the sex ratio was 4.2: 1. In the study of Chandra J, Dogra T.D., Dikshit P.C. [5] in 1979, the male: female ratio was 4.78: 1. The dominance of males in fatal cranio-facial injuries can be due to the patriarchal Indian society where males are bread earners and female drivers are very few as compared to their male counterparts.

The present study shows that the middle age group was most susceptible to fatal cranio-facial road traffic accidents with 23% of cases in age group 21-30 years, followed by 19% in 31-40 years.

Tirpude et al [3] in their study also revealed the commonest age group involved in fatal cranio-cerebral injury due to road traffic accidents was 21-30 years (38.88%) followed by age group 31-40 years (18.51%). Similar trend has been shown by Chandra et al [5] in which most common (27.38%) age group involved was 21-30 years, followed by 31-40 years age group (18.63%). The middle age group is also the main work force of the society, therefore this trend.

Another important finding in our study has been that pedestrians form the major (44%) part of fatal accidental deaths due to head injury. Similar figure has been shown by Tirpude et al [3] where 42.59% of the total cases has been pedestrians. Agnihotri et al [4] showed that pedestrians and motorcyclists formed the commonest type of victims of fatal cranio-cerebral injuries in road accidents. Chandra et al [5] showed that 46% of the victims were pedestrians.

This finding is very significant to highlight the cause of a multilevel approach in preventing road accidents where even an illiterate has to be given a basic knowledge of road traffic rules and safety measures.

In our present study, 22% of the victims died on the spot without receiving any medical aid, while 3% of the victims died on their way to the hospital and 36% of the cases died within 24 hours of accident after receiving hospital treatment.

Chandra et al [5] has found that 36.6% of the cases died on the spot and 36.20 died within 24 hours of receiving medical attention. These figures are indicative of the poor infrastructure in trauma management especially of cranio-cerebral injuries.

The present study showed that most fatal head injuries are caused during the office times, with 30%

of cases between 6:00 - 12:00 hours and 27% of cases between 18:00 - 24:00 hours. This is correlated to the finding that pedestrians form the commonest type of fatal accident cases.

The present study shows that majority (75%) of the cases sustained multiple injuries in association to head injury, while only 25% of the victims had only cranio-cerebral injury.

Fracture of the skull was common (66%) in our study. Chandra et al [5] also found that 79.87% of the cases had skull fracture.

In the present study fracture of temporal bone (45.45%) followed by parietal bone (39.3%) were the main cranial bones involved in fracture. The study of Chandra et al [5] showed that temporal bone fracture was seen in 58.67%, followed by 57.75% of victims having occipital bone fracture and 50.38% of victims having parietal bone fracture. Tirpude et al 3 study revealed that 40.74% of cases had fracture of parietal bone and 38.88% temporal bone.

The present study revealed that subdural haemorrhage was the commonest type of intracranial haemorrhage (68%), followed by extradural haemorrhage (28%) and intracerebral haemorrhage least common (8%). Chandra et al [5] in their study found subarachnoid haemorrhage the most common type of intracerebral haemorrhage (66.9%) followed by subdural haemorrhage (58.2%). Contusion of brain was present in 7% of cases, while laceration of brain was seen in 9% of the cases in our study. This is in contrast to the study of Chandra et al [5] where contusion of brain was present in 23.61% and laceration of brain in 24.8% of the cases.

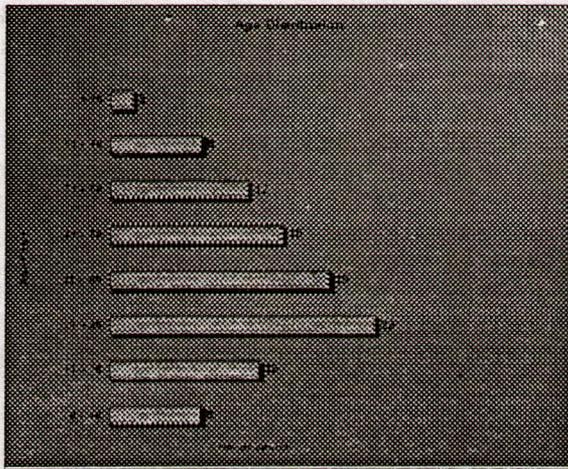
Conclusion:

The first recorded pedestrian accident was in Britain in 1896, where a car traveling at 4 miles/hour killed a man. Today, hundred times the number of vehicles that were plying in 1896, travel at speeds of nearly 100 miles/hour. This comparison is enough to throw light on rate of increase in road traffic accidents

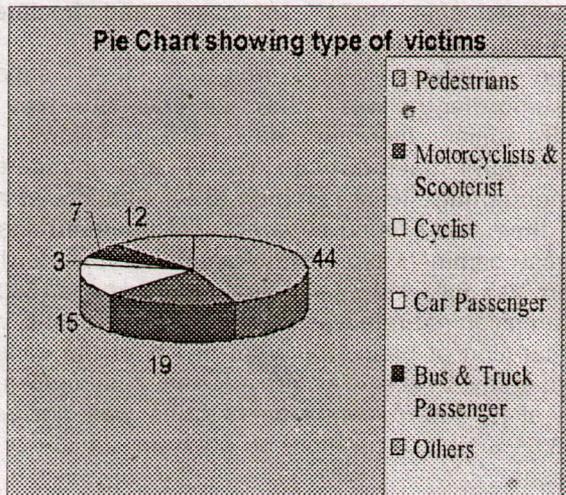
In our study, the triad of middle aged- male- pedestrians being most accident-prone is very significant which other authors have also revealed. This is a good indicator for a faulty traffic management system where pedestrian safety is always overlooked.

The finding that majority of the fatal victims of cranio-cerebral injury of road traffic accidents died on the spot or within twenty four hours of accident highlights the poor traumatic management infrastructure prevalent.

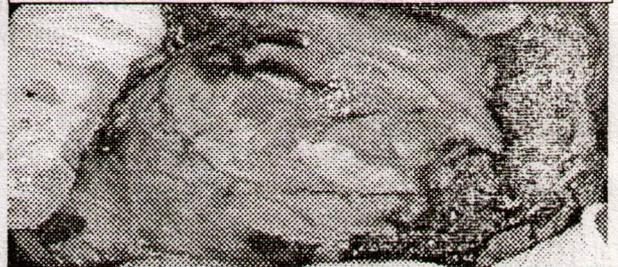
There are needs to be a proper national reporting system of road traffic accidents so that an overall picture can be drawn for proper traffic management planning.



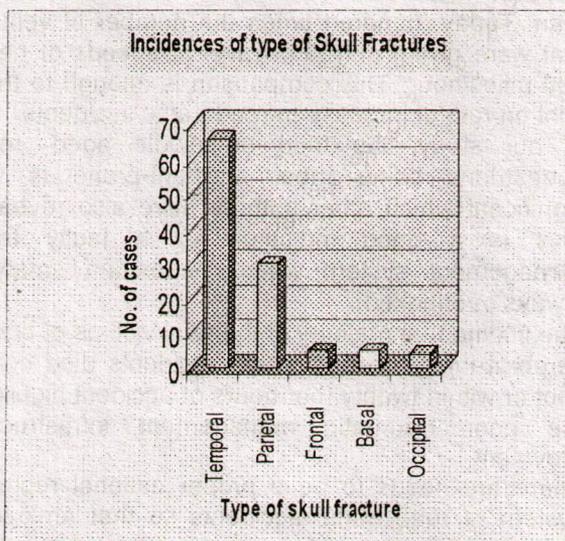
A Case of Road Traffic Accident



A case of Road Traffic Accident with split laceration of scalp



A case of Road Traffic Accident showing scalp haematoma with fissured fracture of Parietal bones.



References:

1. Report of The Institute of Road Traffic Education, New Delhi in www.newsindiatimes.com/2002/09/13/med30-poor.html.
2. Banerjee KK, Agarwal BB, Kohli A, Aggarwal NK. Study of head injury victims in fatal road traffic accidents in Delhi: Indian Journal of Medical Science, 1998 Vol: 52, Issue: 9 Page 395.
3. Tirpude B.H., Naik R.S., Anjankar A.J., Khajuria B.K. A Study of the Pattern of Cranio-Cerebral Injuries in Road Traffic Accidents: Journal of Indian Academy of Forensic Medicine, 1998 Vol: 20 No.1 Page 9-12.
4. Agnihotri A.K., Joshi H.S., Tsmilshina N. Study of Craniofacial Trauma in a Tertiary Care Hospital, Western Nepal : Medico-legal Update, 2005 Vol: 5 No.1 Page 23-24.
5. Chandra J, Dogra T.D., Dikshit P.C. Pattern of Cranio-intracranial Injuries in Fatal Vehicular Accidents in Delhi, 1966-76: Medical Science Law, 1979 Vol: 19, No.3 Page 186- 194.

Role of Chemical Examination in Formation of Opinion as to Cause of Death Following Poisoning

Dr.Sobhan Kr. Das, M.D.

Asst. Professor, Dept. of Forensic Medicine, N.R.S Medical College, Kolkata

Residence:

Dr.Sobhan Kr.Das

Niranjan Appartment, Flat-2a, 146, Jugipara Road, Kolkata-700028

Ph:(033) 2500 2188, Mob: 9830414835

Abstract

Barring some corrosive poison very few poisons leaves any conclusive evidence in the body to be detected after death. Identification of poison and its concentration is essential to form a definite opinion as to cause of death from poisoning. On long storage there is a chance of production of alcohol as decomposition artifact.

Poison detected only in stomach and Intestine may be post mortem introduction of poison. Study of chemical examiner's report from West Bengal State Forensic Science Laboratory reveals the deficiencies in reports and difficulties in formation of opinion as to cause of death from poisoning.

Key Words: cause of death, definite opinion, Concentration of poison, Decomposition artifact]

Introduction:

More than (3000) three thousand autopsies are done annually at N.R.S. Medical College, Kolkata and out of those several hundreds of cases are being dealt with every year at our N.R.S. Medical College Police Morgue either with definite history of poisoning or more often simply with suspicion of poisoning and many of those cases shows no definite signs of poisoning on autopsy where chemical examiner's report is obligatory for arriving at a final opinion as to the cause of death. It is undeniable fact that there is no poison on earth that can kill a person instantaneously without producing any symptom and sign during life and also true is that other than several corrosive poisons, very few poison leaves any conclusive evidence in the body of victim to be detected after death. Therefore barring few corrosive or irritants which may also cause death due to neurogenic shock almost all kinds of poison must reach into the system to produce ill effect or death and hence chemical analysis for detection of poison and their concentration in the body fluids and viscerae is very much necessary for proper scientific interpretation whether death was the effects of poisoning.

On absorption according to their different toxicokinetics different body fluids& tissues will show different level of concentration. Liver being the largest and most important organ of metabolism and kidneys being the most important organ of excretion for non volatile poisons, detection of poison is most likely in those organs. Though spleen is not routinely preserved it is also very important organ for detection of poison. Detection of poison in different body fluids is almost Confirmatory of poisoning during life.

So stomach & Intestine must be preserved separately from liver and kidney (spleen if preserved).

Many substances which are normally being introduced into our body either through food and drinks or by skin and lungs with out causing any severe ill health leading to death and some substances been produced on decomposition of body tissues, some may even be a normal components of different types of body tissue, all those may be detected in small non fatal concentration in various body fluid or viscerae. Moreover presence of poison in the stomach and intestine but not detected in any of the body fluid or tissue may be a indication of post mortem introduction into the stomach or intestine .In some cases on ingestion of large amount of corrosive poison may cause very rapid death due to neurogenic shock but in those cases evidence of corrosion in mouth and oesophagus are usually present. Much higher concentration in blood than liver& spleen indicative of perenteral administration of poison. Sometimes fatal concentration in blood or viscera may not be indicative of cause of death particularly in tolerant person, nonetheless fatal concentration of poison in body fluids or viscera is important indication to cause of death in ordinary circumstances though post mortem concentration in blood may be higher than antemortem blood concentration. Therefore quantitative analysis is vitally important to ascertain the cause of death from that poisoning in otherwise healthy person without serious injury.

Material and Method:

An analysis were done on reports of Chemical Examiner of West Bengal State Forensic Science Laboratory, received by the N.R.S. Medical College,

Kolkata in last ten years (1995-2004), to study the importance of these reports in formation of opinion as to the cause of death.

Observation and Analysis:

- Total reports studied were: 108
- Positive Cases [Any type of poison detected] only 15 cases.
- **Only three types of poison were found to be detected.**

In all cases detected poisons are corroborative to P.M.findings or history in inquest, except in one case it was contradictory to history & p.m findings where there was history of & evidence of corrosive poison in the stomach but C.E's report showing detection of endosulphan.

- In all cases 3(three) plastic containers were used for sample collection.
- One Jar for stomach with its contents, liver and, kidney.
- One for control of preservative,
- One for blood without preservative.

In all cases preservative used were saturated solution of common salt (NaCl)

No poison could be detected from any blood sample.

In all positive samples- blood, viscerae collected from fresh cadavers except one where body was in early decomposition.

- Delay from sample collection in mortuary to receipt of sample by FSL was: Minimum of 5 days and maximum of 5 months.
 - Delay at FSL from receipt of sample to preparation of report: Minimum of...1month and maximum of...4yrs 7 month.
1. Endosulphan detected in 3 cases where interval of collection of samples at mortuary to preparation of report by FSL is --- maximum of 4years and. minimum of 1yr. 6months.
 2. Propoxur detected in one case where interval between collections of sample at mortuary to FSL report was--- 1yr 6 months
 3. Sulphuric acids detected in 2 cases where interval of collection of sample and FSL report were 2yrs and 2.5 yrs.

In remaining 9 cases out of 15 cases: detected poison were alcohol:

- Only ethanol detected – 3(three) cases,
- Both ethanol & methanol in one sample: 6(six) cases.
- But in no single case methanol is detected as an only poison.

Alcohol detected from samples where interval from collection of blood & viscera at mortuary up to report

by FSL were: Maximum 4yrs. 10 months. Minimum 1(one) month.

In no case concentration of detected chemical (poison) in any particular tissue or body fluid was mentioned neither there was any mention of adopted method of chemical examination.

It is observed that there are delays in sending the samples from mortuary to FSL and even more delay sometimes for prolong period at FSL itself before chemical analysis.

Stomach and intestines are preserved with liver and kidney in a same plastic container, which is unscientific for the purpose of formation of opinion on whether there was any systemic effect of poison.

- Endosulphan, propoxur, sulphuric acid is detectable even after prolong preservation in ss of common salt.
- Ethyl alcohol and Methyl alcohol were detected from the samples preserved in SS of Common Salt in a plastic
- Container stored for as long as 4 yrs.where chances of endogenous production of alcohol is very high
- As there is no mention of concentration of any poison whatsoever it is impossible to know from which tissue or body fluid they were isolated because fatal concentration is not same in all tissue or body fluid. And in case of ethyl alcohol whether they are actually decomposition artifact

Conclusion:

Our FSL report sometimes only corroborate physical findings on autopsy and circumstantial evidence, not really reliable to form an opinion as to the cause of ari for examination of sample that raises question of reliability of findings of C.E's report particularly in findings of alcohol detection.

Suggestions for Action:

1) From government:

One modern poison detection unit or laboratory should be set up with all medical colleges having post mortem works.

The Laboratory:

Must have capability of analyzing at least 4-5 samples a day.

Where normally Body fluids (blood, urine, Vitreous humor, bile gastric lavage fluid, vomitus etc.) will only be taken for examination.

In special cases (like anesthetic death, neurotic poison, spinal poison) brain, spinal cord, lung, bone marrow, hair may be taken for examination.

The lab should supply all containers for collection & preservation of samples to be examined.

Report must reach the Forensic department within a fortnight of receipt of samples.

Report must contain:

- Identification of poison
- Concentration in type of tissue or fluid
- Date of collection & date of examination.

Desirable: a) particular method adopted for toxicological analysis with standard fatal concentration of that particular poison in that particular fluid or tissue. b) Method of preservation & name of preservative.

2) From autopsy surgeon:

Properly sealed Samples collected during autopsy should reach the laboratory within 48 hrs of its collection, by the department staff-only not via police. Samples to be collected preserved and despatched to the laboratory as per standard protocol or as desired by the laboratory.

All usual viscera collected should be preserved properly in mortuary cool chamber for examination if necessary, over and above the examination of body fluid but only for a period of three months, after that all will be destroyed and disposed of.

3) From attending doctor in hospital

In admitted cases of suspected poisoning all available body fluids must be collected & properly preserved to be sent to laboratory in case of death of that patient. Above all sufficient efficient, disciplined, accountable manpower is essential to make the process sustainable reliable and confidential.

Final Objectives:

1. To minimize, the delay of sample examination in order to maximize chance of poison detection to minimize the chance of decomposition artifact.
2. More efficient use of space in already overloaded mortuary particularly centers like N.R.S. Medical College Hospital, Kolkata where more than 3000 post mortem examinations are being done annually.
3. To give definite opinion promptly in cases of death from poisoning as well as determining the manner of death egg, suicidal, homicidal, and accidental.

Rapid scientifically conclusive evidence only helps in right & timely justice.

CHART-1
Total cases-108
Positive cases-15

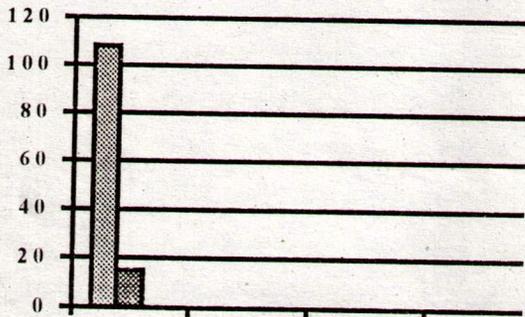


CHART-2
Proportion of poisons in positive samples.

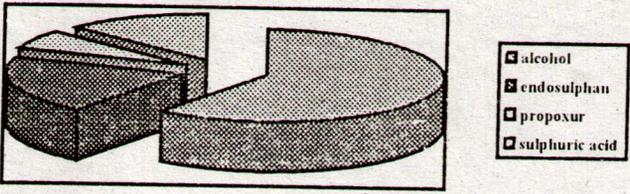


Table-1

Total cases studied-108. Positive cases [samples where any poison detected]--15

Name of poison	No. Of cases	Percent %		Interval from collection to chemical examination	
		% Of total samples	% Of total positive samples	Maximum	Minimum
Endosulphan	3	2.8	20	4 Yrs. 7 Month.	Month.
Propoxur	1	0.9	6.66	1 yr 6 month.	
Sulphuric Acid	2	1.85	13.33	2 Yrs. 6 month.	2yrs.
Alcohol [Ethyl alcohol -3 Methyl alcohol-nil Ethyl + methyl alcohol-6]	9	8.33	60	4 yrs.10 month.	1 month.

References:

- Mukharjee J. B, Forensic Medicine and Toxicology 2nd Edition 2000.
- K.S. Narayan Reddy, The essentials of Forensic Medicine and Toxicology, 17th Ed.
- Apurba Nandi Principles of Forensic Medicine 2nd edition, Central
- Taylor's Principal and Practice of Medical Jurisprudence. 12th Edition. Edited by Keith Simpson. J. A. Churchill Ltd. p.218-220, 230-233.
- Modern trend in forensic medicine, edited Keith Simpson, London butterworth, 1967. p.315.
- Gradwhol's Legal Medicine, 3rd Ed, 1976 Ed. F.A. Camps. p.558, 559, 573.
- Modi's Medical Jurisprudence & Toxicology, 23rd Ed. Edited by K. Mathiharan & Amrit K. Patnaik. Page: 18-32.
- Forensic Toxicology, Website Medical Toxicological Unit Lab, Part of Guy's Thomas Hospital Trust Pathology.
- Guide to obtaining specimens at post mortem for analytical toxicology, website Regional laboratory for Toxicology.

Determination of Age in living by closure of Cranial Sutures A Radiological Study

*Lt. Col. (Dr.) V. B. Gaur, **Dr. V. B. Sahai, ***Dr (Brig) Amarjit Singh, ****Dr Amit Kharat

*Professor and Head, Department of Forensic Medicine & Toxicology

***Professor of Radiology and Dean

****Lecturer, Department of Radiology,

Dr D Y Patil Medical College and Hospital, Pimpri, Pune – 18.

**Ex. Director Medical Education – Uttar Pradesh, Director, Subharti Medical College, Meerat, U.P.

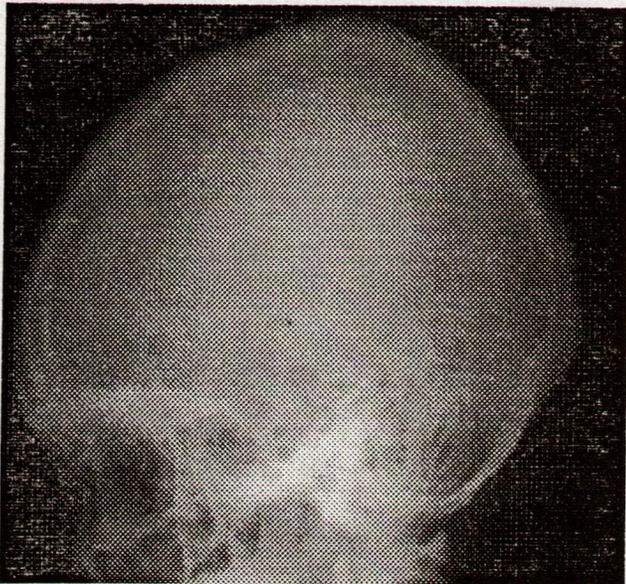
Introduction:

Determination of age is a common medico legal problem both in the living and dead. An opinion with reasonable accuracy can be given up to 25 years of age. Beyond this, age determination is associated with high percentage of deviation.

Changes in the hair, eyes, odontological changes as based on Gustafson's law and closure of Cranial sutures are some of the data helpful in the middle age group and upwards. The present study has been undertaken to find out the reliability of closure of Cranial Sutures as one of the data in determination of age in the living.

Material and Methods:

One hundred and four (104) individuals of different age groups were taken up for the study. Each individual was subjected to radiological examination of the skull with a view to study the Sagittal, Coronal and Lambdoid sutures, A special view (Gaur, Sahai, and Saxena) was evolved by trial in order to get all the basic three sutures in one film.

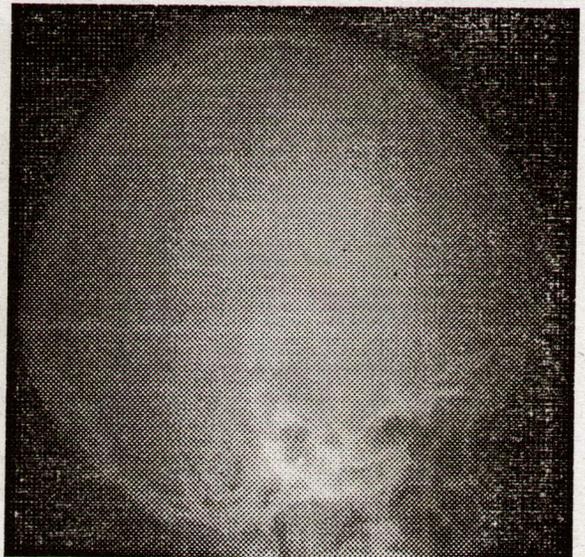


The patient was positioned for the true lateral view, but the tube head was kept at 30 degree towards

feet and 15 degree towards nose, keeping the distance of the tube head at 36 inches.

The following exposure factors were utilized using the grid (Moving Bucky.)

- I. 20 MA s
- II. 80 K Vp



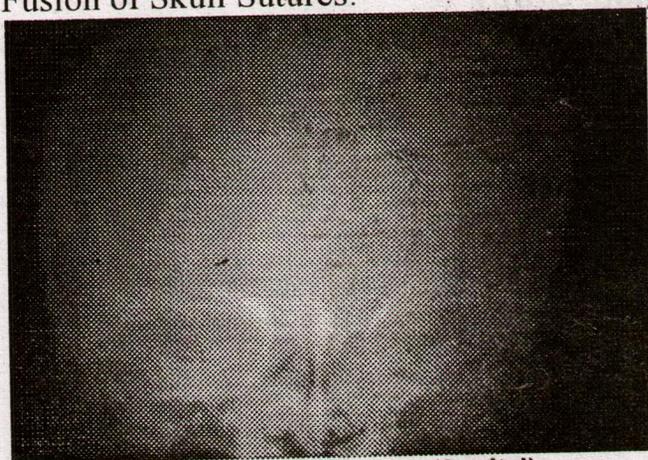
Advantages of this Special View:

1. All the three basic sutures were clearly visible and the study of all the three sutures could be made with one film.
2. Sutural spiking was seen more clearly and the distance from one spike to the other was visible in all three sutures clearly in one film.
3. Details of the fusion of sutures were seen, in which a ready comparison could be made of the various portions of various sutures, which could have been practically difficult to appreciate in two different films.

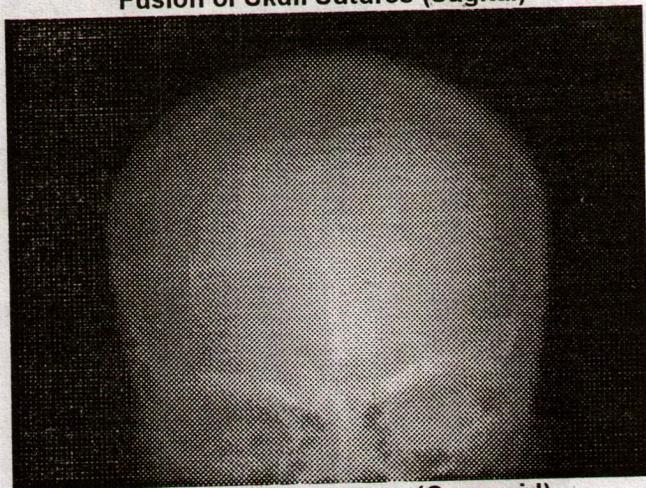
Disadvantages:

1. Except for the sutures the other details of the structures of the skull were not seen.
2. Being a lateral view, yet sella turcica could not be studied in this view.

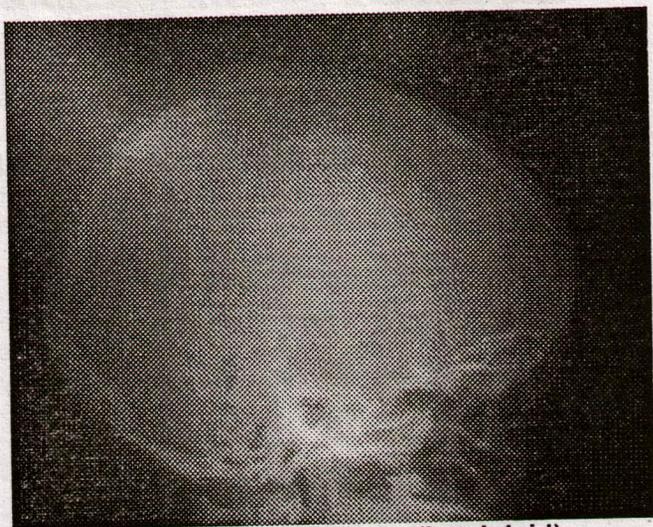
**Observations – are given in the tables:
Fusion of Skull Sutures:**



Fusion of Skull Sutures (Sagittal)



Fusion of Skull Sutures (Coronoid)



Fusion of Skull Sutures (Lambdoid)

In the 20 – 25 years age group 20 cases were studied and there was no evidence of fusion of any of the sutures.

In 26 – 30 years of age group 20 cases were studied and in this group also none of the sutures showed any evidence of fusion.

Twenty-four cases were studied in the age group 31 – 35 years. In this group Sagittal sutures showed complete fusion in 14 cases (58.33%), Partial fusion in 10 cases (41.67%). Coronoid sutures, 7 showed complete fusion (19.17%) and 17 showed partial fusion (70.83%) Lambdoid sutures, there was no evidence of fusion in this age group.

In the age group of 36 – 40 years 19 cases were studied and the sagittal sutures showed complete fusion in 12 cases (63.13%) and partial fusion in 7 cases (36.84%); Coronoid sutures showed complete fusion in 11 cases (57.89%) and partial fusion in 8 cases (42.11%) and lambdoid sutures 11 cases showed partial fusion (57.89%). The last age group comprised 21 cases belonging to age group 41 – 45 years and above. The sagittal suture showed complete fusion in 20 cases (95.24%) partial fusion in one case (4.76%) Coronoid suture in 16 cases (76.19%) showed complete fusion, 5 cases (21.81%) showed partial fusion and Lambdoid sutures in 9 cases (42.86%) showed complete fusion and partial fusion in 11 cases (52.38%)

Discussion:

1. The Special view described has been found helpful in studying all the sutures in one film.
2. If there is complete, non fusion of all the sutures, it can be assumed with reasonable accuracy that the person is below 30 years. This finding is in agreement with most of complete fusion of this suture.
3. The first suture to start fusion is the sagittal and in the age group 31 – 35 years, there is either complete or partial fusion of the sutures and by 40 years and above there is complete fusion of this suture.
4. If the Sagittal suture is completely fused the probable age can be given as above 40 years.
5. Lambdoid suture is the last to start fusion. Fusion commences in 31 – 35 years age group and the maximum percentage of fusion is above 40 years of age group.
6. If there is complete or partial fusion of all the three basic sutures, it may be safely concluded, the person is above 40 years.

28

Conclusion:

Study of Cranial Sutures by Radiological means is helpful to some extent in determining the age in the living. The Sutures, which are helpful, are sagittal, coronoid and Lambdoid. Complete absence of closure of these sutures indicate the age to be below 30 years

and complete fusion of all the three sutures fixes the age group to be above 40 years. Hence the present study indicates that along with other data, the Radiological Study of Cranial Sutures is a helpful Diagnostic aid in determination of age in the living.

Table No. I: Fusion of Skull Sutures (Sagittal)

Sr.No.	Age Group in Years	Fusion	Partial Fusion	No Fusion	Total
1	20 – 25	0	0	20	20
2	26 – 30	0	0	20	20
3	31 – 35	14 (58.33%)	10 (41.67%)	0	24
4	36 – 40	12 (63.13%)	7 (36.84%)	0	19
5	41 – 45 & Above	20 (95.24%)	1 (4.76%)	0	21

Table No. II: Fusion of Skull Sutures (Coronoid)

Sr.No.	Age Group in Years	Fusion	Partial Fusion	No Fusion	Total
1	20 – 25	0	0	20	20
2	26 – 30	0	0	20	20
3	31 – 35	7 (19.17%)	17 (70.83%)	0	24
4	36 – 40	11 (57.89%)	8 (42.11%)	0	19
5	41 – 45 & Above	16 (76.19%)	5 (21.81%)	0	21

Table No. III: Fusion of Skull Sutures (Lambdoid)

Sr. No.	Age Group in Years	Fusion	Partial Fusion	No Fusion	Total
1	20 – 25	0	0	20	20
2	26 – 30	0	0	20	20
3	31 – 35	0	7 (29.17%)	17 (70.83%)	24
4	36 – 40	0	11 (57.89%)	8 (42.11%)	19
5	41 – 45 & Above	9 (42.56%)	11 (52.38%)	1 (4.76%)	21

Reconstruction of body injuries leads to unraveling mystery behind unidentified mutilated skeletonised human remains

Dr. S. P. Garg

Assistant Professor & Head

Department of Forensic Medicine, S. S. Medical College, Rewa (M.P.)

Abstract:

Medico legists are frequently requisitioned by investigating agencies to examine and opine regarding identity, cause, manner & time since death of unidentified mutilated decomposed/ skeletonised human remains. Such an opinion in some of these cases can be very intriguing or even impossible to make. However, availability and examination of relevant facts/ information/ documents with regards to circumstantial evidences and their corroboration with autopsy findings including reconstruction of body injuries and examination of articles pertinent to the case can do wonders in this regard.

The case relates to unidentified mutilated human remains in advanced stage of decomposition, partial adipocere formation, near skeletonisation & partial mutilation, recovered from a ground well not in use for drinking water purpose, tied to a heavy stone slab. The pelvis and left Femur bones showed sharp cut injuries in unique and patterned fashion.

The paper discusses important issues of reconstructive Forensic Medicine in the light of the given case.

Key Words: Unidentified mutilated human remains, Reconstruction, Sharp cut effect, Bony injuries, Homicide.

Case Report:

Dead body of an approximately 30 years old unidentified male was referred to Department of Forensic Medicine, S. S. Medical College, Rewa (MP) in advanced stage of decomposition, near skeletonisation & partial mutilation for expert opinion.

Police gave the history that the remains were recovered from a ground well with 3' deep column of water (not in use for drinking water), tied with nylon rope to 36"x9"x4" size stone slab. 1.5mx1.25m white scarf and few clothings were found entangled in the remains, recovered from the site.

The remains were cleaned & cleared of scanty decomposed soft tissues present at places & were further examined in detail. Neck cartilages, left clavicle, left humerus, right radius, both wrist and hand bones, three cervical & seven thoracic vertebrae, seven ribs (3-right, 4-left) & few feet bones were missing. The bones had greenish algae deposits at places due to persistent and prolonged suspension in water.

The bones belonged to a single individual, male in character. Age was calculated to be 30 years (25-35 years) at death. Stature was ascertained to be 5'8" (5'6"-6').

Multiple sharp cuts with a definite pattern caused by heavy, hard & sharp object were present over pelvis (more on ischiopubic region), sacrum & head of left femur detailed as under:

1. Sharp cut effect right iliopubic eminence, anteroposterior, 2.5cm long, 0.7 cm deep
2. Sharp cut effect right arcuate line, transverse, 2cm long, 0.1 cm deep
3. Sharp cut effect both pubic crests, transverse, single infliction, 5cm long, 1 cm deep
4. Sharp cut effect non displaced through & through cut left pubic ramus, 2.3 cm long
5. Sharp cut effect inner aspect of left ischial tuberosity, transverse, 1.5cm long, 0.1 cm deep
6. Sharp cut effect both ischiopubic rami tangentially downwards starting 4.5 cm below pubic tubercle, 4 cm long, bone piece missing
7. Sharp cut effect lower half of right ischiopubic ramus with 3cm long piece partially displaced inwards in alignment with 1.5 cm long cut in lower part of right acetabulum
8. Sharp cut effect left acetabulum medial margin 2.5x1.5 cm (bone piece missing) & 2x0.5 cm one above other, 2x0.3 cm cut over head of left femur just below and lateral to fovea,

Note: on reconstruction both (8&9) are in alignment when hip is articulated in slight flexion, adduction and medial rotation

1. Sharp cut effect left arcuate line 4x0.8 cm, 8.5x0.7 cm, 9.2x1 cm
2. Superficial sharp cut effect left iliac fossa, nearly transverse, 4 cm long
3. Sharp cut effect on ventral aspect of sacrum 6 cm, 3.5 cm (vertical right lateral 1/3rd) 3.5x 1 cm, transverse (upper 1/3rd, bone piece missing) 1x1 cm, obliquely vertical right end of sacral promontory.

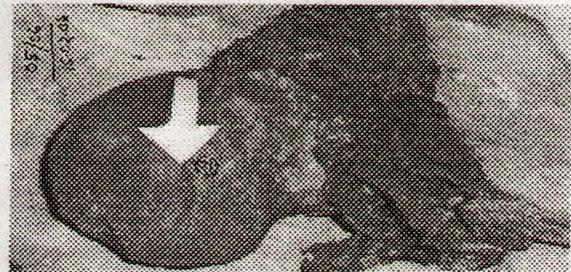
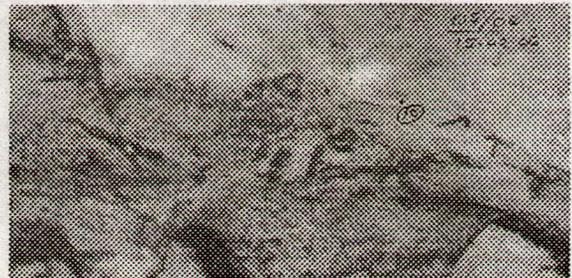
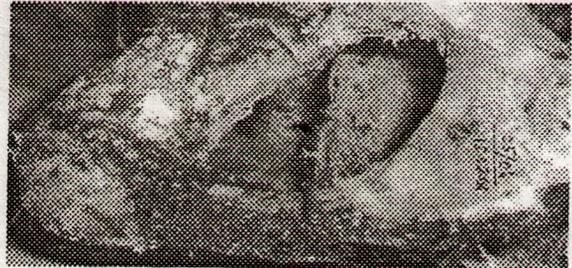
Note: The bones showed blackish, thick & tenacious material possibly clotted blood adherent to the cut effects more on superodorsal aspects of both pubic bones, outer aspects of both ischiopubic rami and right iliopubic eminence.

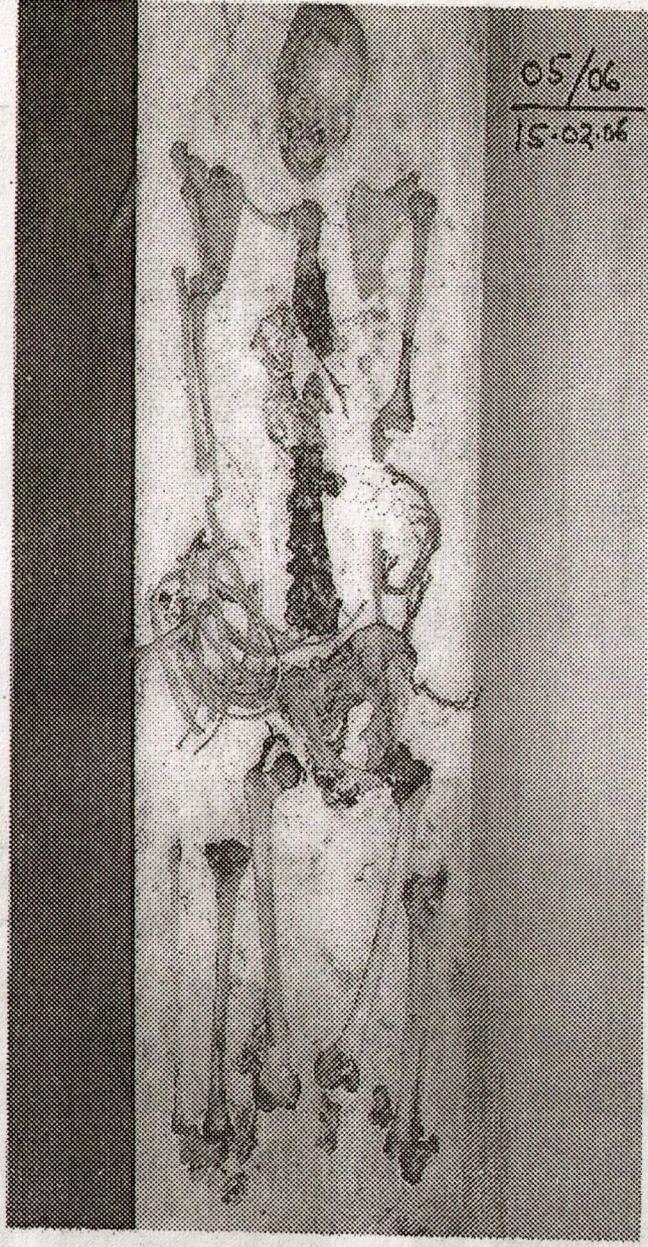
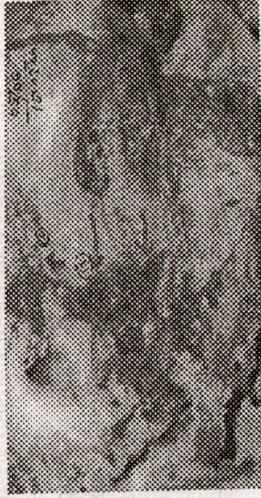
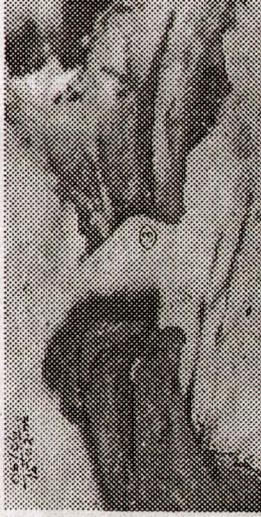
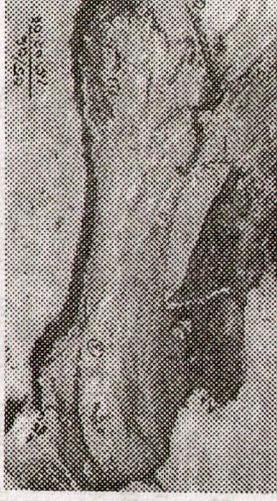
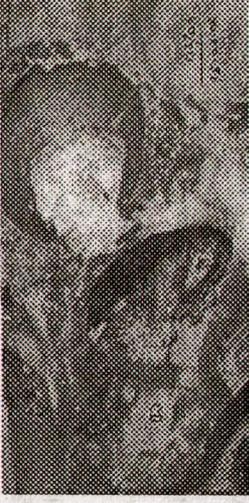
Inference & Discussion:

- The injuries had been caused by hard, heavy & sharp cutting weapon.
- The pattern & site of injuries suggested that there was deliberate attempt to chop off genitals (concentrated over perineum), which generally refers to the intent to punish someone for sexual crimes.
- Multiple & repeated forceful inflictions indicated elements of deep anger, revenge & possibly involvement of more than one persons.
- The pattern & site of injuries suggested that there was deliberate attempt to chop off genitals (concentrated over perineum), which generally refers to the intent to punish someone for sexual crimes.
- Multiple & repeated forceful inflictions indicated elements of deep anger, revenge & possibly involvement of more than one persons.
- The intention to dispose of the body secretly was clear.

Investigating officer was summoned to apprise him of the facts of the case. 10-15 persons of the same village were rounded up, four of them confessed of having committed murder. The deceased was identified as a 30 years old dacoit operating in the nearby jungle. The dacoit used to frequently visit the village for extortion and he recently had developed illicit sexual relationship with a woman who happened to be daughter of one of the persons making

confessions of the crime. The villagers planned to teach the man a lesson befitting to his wrongs themselves, as they did not have faith on the police. They killed the fellow on one of the night about three months before recovery of the body, when he secretly was paying visit to the lady. They had disposed off the body into a well in the outskirts of the village, dug out to fetch water for the crops. The well remained unused for nearly three months, as it was rainy season.





Study of Crime Against Women: Role of Forensic Medicine

*Dr. T.K.K. Naidu, M.D., LL.B., **Dr. Mukesh Yadav, M.D., LL.B., PGDHR

*PROF. & HOD, Forensic Medicine, Prathima Institute of Medical Sciences, Nagunur, Karimnagar, A.P.-505417.

**PROF. & HOD, Forensic Medicine, Muzaffarnagar Medical College, Muzaffarnagar, U.P.-251203.

Abstract

Due to rise in crowds naturally there is fall in cultural values and escalation in crimes. Crime against women is on the rise especially sexual crimes. Though crime is prevalent in every country and society, most of them either goes undetected or unreported. As per National Crime Records Bureau (NCRB), New Delhi, a crime take place every 17 seconds, among them one dowry death every 77 minutes, one crime against women every 3 minutes and finally one rape or sexual assault every 27 minutes. With above crime scenario, Forensic Medicine plays an important role in helping to prevent, early detection, providing expert medicolegal and scientific reports at earliest, which will result in quick trial and instant administration of justice to victims. Due to lack of legal or medicolegal and scientific awareness and knowledge among victims, investigating agencies, medical and paramedical staff, the end result is either 'justice hurried is justice buried' or 'justice delayed is justice denied' to the victim. There is need to give importance to Forensic Nursing, impart medicolegal knowledge to paramedical and health workers in rural and semi-urban levels as to how to handle case of crimes committed against women and report them. One accused acquitted means breeding of hundred criminals. Prevention and detection is better than conviction.

Key Words: torture, Sexual Assault, Dowry Death, Crime, Women.

Introduction:

Crime Against Women [CAW] is centuries old even in mythology Ramayana and Mahabharata stories of Sita being fire tested to prove her chastity after being kidnapped by Ravana, striping of Draupadi by Dushasana in open darbar. Still this social crime CAW is continuing even today. Ramas, Ranas and Dushansa are born and behave like them. Goddess like: Lakhmi, Saraswati, Sita, Radha and Kali are worshiped and crores are spent in building their temples, but in real life CAW is a every day tragedy to be read in every possible newspaper. Majority of the case either go undetected or unconvicted due to lack of dedication, devotion, cooperation and co-ordination of different departments involved in CAW investigation. Extra effort or interest on part of forensic pathologist can only solve these cases. CAW starts from cradle to cremation and birth to burial ground. Women suffer the most because they're naturally, biologically and physically less stronger and less aggressive than men.

According to National Crime Records Bureau's (NCRB) recent report '**Crime Clock-2005**', which tracked criminal activities over the last year, the country reported one crime against women every three minutes; one molestation every 15 minutes; one rape every 29 minutes, one dowry death every 77 minutes, and one sexual harassment case every 53 minutes. Among the crimes listed by the NCRB,

rape, molestation, sexual harassment, and dowry deaths were reported more frequently. The figures could be much higher as only those crimes, which were reported to the police under the Indian Penal Code (IPC), were listed on the Clock. Out of all the crimes against women rape is most heinous one. Delhi is the least safe city for women. In 2004, it accounted for 30% of rapes recorded in the country's 35 major cities, according to the Bureau. [1] There were 457 reported rapes in the city out of 1510 cases reported in others. According to the NCRB of India, there were 7026 dowry deaths in India in 2005. [2] Two to three burnt and mangled young women are admitted into the overcrowded 45-bedded Victoria Hospital at Bangalore Medical College every day. The police list the cause of accident as "stove burst" but social worker calls them dowry deaths. [2] Vimocha, an NGO that has been tracking unnatural deaths of women in Bangalore and its outskirts for over a decade found that in 2007, three dowry or harassment-related deaths per day, with burning accounting for half, hanging and poisoning account for the rest as compared to one death each day in the year 1997. [2] In the year 2006, the medical journal *The Lancet* had reported that female foeticide had led to 10 million girls missing over two decades. The findings were based on a survey of 1.1 million households.[3]

A recent UN Population Fund report had revealed that around two-thirds of married women in India were victims of domestic violence. One incident of violence translates into women losing seven working days in the country. The report claimed that 70% of married women in India between the ages of 15-49 years were victims of beating, rape or coerced sex. The National Family Health Survey-III, carried out in 29 States during 2005-06, has found that a substantial proportion of married women have been physically or sexually abused by their husbands at some time in their lives. [2]

Violence affects the lives of millions of women worldwide, in all socio-economic and educational classes. It cuts across cultural and religious barriers, impeding the right of women to participate fully in society. Violence against women takes a dizzying variety of forms, from domestic abuse and rape to child marriages and female circumcision. All are violations of the most fundamental human rights. In a Statement to the Fourth World Conference on Women in Beijing in September 1995, the United Nations Secretary-General, Boutros Boutros Gahli, said that violence against women is a universal problem that must be universally condemned. But he said that the problem continues to grow. The Secretary-General noted that the domestic violence alone is on the increase. **Studies in ten countries**, he said, have found that between **17 to 38% of women have suffered physical assaults by a partner**. In the **Platforms for Action-1995**, the core document of the **Beijing Conference**, Government declared, **"violence against women constitutes a violation of basic human rights and is an obstacle to the achievement of the objectives of equality, development and peace"**.

The Vienna Accord of 1994 and the Beijing Declaration and the Platform for Action (1995) have acknowledged that domestic violence is undoubtedly a human rights issue. The United Nations Committee on Convention on Elimination of All Forms of Discrimination against Women in its General Recommendations has recommended that State parties should act to protect women against violence of any kind, especially that occurring within the family. The phenomenon of domestic violence in India is widely prevalent but has remained invisible in the public domain. The civil law does not address this phenomenon in its entirety. Presently, where her husband or his relatives subject a woman to cruelty, it is an offence under section 498A, IPC. [5]

Domestic violence is undoubtedly a human rights issue and serious deterrent to development. The Vienna Accord of 1994 and the Beijing Declaration and the Platform for Action (1995) have acknowledged

this. The UN has recommended that State parties should act to protect women against violence of any kind especially that occurring within the family. [6] The phenomenon of domestic violence is widely prevalent but has remained largely invisible in the public

domain. Presently, where her husband or his relatives subject a woman to cruelty, it is an offence under section 498-A, IPC. The civil law does not, however, address this phenomenon in its entirety. It is, therefore, needed to enact a law keeping in view the rights guaranteed under articles

14, 15 and 21 of the Constitution to provide for a remedy under the civil law, which is intended to protect the woman from being victims of domestic violence and to prevent the occurrence of domestic violence in the society. The Act [7] provides provisions for the following:

- (i) It covers those women who are or have been in a relationship with the abuser where both parties have lived together in a shared household and are related by consanguinity, marriage or through a relationship in the nature of marriage or adoption. In addition, relationships with family members living together as a joint family are also included. Even those women who are sisters, widows, mothers, single women, or living with the abuser are entitled to legal protection under the proposed legislation. However, whereas it enables the wife or the female living in a relationship in the nature of marriage to file a complaint under the proposed enactment against any relative of the husband or the male partner, it does not enable any female relative of the husband or the male partner to file a complaint against the wife or the female partner.
- (ii) It defines the expression "domestic violence" to include actual abuse or threat or abuse that is physical, sexual, verbal, emotional or economic. Harassment by way of unlawful dowry demands to the woman or her relatives would also be covered under this definition.
- (iii) It provides for the rights of women to secure housing. It also provides for the right of a woman to reside in her matrimonial home or shared household, whether or not she has any title or rights in such home or household. This right is secured by a residence order, which is passed by the Magistrate.
- (iv) It empowers the Magistrate to pass protection orders in favour of the aggrieved person to prevent the respondent from aiding or committing an act of domestic violence or any other specified act, entering a workplace or any other place frequented

by the aggrieved person, attempting to communicate with her, isolating any assets used by both the parties and causing violence to the aggrieved person, her relatives or others who provide her assistance from the domestic violence.

"A man will think 10 times before he traumatizes his wife in any way"- comments by social activist Nafisa Ali on the ACT. [8]

It provides for appointment of Protection Officers and registration of Non-Governmental Organizations as service providers for providing assistance to the aggrieved person with respect to her medical examination, obtaining legal aid, safe shelter, etc.

Duties of medical facilities:

If an aggrieved person or, on her behalf a Protection Officer or a service provider requests the person in charge of a medical facility to provide any medical aid to her, such person in charge of the medical facility shall provide medical aid to the aggrieved person in the medical facility. This section seeks to provide that the person in charge of the medical facility shall be bound to provide medical aid to the aggrieved person if requested by her or on her behalf by a Protection Officer or a service provider. [Section 7] [9]

Role of Forensic Medicine:

Role of Forensic Medicine is crucial and critical in prevention, awareness, detection and conviction of perpetrators of CAW. A well-established medicolegal system only can act as deterrent to this menace.

Prevention: CAW is a preventable crime:

1. If forensic trained nurses as in west, Sexual Assault Nurse Examiners (SANE) are employed.
2. The special organization with coordination of services of Sexual Assault Resource Team (SART) is helpful. To appoint forensic experts at district level hospitals.
3. To train, organize seminars and workshops for lawyers, police officers, Para medical staff and NGOs as how to handle cases of CAW, medico legally.
4. To bring about awareness among women in particular and public in general as to how where and when to bring to the notice of police in cases of CAW.
5. Introduce one year PG diploma course in forensic medicine after MBBS course, so as to deal with cases in rural and semi urban areas.
6. Use of 'Safe Kit' in case of rape or sexual assaults as designed by NGO, CEHAT of Mumbai to incorporate forensic nursing in nursing courses.

Common Cases of CAW:

- Sexual assault.
- Rape.
- Dowry death.
- Molestation.
- Cruelty by husband and other in-laws.
- Eve teasing alleged love with homicidal ending.
- Domestic Violence.
- Sexual Harassment of Women at Work Place.

Naina Sahani tandoor murder case, Jessica Lal case, Priyadarshini Matto case, Miss Bhatnagar murder case and many more cases go undetected or unconvicted due to improper medicolegal investigation either justice is hurried and buried or delayed and denied. Medicolegal experts should always give prompt, scientific and accurate report in cases, of CAW for fast trial instant justice to the victims. One rapist convicted 100 rapes can be prevented.

Examples:

- Collecting minute trace evidences,
- Recording of proper and exact history of the crime from investigating agencies
- Conduct postmortem with proper instruments and collect different samples of blood, viscera in poisoning cases of CAW followed by prompt sending and obtaining result from Forensic Science Laboratory.
- DNA finger profiling from sources to identify suspects from hair, blood, semen and other biological fluids from scene of violent crime especially in rape cases.

Instances:

- Shoot particles in trachea are present in dowry death cases due to ante mortem burn death.
- Postmortem staining, dribbling of saliva, and ligature mark, if properly examined gives clues of ante or post mortem hanging or strangulation.
- Diatom test, a positive sign of ante mortem drowning.
- Female infanticide hydrostatic test indicates still or dead born.
- Proper collection and preservation of clothes and undergarments helps in rape and assault cases
- Proper documentation of ante and postmortem injuries on private part in sexual assault and torture cases.
- Medicolegal examination of ante mortem and post mortem burns
- Above are some common instances, which need detail and meticulous examination for administration of justice to the victim in CAW cases.

Conclusion:

In India, to prevent CAW Medico legal services have to be improved and upgraded. Communication gaps and hiccups between different investigation agencies to be narrowed or plugged. CAW is preventable and can be eradicated if it can be tackled in multiphase efforts. However, Forensic Medicine has a critical role in striking a balance between law, public and police properly. Though many laws have been enacted for prevention of CAW ground reality is different, due to illiteracy, ignorance of law and neglected medicolegal services, in rural areas cases go unreported or unconvicted. If advanced technology like brain mapping, narcoanalysis DNA profiling polygraph methods are used CAW cases can be solved. In modern day society pre and post marital affairs, influence of electronic media, films, books, T. V. Serials, alcohol and drugs have resulted in raise in CAW cases all over the country.

Police should give priority to deal with the cases of CAW without any favouritism. There is need for opening more than one police station in a district to deal with CAW. There is need for organizing seminar, workshop, etc., on human rights of women to create awareness on women issues. [9]

The need for a Witness Protection Programme in India has long been felt. The 198th report of the 17th Law Commission of India, headed by the Chairman, Justice M. Jagannandha Rao, submitted to government of India a fortnight ago, has recommended a Witness Identity Protection (WIP) Programme. [10]

The report proposes that witness identity should neither be available to any of the accused nor be in the public domain. It recommends the use of videoconferencing to conceal identity; alternatively, a physical shield could be provided to ensure the defendant's right to cross-examine the witness.

The government will have to guarantee anonymity to the witness.

In order to provide a remedy in the civil law for the protection of women from being victims of domestic violence and to prevent the occurrence of domestic violence in the society this Act [7] is an answer and Forensic Medicine experts could be of great help in prevention of CAW. Last but not least prevention and detection of CAW is better than conviction. Condemn control and prevent crime against women.

References:

1. The Hindu, September 4, 2006.
2. [Sanchita Sharma, 'Tech city's burning issue', Hindustan Times, February 4, 2007: 8.
3. [Vidya Krishnan, 'Missing brides of Rajasthan', Hindustan Times, March 11, 2007: 15.
4. [Kounteya Sinha, '37% married women abused', The Times of India, March 12, 2007: 9.
5. Ratanlal and Dhirajlal. The Indian Penal Code. 28th Edition-1997.
6. [The UN Committee's Recommendation on Convention on Elimination of All Forms of Discrimination against Women (CEDAW), in its General Recommendation No. XII (1989).
7. [The Protection of Women from Domestic Violence Act, 2005 (43 Of 2005).
8. 'Is new Act a sarkari okay for live-ins?' The Times of India, November 8, 2006: 2.
9. [Centre considering Bill to check Domestic Violence: NHRC', The Tribune, May 11, 2005: 13.
10. "Law panel moves on witness safety", The Times of India, September 16, 2006: 1, 9.

Handedness in Skeletal Remains

*Tanuj Kanchan, **T. S. Mohan Kumar, ***G. Pradeep Kumar, ***K. Yoganarasimha

*Assistant Professor

*Assistant Professor, Department of Forensic Medicine, Kasturba Medical College, Manipal.

***Professor, Department of Forensic Medicine, Kasturba Medical College, Manipal.

Corresponding Author:

Dr Tanuj Kanchan

*Assistant Professor

Department of Forensic Medicine, Kasturba Medical College, Mangalore- 575001, Karnataka, India.

Phone No. +91 824-295565 (O) +91 9448252394 (R) Fax: +91 8242428183

Abstract

Identification of a highly decomposed body and skeletal remains is of paramount importance in the investigation of a crime. While general characteristics of the skeletal remains like age, sex, stature, race etc. place the subject in a specific group, determination of any special characteristic can help identify the remains further. Handedness can be an important individual skeletal characteristic and an important criterion of identification in highly decomposed bodies and skeletal remains when used in corroboration with other findings. A case report of skeletal remains examination that was suggestive of handedness presented with review of relevant literature.

Key Words: Identification; Skeletal Remains; Handedness.

Introduction:

Identification is a vital component of a medicolegal investigation especially when the body is in advanced stage of putrefaction or skeletonisation. While determination of general characteristics such as race, sex, age and stature from bones give a valuable information in establishing the identity of the individual, determination of any special characteristics like natal changes, skeletal changes with particular reference to those due to mechanical stress resulting from handedness, musculoskeletal activity and occupation can help in narrowing down positive identification to a few individuals [1,2,3].

Handedness is an important aspect of human personality, and is defined as the hand that one prefers to use, regardless of performance. Overall handedness is the consistent preference for one hand in humans. Handedness is usually classified as Right and left or right and non-right, a third category is added to include ambidexterity i.e. ability to perform acts requiring manual skills with either hand. Many studies have been done based on Anatomist Bo Ingelmark's observation, that right and left-handedness are reflected in a slight lengthening of the bones in the dominant arm [4]. This lengthening is attributed to load bearing tasks such as lifting, digging, throwing etc., rather than by fine motor skills like and writing [5].

Bones grow both circumferentially and longitudinally. Growth in diameter is dependent on periosteal ossification, and length on endochondral ossification of the epiphyseal plate. Genetic, hormonal, nutritional as well as Mechanical stress influences the bone growth.

However, environmental stress has also been considered as a favoured cause for dsymmetry over biomechanical influences [6].

Case Summary:

In July 2004, police recovered a partially skeletonised body in hanging state from the forest area of Kollur, Karnataka. Medicolegal autopsy was performed and a set of bones were sent to Kasturba Medical College, Manipal for an opinion, included skull with mandible, 7th cervical, 15t and 2nd thoracic vertebrae, right hip bone, right fibula, right and left humerus, ulna, femur and tibia. The bones were wet, yellowish brown in colour, with cartilaginous attachments at articular surfaces and decaying odour. Maggots and pupae were present all over the bones. After preliminary examination, the bones were kept in 10% sodium hypochlorite solution. The bones were reexamined in detail after two days. Calipers, osteometric board and weighing machine were used to measure various dimensions of the limb bones.

Among the various dimensions of the upper limb bones (humerus and ulna), length and weight indices showed obvious increase for the right side when compared to left side. Articular surface dimensions were found to be more on the right side in humerus while supinator crest was more prominent and supinator fossa deeper in the right sided ulna. (Tables 1 & 2). After detailed examination of the skeletal remains it was opined that the Dones belonged to a right handed male aged about 50 years. Stature was estimated to be between 172-176 cms.

Discussion:

Human hand preferences develop in early childhood and the bones of the arm on the preferred or dominant side are subjected to consistent greater loading and tend to grow slightly more in length during childhood and adolescence. Mechanism of this skeletal asymmetry is the bone growth response to loading just like disuse of a limb leads to atrophy. On exposure to repeated high levels of mechanical loading, bones respond by growing more vigorously and increasing in density [5]. Handedness may affect the long bones of the dominant side in terms of trabecular structuring. More stress and strain on the dominant side, depending on the occupation, may cause differences between the sides [3], often referred to as directional asymmetry. Morphological asymmetry is concerning length, weight and articular surface dimensions was pronounced in upper limbs and has been attributed to handedness. Various dimensions of Humerus and Ulna were larger on the

This pattern of asymmetry in relation to dominant side has been observed in hand length [11], and muscles and bone weight of upper limbs [12]. Various other indicators of handedness towards the dominant side are- deflection and beveling of glenoid fossa of scapula [13], larger and prominent rhomboid fossa [3], shorter clavicle with pattern of symmetry in curvature, robusticity, morphology of ligament and muscle attachment sites [14], greater arm bone length, circumference, weight and articular surfaces with prominent muscle attachment markings, including intertubercular sulcus of humerus [15], supinator crest hypertrophy and prominent supinator fossa of ulna [7]. Approximately 90% of the world's population is right handed. This skeletal asymmetry due to handedness, especially in a left-handed individual enhances the precision of identity

Table 1: Comparative dimensions of humerus

	Right	Left
Length	33.7 cms	33.0 cms.
Weight	161.43 gms.	147.46 gms.
Head circumference	14.0 cms.	13.7 cms.
Vertical head diameter	7.5 cms.	7.3 cms.
Max. Shaft circumference	7.2 cms.	7.0 cms.
Distal articular breadth.	6.3 cms.	6.2 cms.

Table 2: Comparative dimensions of ulna

Ulna	Right	Left
Length	28.9 cms	28.2 cms.
Weight	74.97 gms.	67.97 gms.
Supinator Crest	More Prominent	Less Prominent
Supinator fossa	Deeper	Less deep

References:

- Pickering RB, Bachman DC. The Use of Forensic Anthropology, New York: CRC press, 1997. pp.93-95
- Mant AK. Identification of the living and dead. In Mant AK, editor. Taylor's Principles and Practice of Medical jurisprudence. New York: Churchill Livingstone, 1984, pp. 156, 175.
- Krogman WM, Iscan Y. The Human Skeleton in Forensic Medicine. Springfield: Charles C. Thomas, 1986, pp. 376, 401, 402, 407, 409-410.
- Ingelmark BE. Asymmetry in the length of extremities and their relation to right and left.: handedness. Uppsala LaekarE3foennng for 1974; 52: 17-82.
- Steele J, Mays S. Handedness and directional asymmetry in the long bones of the human upper limb. Int J Osteoarchaeology 1995; 5: 39-49.
- Albert AM, Greene DL. Bilateral asymmetry in skeletal growth and maturation as an indicator of environmental stress. Am J Phy Anthropology 1999; 110: 341-349.
- Kennedy KA. Morphological variations in ulnar supinator crests and fossa as identifying markers of occupational stress. J Porensic Sci 1983; 28 (4): 871-876.
- Plochocki JH Allateral variatiorn in limb articular surface dimensions. Am J Hum Bioi 2004; 16: 313-333.
- Latimf HB, Lowrance E\N. Bilateral asymmetry in weight and in length of human bones. The Anat Reconfr1965; 152: 217-224.
- Ouk T, Leben-Seljak P, Stefancic M. Lateral asymmetry of human long bones. Variability and evolution 2001; 9: 19-32.
- Means LW, Waiters RE. Sex, hanedness and asymmetry of hand and foot length. Neuropsychologia 1982; 20 (6): 715-719.
- Pande BS, Singh 18. One-sided dominance in the upper limb of human fetuses as evidenced by asymmetry in muscle and bone weight. J Anat 1971; 109 (3): 457-459.
- Schulter, Ellis FP. Evidenc of handedness on documented skeletons. J Forensic Sci 1980; 25: 624-630.
- Mays S, Steele J, Ford M. Directional Asymmetry in the Human Clavicle. Int J Osteoarchaeology 1999; 9: 18-28.
- Vettivel S, Selvaraj KG, Chandi SM, Indrasingh I, Chandi G. Intertubercular sulcus of the humerus as an indicator of handedness and humeral length. Clin Anat 1995; 8: 44-50.