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Profile of Medicolegal Autopsy Cases at Tertiary Care Centre in Bagalkot, Karnataka

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Abstract

Background: The profile of medicolegal autopsy cases is important in order to know the death statistics in a region due to unnatural causes and also help to address the demographic needs according to the mortality statistics specific to that area. *Material and Methods*: The present study is a retrospective study of autopsies performed at the tertiary care centre, S Nijalingappa Medical College, Bagalkot, Karnataka India. Data collected from department of medical records and department of forensic medicine from January 2016 to December 2017 comprising 64 cases. *Results*: Out of 64 cases maximum number of the postmortem were in the age group of 21–30 years, majority of victims were males (61%), in identified bodies 88% were Hindu, 8% Muslim, 4 % were others. In our study 57.5% were rural residents and only 34.5% were urban. In 8% cases religion and residential status could not be determined. Death due to burn injuries and its complications formed majority of cases (37.5%) in our study followed by RTA (22%) and poisoning (15.5%). *Conclusions:* In our hospital based study of medicolegal autopsy cases- majority were in 3rd decade of life, males constituted more in number as compared to female, rural residents were more in number, Hindus being majority in number formed bulk of cases, burns, RTA and poisoning were seen as leading cause of death in medicolegal autopsies.

Keywords: Autopsy; Natural Deaths; Unnatural Deaths; Road Traffic Injuries; Burns; Hanging.

Introduction

Autopsy means (autos = self, opis = view) to see for oneself. Necropsy (necros = dead, opis = view) is most accurate term for the investigative dissection of the dead body, but the term autopsy is commonly used and is more popular. Postmortem (post = after, mortem = death) examination is an alternative term used but suffers from lack of precision about the extent of examination. In some countries, many bodies are disposed off after external examination without dissection, in such situation; the procedure is called as postmortem examination [1].

The objective of medicolegal post-mortem examination is to establish the identity of a body, when not known; to ascertain the time since death and the cause of death; and whether the death was natural or unnatural and if unnatural, whether it was homicidal, suicidal or accidental. In case of new born infants, the question of live birth and viability assume importance and should be determined [2]. The term "postmortem examination" is often used as a simile for "autopsy." Basically, it is not [3]. A postmortem examination means only what it says that the body was examined after death. It can mean and often does mean that the physician merely looked at the body, fully clothed, or that he "viewed" the body at a funeral home or in a morgue. A complete autopsy involves opening all body cavities and all organs of the trunk, chest, and head [4]. In all cases, a complete and not a partial examination are more necessary in this country on account of the imperfectness of the preliminary evidence as to the possible cause of death [5].

Material and Methods

The present study is a retrospective study of

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medicolegal autopsies performed at S. Nijalingappa Medical College, Bagalkot, Karnataka, India, from January 2016 to December 2017. Permission was not taken from IEC as it was a record based study without involving any live subjects or experimentation. During the study period 64 medicolegal autopsies were performed by dept of Forensic Medicine. Data were collected using a pre-designed format from postmortem registers/records; Inquest papers and Post mortem reports maintaining at most confidentiality.

Results

From the Table 1- Out of total 64 cases 61% were Male and 39 % were Female. A significant number i.e. 26.5% were in the age group of 20 – 30 years and least number of cases (1.5 %) were seen after 70 yrs of age.

From the e Table 2- 92% were Identified,8% were Unidentified. Of the identified 88% were Hindu, 8% Muslim, 2% were others. In 8% cases Religion could not be determined as they were unidentified bodies.

From the Table 3-34.5% were Urban and 57.5% were Rural residents.

From the Table 4- highest number of cases seen in May to August (40%) and less number in September-December.

From the Table 5- death due to burn injuries (37.5%) was most common cause of death, followed by Road traffic accident (22%), Poisoning (15.5), Railway accidents (08%) and snake bite in 4.5%.

Table 1: Age & Sex wise distribution of cases

Age (in years)	Male	Female	Total	Percentage (%)
0-10	01	01	02	03
11-20	03	04	07	11
21-30	07	10	17	26.5
31-40	11	05	16	25
41-50	08	03	11	17.5
51-60	05	01	06	9.5
61-70	03	01	04	06
71-80	00	00	00	0
81-90	01	00	01	1.5
Total	39 (61%)	25 (39%)	64	100

Table 2: Distribution of cases according to Religion

Religion	No	Percentage
Hindu	52	88
Muslim	5	8
Others	2	4

Table 3: Distribution of cases according to residence

Region	No	Percentage
Urban	22	34.5
Rural	37	57.5

Table 4: Month wise distribution of cases

Months	Total	Percentage
January – April	23	36
May – August	27	40
September-December	14	24

Table 5: Distribution of cases according to cause of death

Cause of Death	No. of Cases	Percentage
Burns	24	37.5
RTA	14	22
Poisoning	10	15.5
Railway accidents	05	08
Snake bite	03	4.5
Hanging	02	03
Unknown	02	03
Fall from height	01	1.5
Honey bee	01	1.5
Operational death	01	1.5
Natural	01	1.5

Discussion

During the study period a total of 64 cases of mediolegal autopsies were performed by department of forensic medicine department. Out 64 cases maximum number of the postmortem were in the age group of 21–30 years which is the most productive year in ones life (Table 1). Findings of our study are consistent with findings of other authors [2,3,6,10,11].

In our study majority of victims were males (61%), similar findings are see in following studies. Murthy et al [5] studied 150 cases out of which 123 (82%) males and 27(18%) were females. Singh et al [6] studied 200 cases with 170 (85%) males and 30 (15%) females. Bhullar et al [7] and Sharma et al [8] found 66.5% males and 33.5% females. Similarly Singh et al [9] studied 74.8% males and 24.2% females in their study and KV Radhakrishna et al [10] in which males were 69%. The reason being that as males are bread earners and females usually doing house hold work, which makes the males more vulnerable to accidents, violence and stress and also males predisposed for addiction and risk taking behaviour .

In our study of the identified 88% were Hindu, 8% Muslim, 4% were others. Similar findings are observed in studies by other authors [2,3,6,10]. This difference may due to prevailing population dynamics across India.

In our study 57.5% were rural residents and only 34.5% were urban. This finding is contradicting to results of other studies in which urban residents were in majority [2,3,6,10,11]. This difference is due to our centre is attached with rural police station of Bagalkot and n other studies with city police stations and also our hospital serves mainly rural population and hospital deaths form bulk of autopsies performed. In 8% cases Religion and Residential status could not be determined.

Death due to burn injuries and its complications formed majority of cases (37.5%) in our study followed by RTA (22%) and poisoning (15.5%). But in other studies [2,3,6,10,11] RTA was seen as most common cause of death followed by suicide by hanging nest most common. This difference may again be due to most autopsies at our centre being from admitted cases of burns and poisoning being most common method employed by rural population. In month wise distribution findings of our study showed more cases in the period between May to August and similar findings are seen in a study by Patel et al [11].

Conclusions

Study conducted at SN Medical College Bagalkot to know the profile of medicolegal autopsies during a period one year from January 2016 to December 2017 comprising. A total cases comprising 64 medicolegal autopsies were included in the study, in our study we found following - majority were in 3rd decade of life, males constituted more in number as compared to female, rural residents were more in number, Hindus being majority in number formed bulk of cases, Burns RTA and poisoning were seen as leading cause of death in medicolegal autopsies. Maximum number of cases were recorded in the period between May to August.

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Case Scenario Based Teaching in Forensic Medicine to Improve Student Learning

Amit Sharma*, Shahina, P.C. Dikshit*****

Abstract

Case scenario method is a powerful student-centred teaching strategy that can impart students with critical thinking, communication, and interpersonal skills and allows students to develop a collaborative, team based approach to their education. A cross sectional study was conducted on 3rd semester students (n=100) at Forensic Medicine department, Hamdard Institute of Medical Sciences & Research, Jamia Hamdard for period of 4 months to use case scenario based (CSB) learning approach as a tool to improve students understanding of applied aspects of Forensic Medicine and encouraging them to actively participate in teaching learning processModules were prepared for case based teaching methodologies on four topics of Forensic Medicine namely medico-legal autopsy, mechanical injury, Thanatology and crime scene investigation.At the end of study program feedback evaluation of the program was done using questionnaire containing items pertaining to student's satisfaction and participation based on Likert's 5 rank scales. The assessment was done using MCQ's and OSPE. More than 75 % of the students reported improvement in learning and engagement due to more active participation, were more organized in learning approach, increased analytical skills and problem solving ability and improved communication skills, collaborative skills by case scenario based (CSB) learning approach.

Keywords: Case Scenario Based Learning; Forensic Medicine; Students Learning.

Introduction

In many medical colleges the teaching is very teacher centred, mainly emphasising on acquiring theoretical knowledge that does not train the students on clinical aspects, therapeutics and hidden evidences. Forensic Medicine is no exception to this. In the past decade or so a number of education programmes have been developed in different institution.

Case method is a powerful student-centred teaching strategy that can impart students with critical thinking, communication, and interpersonal skills.

Case Based Learning (CBL) is an educational paradigm closely related to the more common Problem Bases Learning (PBL). This PBL approach is andragogical (adult teaching/learning), posing contextualised questions that are based upon ''real life'' problems that may be clinical or non-clinical [1]. CBL's main traits derived from PBL are that a case, problem, or inquiry is used to stimulate and underpin the acquisition of knowledge, skills, and attitudes. Cases place events in a context or situation that promote authentic learning [2]. Cases are generally written as problems that provide the student with a background of a patient or other clinical situation. Supporting information is provided, such as latest research articles, vital signs, clinical signs and symptoms, and laboratory results. CBL allows students to develop a collaborative, team based approach to their education.

Having students work through complex, ambiguous, real world problems engages students with the course material, encouraging them to "see it from an action perspective, rather than analyze it

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from a distance" [3]. Case studies are, by their nature, multidisciplinary, and "allow the application of theoretical concepts…bridging the gap between theory and practice" [4]. Working on cases requires students to research and evaluate multiple sources of data, fostering information literacy.

Case method is also effective at developing real world, professional skills. Working on case studies requires good organizational and time management skills. Case method increases student proficiency with written and oral communication, as well as collaboration and team-work. "Case studies force students into real-life situations," training them in managerial skills such as "holding a meeting, negotiating a contract, giving a presentation, etc." [5].

Aim & Objectives

Aim

To use case scenario based (CSB) learning approach as a tool to improve students understanding of applied aspects of Forensic Medicine and encouraging them to actively participate in teaching learning process.

Specific Objectives

1. To ensure students participate actively in teaching learning process.
2. To make students self-directed learners.
3. To improve students understanding of applied aspects of Forensic Medicine.

Methodology

This cross sectional study was conducted on 3rd semester students (n=100) at Forensic Medicine department, Hamdard Institute of Medical Sciences & Research, Jamia Hamdard for period of 3 months. Modules were prepared for case based teaching methodologies on following four topics of Forensic Medicine:

1. Medico-legal autopsy
2. Mechanical injuries,
3. Thanatology and
4. Crime scene investigation.

Students were divided into 10 groups each having 10 members. The topic of discussion from the prepared modules were conveyed to the students seven days in advance. During the session a case scenario pertaining to the topics of discussion e.g. court room scene, crime scene, etc. was put before the groups of the students. Each group was given 10 min to discuss the case scenario amongst their group members. Systematicallyone group was selected and asked to complete the desired task in 20 min and then discuss their findings to rest of groups in next 10 min. Rest of the groups then provided feedback, comments and suggestions moderated by the faculty member to the presenting group during next 20 min. The whole one exercise was completed in 1 hour. It was made sure that all the groups were exposed to all the modules during the study period.

Examples of the Modules

Example 1

A 25 yrs male, found dead at his home on 21.10.2015 at 8:30 am. Your team is assigned to go to the scene of crime and investigate. Your tasks are to:

a. Organize your team and designate specific responsibility to each member clearly mentioningthe role of every member.
b. Secure the crime scene.
c. Collect evidences in scientific manner.

At the end of the task discuss the difficulties you faced in completing the given tasks and provide suggestions to overcome them.

A dummy crime scene was created in the demonstration room of the department. Other groups were asked to observe and provide their feedback in the later part of the module.

Example 2

A 5 years child is brought before you having multiple injuries. His parents told you that he fell from stairs (20-25 in numbers) while running down on the staircase yesterday morning (20 hours before the examination). The child is not telling you anything and crying continuously. Your tasks are:

A. Examine the child and prepare detail injury report.
B. Comment upon the duration and nature of the injuries based on the examination report.
C. What inference/opinion you can derive from the report.

At the end of the task discuss what other points

you want to ask from the parents while taking the history and what investigations you want to advise in this case and why?

A dummy patient (one of the student from other group) was kept for the examination. Injuries were drawn/ painted on the body parts of the patient to provide a touch of reality to the case.

At the end of study program feedback evaluation of the program was done using questionnaire containing items pertaining to student's satisfaction and participation (Annexure 1) based on Likert's 5 rank scales.

The final assessment was done using MCQ's and OSPE. The MCQ and OSPE stations were finalized after consulting with other faculty members of the department to make sure all the desired leaning objectives could be assessed through them. The training of staff members was done before appointing them as observers for the OSPE stations.

Planning

- Permission was taken from the Dean of the Institute and Head of Department to conduct this Project.
- Institution ethical committee clearance was taken for this project.

Counseling of Students

- Before starting the project, the students were counseled regarding the objectives and methodology.
- The counseling sessions were held during the practical and tutorial sessions. Students were counseled in four batches of 25 students each. All their queries related to the project were answered satisfactorily.

Discussion with Faculty and Sensitization

- A presentation was made before the faculty members regarding the project explaining the aims, objectives and methodology. Comments of the faculty members were duly noted. A copy of the project format along with the questionnaire was given to each one of them and were requested to give their suggestions in the next meeting scheduled one week after. This time was given so that they can go through the project thoroughly.
- In the second meeting, held after a week time, suggestions and comments of the faculty members were collected and incorporated related to preparation of modules and assessment.
- MCQs and OSPE stations were planned after consulting with the faculty members. The support staff of the department were sensitized towards their role as observers OSPE stations. The assessment was done in 2 sessions- one session of 30 min in which 50 MCQs were given to the students and in second sessions where students were assessed in batches of 25 on 10 OPSE stations.

Collection of Feedback

- *Students' Feedback*
- At the end of study program feedback evaluation of the program was done using questionnaire containing items pertaining to student's satisfaction and participation based on Likert's 5 rank scales**.**The questionnaire was prepared and validated.Prior written consent was taken from each student before filling up the feedback Performa.A total of 20 items in the assessment tool coveredall of Bloom's taxonomy of learning domains andwere divided into four key areas: clinical reasoningskills (cognitive), reflection on practice (cognitive/affective), teamwork (affective) and presentation(psychomotor) (Annexure 1).

Observations and Results

A total of 100 medical students in ten groups participated in the study (response rate: 100%); of these, 67% were female and 33% were male. The mean age of the students was 19 years old.

Most students reported positive feelings towards

Table 1: Gender wise distribution of the students

Gender	No of Students
Male	37
Female	63

Table 2: Learning and engagement

Statements	Completely Agree (5)	Agree (4)	Null response (3)	Disagree (2)	Completely Disagree (1)
I found easy to comprehend the topic	52	29	02	12	05
I am more involved in class group discussions than before	54	33	00	09	04
The applied aspect of Forensic Medicine is better understood	46	48	00	06	00
Now I am more systematic in my learning	62	18	05	10	05
I set specific times to study these topics before discussion	41	38	09	08	04
I enjoy learning new information	64	35	00	01	00
Began to use more resources for finding relevant information	46	41	02	09	02
Average	**52.2**	**34.6**	**2.6**	**7.8**	**2.8**

Table 3: Attitude

Statements	Completely Agree (5)	Agree (4)	Null response (3)	Disagree (2)	Completely Disagree (1)
Now I am now more organized in my learning approach	61	28	02	07	02
I enjoyed the challenge	42	36	04	15	03
I learn from my mistakes	56	28	06	07	03
I am aware of my limitations	70	24	06	00	00
Average	**57.3**	**29**	**4.5**	**7.2**	**2**

the case scenario based (CSB) learning approach.

Of the students, 86.8% either agreed or strongly agreed that their learning had improved due to (CSB) learning approach. With regards to the perceived effect of case scenario based (CSB) learning approach on their own performance, the vast majority of respondents agreed or strongly agreed that case scenario based (CSB) learning approach had improved their self-assessment (88.7%).

Students reported that their engagement had improved as a result of their participation in the case scenario based (CSB) learning approachprocess. Most respondents agreed or strongly agreed that they felt more involved in class group discussions than before (87%).

Changes in attitudes as a response to case scenario based (CSB) learning approach were also examined. A large proportion of participants agreed or strongly agreed that now they were more organized in learning approach (89%) and enjoyed the challenges (78%). Participants also agreed or strongly agreed that they had become more aware of their limitations (94%) and learnt from the mistakes committed during completion of tasks (84%) as a result of case scenario

Table 4: Problem analysis

Statements	Completely Agree (5)	Agree (4)	Null response (3)	Disagree (2)	Completely Disagree (1)
I like to gather facts about a problem before I make a decision	56	38	04	02	00
I am able to focus on a problem	38	46	10	04	02
Improved ability to analyze problems	63	28	05	04	00
More able to reach learning objectives	52	39	04	03	02
More able to fulfil tasks related to problem analysis	34	48	09	07	02
Average	**48.6**	**39.8**	**6.4**	**4**	**1.2**

Table 5: Communication, teamwork and collaboration

Statements	Completely Agree (5)	Agree (4)	Null response (3)	Disagree (2)	Completely Disagree (1)
I learned a lot from my classmates.	63	34	02	01	00
Improved communication skills	58	35	02	04	01
Improved teamwork	60	27	06	05	02
More willing to help other group members understand difficult issues	41	48	08	03	00
Average	**55.5**	**36**	**4.5**	**3.3**	**0.7**

based (CSB) learning approach.

The role of case scenario based (CSB) learning approach in the development of problem analysis skills was also investigated. A large percentage of participants agreed or strongly agreed that case scenario based (CSB) learning approach had increased their analytical skills as well as their ability to achieve their learning objectives and fulfil tasks related to the analysis of problems (88.4%).

Regarding the impact of case scenario based (CSB) learning approach on the development of personal and professional skills, 91.5% of respondents agreed or strongly agreed that their communication skills, collaborative skills and ability to work as part of a team had improved as a result of case scenario based (CSB) learning approach.

A total of 83 % students obtained more than 70% marks in the assessment.

Table 6: Result of MCQ and OSPE assessment

Percentage of Marks obtained	80.1-85	75.1-80	70.1-75	65.1-70	60.1-65	55.1-60	50.1-55	< 50
Percentage of Students	11	67	5	3	7	1	4	2

Discussion

Due to unavailability of much published work the results of Case Scenario Based (CSB) learning or its component group discussion in Forensic Medicine could not be discussed. A similar study was done by Wojciech Pawlina et al who got similar response from the students [6]. In their study 82% of the students felt that these sessions were a useful method of providing clinical correlations with basic sciences subject similar to our findings.

As noted by Albanese MA et al [7] & Des Marchais JE [8], most students enjoy the active participation and consider the process to be clinically relevant & stimulating similar to our case. Diana et al were of the view that students in a problem-based curriculum are provided with many clues and directions that directly or indirectly play a role in their decisions on what to study, such as reference literature, course objectives, lectures and tests [9]. In addition, students become better self-directed learners over the four curriculum years. This can help them become lifelong learners.

In a review of study on advantages of problem based learning, Diana Dolmans et al found that there is evidence towards increased retention of knowledge, enhancement of integration of basic science concepts into clinical problems, the development of self-directed learning skills, and enhancement of students' intrinsic interest in the subject matter in PBL [10].

David Vernon in his meta-analysis showed a general approach showing superiority of PBL over the traditional methods [11]. PBL also promotes interdepartmental collaboration particularly between basic & clinical scientists [12].

Conclusions

To conclude it is to be mentioned that CSB is an effective tool to make students understand the applied aspects, improves their analyzing and problem solving abilities and generates more interest amongst them.

Implications

Case Scenario base learning is a very good approach which drives student centered learning & incorporates integration and practical application of the knowledge of basic science, simultaneously helping students become lifelong learner. It can be a very useful method if taken up as a hybrid approach with traditional method.

Outcomes: What this study adds

This study tends to improve the students understanding of applied aspects of Forensic Medicine using modules and scenario based learning approach, something which cannot be learned by using traditional methods.

Limitations

- The time of 4 months is not enough to include all topics of Forensic Medicine in this study.
- Since this type of modules are not exam centric, students tends to lose interest after some time.
- All the case scenarios were not real. It would had been more educative and interesting if students examined actual case or visited actual crime scenes.

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Original Article

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Age Estimation Based on the Pattern of Eruption of Permanent Teeth

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Abstract

Age estimation is one of the prime factors employed to establish identity. It is possible to arrive at a close estimation of age in children by studying the eruption pattern of the deciduous and permanent teeth. Subjects from different ethnic and socioeconomic groups present different stages of maturation, with remarkable genetic variations in the order of appearance of tooth. Hence there is a need to study the chronology and sequence of tooth eruption for the different populations [2]. In the present study, students from three different schools, belonging to different socioeconomic status were examined to present a new data on the timing and sequence of eruption permanent tooth. A total of 2925 students were selected for the study after ascertaining their exact age from the records. The mean age of eruption of permanent maxillary teeth is as follows: First molar (6.9 ± 0.7 years), Central incisor (7.8 ± 0.8 years), Lateral incisor (8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and Second molar (12 ± 0.8 years). The mean age of eruption of permanent mandibular teeth is as follows: First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8±0.8years),First premolar(11.1 ± 0.5 years), Second premolar (11.8 ± 0.8 years) and Second molar (11.9 ± 0.7 years). The mandibular teeth tended to erupt earlier than the corresponding maxillary teeth in both sexes except the premolars.

Keywords: Age; Children; Eruption; Mandibular; Maxillary; Permanent Teeth.

Introduction

Age estimation is one of the prime factors employed to establish identity. The needs of determination of age vary from intrauterine life to old age for different purposes. After birth and during those years when a child is developing, it is possible to arrive at a close estimation of age by studying the pattern of eruption of permanent and deciduous teeth [1]. Subjects from different ethnic and socioeconomic groups present different stages of maturation, with remarkable genetic variations in the order of appearance of the ossification centre and tooth formation (Carvalho et al., 1990), requiring the establishment of patterns of chronology and sequence of tooth eruption for the different populations [2].

In literature there are a great number of investigations with regard to the eruption of teeth from various countries and among different races. Tables on eruption of the permanent teeth were published as early as 1837, when Saunders counted the individual tooth present in 1,046 children of 9 to 13 years. Twenty years later, Cartwright counted the teeth in 3,074 children throughout the school-age range, and published a table which has served as a model for scores of additional investigations during the 19th century. A study on British children done by E.M.B. Clements, E. Davies Thomas and Kathleen G. Pickett in 1947 included 1427 boys and 1365 girls attending elementary schools [3]. Albert A. Dahlberg and Renée M. Menegaz-Bock conducted a study on Pima Indian children (470 boys and 487 girls) ranging in age from 3 to 14 years and 11 months [4]. Here the observations are made on the basis of dental casts collected over a period starting in 1946 and continuing through 1957. Timing and sequence of eruption of permanent teeth in a longitudinal sample

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of children from Oregon was studied by Bhim Sen Savara and John C. Steen [5]. J Diamanti and G C Townsend studied the pattern of permanent tooth emergence in Australian children [6]. A randomly selected sample of 8676 children comprising 4476 boys and 4200 girls aged four to 16 years provided data for the study. These children represented approximately one-fifth of the total attendees at South Australian Dental Service (SADS) clinics during 1988.

A study conducted in the Aegean city of Izmir, Turkey comprises data from 1046 male and 1055 female patients (total 2101), aged 3.98 to 24.91 years (J.S. Wedl, V. Schoder, F.A.S. Blake, R. Schmelzle, R.E. Friedrich) [7]. They were examined in 2002 and the examination occurred within the framework of a dental check-up performed at two schools and one pre-school unit. Wisdom teeth were excluded. .

One of the earliest acceptable studies of eruption of permanent teeth of Indian children, is that of Shourie (1946) [8]. He prepared a table from investigations carried out in school children in the age group of 6 to 21 years drawn from the rice eating area of Madras (South India) and the wheat eating area of Lahore (now in Pakistan). S. Kaul, Sushama Saini and Bindu Saxena (1975) [9] studied the gingival emergence of permanent teeth except the third molar among 564 boys and 573 girls aged 6 to 14 years in Chandigarh. The subjects were classified into high, middle and low socio-economic groups. Amrit Tewari and Harpinder Singh Chawla (1978) [10] studied 1510 school children (953 males and 557 females) ranging from 6 to 16 years in the city of Chandigarh.

A community based study on the time of eruption of permanent 2nd and 3rd molar teeth to establish the age of an individual was undertaken on 1100 subjects (550 males and 550 females) residing in Delhi, in the age group of 10-21 yrs by Upendar Kishore, S K Verma and G K Sharma [11].

Studies conducted in South Indian children appear to be very meagre. Rakhi Gupta, Sivapatha sundharam B and Einstein A [12] conducted a study by recent time over 10,156 students (5104 boys and 5052 girls) in the age group of 6 to 9 years, from primary schools in various parts of Chennai. Another recent study done in Chennai [13] on permanent tooth eruption included 963 children (494 males and 469 females) in the age group of 4 to 14.5 years. A study conducted by Dr K Thankappan [14] on the eruption of permanent teeth (1980-1981) in Thiruvananthapuram, Kerala included a total of 2822 subjects (1426 males 1396 females) in the age group of 4 to 21 years.

Given the changing composition of the community due to urbanisation and industrialisation over the past three decades, the improvements in oral health, and the reported secular trends that have occurred in physical growth and development, it is appropriate that new standards for permanent tooth emergence in boys and girls are provided. Therefore, the aim of this study is to present new data on the timing and sequence of permanent tooth emergence in a large sample of children from rural and urban areas of Thiruvananthapuram and to compare these findings with the results of earlier studies.

Materials and Methods

A cross sectional study was done among the students of three different schools from rural, semiurban and urban areas of Thiruvananthapuram during the time period April 2008-September 2009. Two thousand nine hundred students (males and females) were included in the study. Only those with the documentary proof of their date of birth were included in the study. The study was conducted with the approval letter from the Institutional Ethical Committee, Governmental Medical College, Thiruvananthapuram and the Principals of the schools where survey was done. Students who did not have the documentary proof of date of birth and those who were not willing to participate were excluded from the study. For statistical purposes, only completed year was taken into consideration. Random sampling was done by selecting the alternate students from the attendance register. The dental examination was made in the adequate light with the aid of a mouth mirror and a probe. The details of eruption were observed and charted according to the Modified System of Federation Dentaire Internationale (Modified F.D.I).

Data analysis was done with the help of Excel 2007 and SPSS 16 statistical software. The age distribution of the samples was found. The percentage of different teeth erupted at different ages was analysed separately for boys and girls to determine the mean age of eruption of individual tooth.

Results

The distribution of samples according to sex is shown in the Figure 1. Out of 2925 students, 1568

(54%) were males and 1357 (46%) were females.The distribution of students according to age and sex is shown in Figure 2.

Boys and girls were almost equally distributed in each age group except in age group seven and eight where boys are more (70%) than girls (30%).

In boys the upper central incisors erupted at 7.8±0.7 years and the lower central incisors at 7.6±0.7 years. In girls the upper central incisors erupted at 7.7±0.8 years and the lower central incisors at 7.3±0.8 years (Table 1). In boys the upper lateral incisors erupted at 8.7 ± 0.8 years and the lower lateral incisors at 8.0 ± 0.6 years. In girls the upper lateral incisors erupted at 9.0 ± 0.8 years and the lower lateral incisors at 7.8 ± 0.7 years (Table 2). In boys the upper canines erupted at 11.8 ± 1.0 years and the lower canines at 10.9.0 ± 0.8 years. In girls the upper canines erupted at 11.5 ± 0.9 years and the lower canines at 10.7 ± 0.8 years (Table 3). In boys the upper first premolars erupted at 10.7 ± 1.0 years and the lower first premolars at 11.1 ± 0.5 years. In girls the upper first premolars erupted at 10.6 ± 0.9 years and the lower first premolars at 11.1 ± 0.5 years (Table 4). In boys the upper second premolars erupted at 11.6 ± 0.9 years and the lower second premolars at 11.9 ± 0.8 years. In girls the upper second premolars erupted at 11.4 ± 0.8 years and the lower second premolars at 1.6 ± 0.8 years (Table 5). In boys the upper first molars erupted at 7.0±0.6 years and the lower first molars at 6.3±0.7 years. In girls the upper first molars erupted at 6.7±0.7 years and the lower first molars at 6.3±0.8 years (Table 6). In boys the upper second molars erupted at 12.1±0.8 years and the lower second molars at 12.0±0.7 years. In girls the upper second molars erupted at 11.8±0.9 years and the lower second molars at 11.8±0.7 years (Table 7).

The order and time of eruption of permanent teeth in the upper jaw is as follows – First molar (6.9 ± 0.7 years), Central incisor (7.8 ± 0.8 years), Lateral incisor(8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and then the Second molar (12 ± 0.8 years). The order and time of eruption of permanent teeth in the lower jaw is as follows – First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8 ± 0.8 years), First premolar (11.1 ± 0.5 years), Second premolar (11.8±0.8 years), and then the Second molar (11.9 ± 0.7 years).

All teeth erupted earlier in females except upper lateral incisors and lower first premolars.The upper

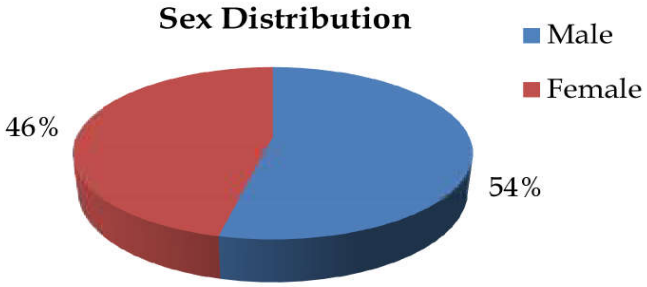

Fig. 1:

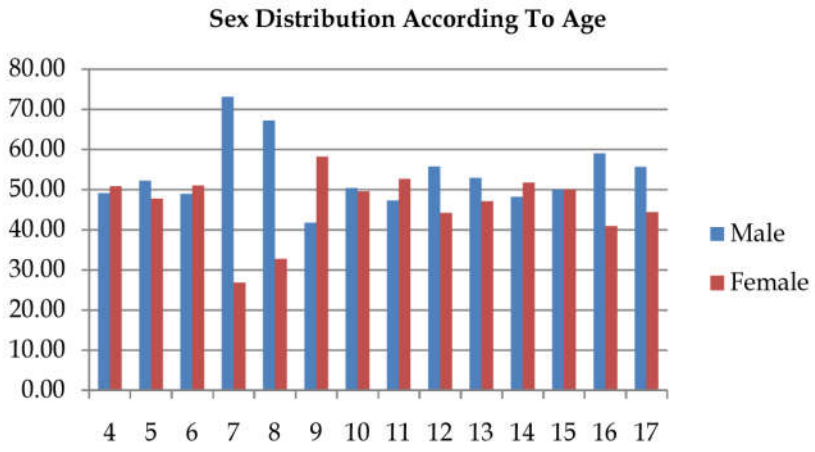

Fig. 2:

Table 1: Mean age of eruption of central incisors in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
11	7.8	0.7	7.7	0.7	7.8	0.7
21	7.8	0.7	7.7	0.8	7.7	0.8
Lower jaw						
31	7.6	0.8	7.3	0.9	7.5	0.9
41	7.6	0.5	7.2	0.6	7.4	0.5

Table 2: Mean age of eruption of lateral incisors in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
12	8.7	0.7	9	0.7	9	0.5
22	8.6	0.8	8.8	0.8	8.7	0.8
Lower jaw						
32	8	0.6	7.8	0.7	7.9	0.7
42	8	0.6	7.8	0.7	7.9	0.6

Table 3: Mean age of eruption of canines in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
13	11.8	0.8	11.5	0.9	11.6	0.8
23	11.6	1.1	11.4	0.9	11.5	1
Lower jaw						
33	10.9	0.7	10.7	0.8	10.8	0.8
43	10.8	0.9	10.7	0.8	10.8	0.8

Table 4: Mean age of eruption of first premolars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
14	10.7	0.9	10.6	0.9	10.7	0.9
24	10.6	1.1	10.6	0.9	10.6	1
Lower jaw						
34	11.1	0.5	11.1	0.5	11.1	0.5
44	11.1	0.5	11.1	0.5	11.1	0.5

Table 5: Mean age of eruption of second premolars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
15	11.6	1.1	11.4	0.9	11.5	1
25	11.6	0.6	11.4	0.7	11.5	0.7
Lower jaw						
35	11.8	0.8	11.6	0.8	11.7	0.8
45	11.9	0.7	11.6	0.7	11.7	0.7

Table 6: Mean age of eruption of first molars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
16	7	0.6	6.7	0.7	6.9	0.7
26	7	0.6	6.7	0.7	6.9	0.6
Lower jaw						
36	6.3	0.4	6.3	0.5	6.3	0.5
46	6.3	0.9	6.3	1	6.3	0.9

Table 7: Mean age of eruption of second molars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
17	12	1.1	11.7	1.1	11.8	1.1
27	12.2	0.5	11.9	0.6	12	0.6
Lower jaw						
37	11.9	0.7	11.7	0.7	11.8	0.7
47	12	0.7	11.8	0.7	11.9	0.7

Table 8: Mean time of eruption of permanent teeth – sex wise

Teeth	Mean age of eruption in years	
	Boys	Girls
Upper jaw		
First Molar	7.0 ± 0.6	6.7 ± 0.7
Central Incisor	7.8 ± 0.7	7.7 ± 0.8
Lateral Incisor	8.7 ± 0.8	9.0 ± 0.8
First Premolar	10.7 ± 1.0	10.6 ± 0.9
Second Premolar	11.6 ± 0.9	11.4 ± 0.8
Canine	11.8 ± 1.0	11.5 ± 0.9
Second Molar	12.1 ± 0.8	11.8 ± 0.9
Lower jaw		
First Molar	6.3 ± 0.7	6.3 ± 0.8
Central Incisor	7.6 ± 0.7	7.3 ± 0.7
Lateral Incisor	8.0 ± 0.6	7.8 ± 0.7
Canine	10.9 ± 0.8	10.7 ± 0.8
First Premolar	11.1 ± 0.5	11.1 ± 0.5
Second Premolar	11.9 ± 0.8	11.6 ± 0.8
Second Molar	12.0 ± 0.7	11.8 ± 0.7

lateral incisors erupted earlier in boys on an average of 3.6 months whereas the lower first premolars erupted at the same time in boys and girls (Table 8).

Discussion

The eruption of permanent teeth in human beings serves as a reliable age indicator as it has a sequential relation with age. But there are limitations on account of the influencing factors such as environment, heredity, nutritional and socioeconomic status. The aim of this study was to present new data on the timing and sequence of permanent tooth emergence in a large sample of children in Thiruvananthapuram and to compare these findings with the results of earlier studies. About 2925 students from different socioeconomic strata were taken as study samples and the findings were analysed statistically.

In the present study the differences in the mean time of eruption for homologous teeth in an arch (left and right) were either small (maximum of one month) or nonexistent. This is in agreement with most of the studies done in past years [3,5,7,9,10,14].

The present study also reveals that in either sex, the permanent teeth erupt first in the lower jaw except the premolars. Both the premolars emerged 3 to 5 months earlier in the upper jaw. It is in agreement with the results of most of the authors [3,4,6,7,10,14]. The maximum difference was noted for canines in both gender (9.6 months) and first molars in males (8.4months), and the minimum difference for second molars in both gender (1.2 months).

The sequence of eruption of permanent teeth in the upper jaw differs from that in the lower jaw, in the present study. The order of eruption in the upper jaw is as follows – first molar, central incisor, lateral incisor, first premolar, second premolar, canine and second molar. The order of eruption in the lower jaw is as follows – first molar, central incisor, lateral incisor, canine, first premolar, second premolar and second molar. However the order of eruption noted by Thankappan K [14] was different in the way that canine erupted after the eruption of first premolar but before the eruption of second premolar. The difference noted in the present study may be due to the early eruption of canine in the lower jaw on an average by 9.6 months when compared with the upper canine. E.M.B. Clements, E. Davies Thomas and

Kathleen G. Pickett [3] in their study on British Children noted a different pattern in the order of eruption. According to this study [3] the sequence of eruption in the upper jaw was – first molar, central incisor, lateral incisor, first premolar, canine, second premolar and second molar. In the lower jaw the sequence of eruption was – central incisor, first molar, lateral incisor, canine, first premolar, second molar and second premolar. J Diamanti and G C Townsend [6] studied the pattern of permanent tooth emergence in Australian children. In the upper jaw, the following sequence was noted: first molar, followed by central incisor, lateral incisor, first premolar, canine and second premolar, then second molar. In the lower jaw the order was: first molar and central incisor, followed by lateral incisor, then canine and first premolar, followed by second premolar and second molar. The order of eruption among most of the studies done in other countries also differ from the present study. This may be due to the influence of the racial characteristics in permanent tooth emergence.

In the present study all permanent teeth erupted earlier in girls except the upper lateral incisors and the lower first molars. However the maximum difference in the mean age of eruption between boys and girls was found to be 3.6 months. The upper lateral incisors erupted on an average 2.4 months earlier in boys when compared with girls. The first molars of the lower jaw erupted almost at the same time in boys and girls. The female preponderance of eruption pattern is in agreement with most of the earlier studies mentioned [5-7,10,12,14-21].

The time of eruption of permanent teeth among the samples taken from the same place of study in 1981 (Thankappan K) [14] is almost similar to the present study. However it is slightly delayed when compared with samples taken from Britain [3], Australia [6], Izmir [7] and Chandigarh [9].

Conclusion

The study was conducted to determine the mean age of eruption of permanent teeth and to compare these findings with the results of earlier studies. Two thousand nine hundred and twenty five students from different schools were drawn as study samples. The results of the study are summarized here.

The mean age of eruption of permanent teeth is as follows:

- *Upper jaw*

  First molar (6.9 ± 0.7 years), Central incisor (7.8 ± 0.8 years), Lateral incisor (8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and Second molar (12 ± 0.8 years).

- *Lower jaw*

  First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8 ± 0.8 years), First premolar (11.1 ± 0.5 years), Second premolar (11.8 ± 0.8 years) and Second molar (11.9 ± 0.7 years).

2. The earliest permanent tooth to erupt in both boys and girls is the first molar, whereas the second premolars, the maxillary canines and the second molars tended to be last to erupt in the sequential order.
3. The mandibular teeth tended to erupt earlier than the corresponding maxillary teeth in both sexes except the premolars
4. The sequence of eruption in the upper jaw differs from that in the lower jaw, however, the order of eruption is same in both sexes.
5. The mean time of eruption of the corresponding right and left teeth do not differ significantly in either the upper or lower jaws in both sexes.

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Original Article

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Socio-Demographic Profile of Dowry Death Victims in a Tertiary Care Unit: A Medico Legal Analysis

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Abstract

Background: The Indian National Crime Records Bureau (NCRB) reports that there were about 8083 dowry death cases registered in India in 2013. India reports the highest total number of dowry deaths with 8,391 such deaths reported in 2010, 1.4 deaths per 100,000 women. *Aim and Objective:* To know the recent pattern regarding unnatural deaths among newly married females so that effective preventive measure can be taken. *Study Design:* Cross sectional Prospective. *Place of Study:* Osmania General Hospital Mortuary Hyderabad. *Duration of Study:* From Nov 2010 to Aug 2012. *Material and Method:* The present study was conducted in Department of Forensic Medicine and Toxicology, Osmania general hospital. A total number of 296 autopsied cases of married woman within 7years of marital life were studied, brought by polices of various police stations in Hyderabad city, and the inquest, were conducted by the Executive Magistrate. *Observation and Discussion:* Dowry death is most common in the age group of 21- 30 years, no age group is an exception to harassment for dowry that finally lead to death of the individual. Hindu females comprised of an alarmingly large group 87%, while the number of deaths in other religion groups the Muslim (12%) and in Christian community is almost negligible. 60.1% in-laws of husband and husband are responsible for killing or forcing the victim to end her life. majority of deaths are due to burns (59.8%), followed by deaths due to hanging (23%), whereas poisoning(11.1%) and other injuries accounts for lowest incidence of deaths(6.1%) 89.2% are found to be suicidal, where as 10.8% are homicidal. Even though the Government of India has passed the Dowry Prohibition Act in 1961 1, till today this social evil was not totally eradicated from our society and has become a major issue of unnatural female deaths. *Conclusion:* This social curse has to be attacked by a multipronged and organized approach by police, women welfare organizations, reputed public servants, and judiciary and by awarding deterrent punishment to all offenders. In our opinion, a rational and practical approach on the above mentioned matter will certainly be helpful.

Keywords: Dowry Deaths; Autopsy; Domestic Violence.

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Introduction

Where the death of a woman is caused by any burn or bodily injury, or occurs otherwise than normal circumstances, within 7 years of her marriage & it is shown that soon before her death, she was subjected to cruelty or harassment by her husband or any of his relatives for, or in connection with any demand for dowry, such death shall be called Dowry death [1].

'Dowry' means any property or valuable security given or agreed to be given either directly or indirectly (a) by one party to a marriage to the other party to the marriage; or (b) by the parents of either party to a marriage or by any other person, to either party to

the marriage or to any other person; at or before or any time after the marriage in connection with the marriage of said parties [2]. In 1961, the Government of India passed the Dowry Prohibition Act, making the dowry demands in wedding arrangements illegal. In 1986, the Indian Parliament added "dowry deaths" as a new domestic violence crime. section 304-B of the Indian Penal Code, where the death of the bride is caused by any burn or bodily injury or occurs other than under normal circumstances within 7 years of her marriage, and it is shown that soon before her death she was subjected to cruelty or harassment by her husband or any relative of her husband for, or in connection with, any demand for dowry, such death shall be called 'dowry death' and such husband or relative shall be deemed to have caused her death. Various sections of IPC (304-B, 498-A, 113-A, 113-B) are directly or indirectly related to the dowry death. The offenders can be sentenced for any period from a minimum of 7 years in prison to a maximum of life [3].

The Indian National Crime Records Bureau (NCRB) reports that there were about 8083 dowry death cases registered in India in 201 3. India reports the highest total number of dowry deaths with 8,391 such deaths reported in 2010, 1.4 deaths per 100,000 women [4]. We undertook the study to evaluate the recent pattern regarding unnatural deaths among newly married females so that effective preventive measure can be taken. The most obvious reason behind such deaths is unending demands for Dowry by the husband or in-laws.

Aim & Objective: To know the recent pattern regarding unnatural deaths among newly married females so that effective preventive measure can be taken.

Material and Method

The present study was conducted in Department of Forensic Medicine and Toxicology, Osmania general hospital, Hyderabad during the period of Nov 2010 – Aug 2012. A total number of 296 autopsied cases of married woman within 7 years of marital life were studied, brought by police of various police stations in Hyderabad city, and the inquest, were conducted by the Executive Magistrate. Details of medico - legal aspects, socio-cultural, economic and other factors were obtained from the investigating officer, friends, relatives, parents, husband or in-laws of the deceased; manner and cause of death from Postmortem examination and toxicological analysis reports. Proforma of the study was filled accordingly from the above details. All the data were reduced to tables, graphs and subsequently subjected to computer aided statistically analysis.

Inclusive Criteria

- All the dead bodies of married women dying within 7 years of marital life, brought to the Osmania General Hospital mortuary, cases have been booked cases under section 304 (B), 306, 498 (A), I.P.C. and 176n Cr. P.C., whose inquest is conducted by Executive Magistrate.
- All the cases of homicide of women within the 7 years of married life are booked cases under section 302 I.P.C whose inquest was conducted by police inspector.

Exclusive Criteria

- Married women dying after 7 years of married life.
- Death of women due to road traffic accidents, snake bite, natural causes and due to various natural calamities.

Observation and Discussion

In recent times, crimes against women are increasing day by day. There are various ways by which women suffer crimes like sexual assault and harassment, eve teasing, rape, torture for dowry, Dowry deaths, torture due to castism etc. Dowry is a major issue regarding torture and deaths of married women within seven years of their marriage. Most dowry deaths occur when the young woman, unable to bear the harassment and torture, commits suicide. Most of these suicides are by burns, hanging, or by poisoning. Sometimes the woman is killed by setting herself on fire; known as "bride burning", and

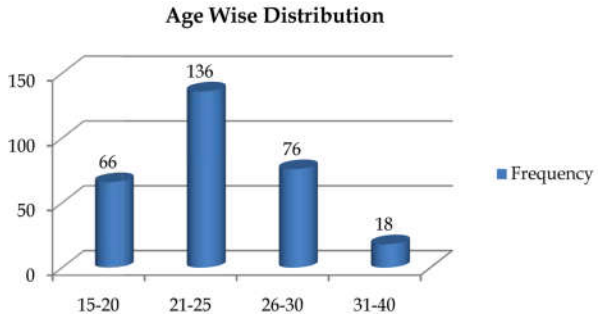

Fig. 1: Age wise distribution of victims

sometimes disguised as suicide or accident. Deaths by burning of Indian women have been more frequently attributed to dowry conflicts [5]. In dowry deaths, the groom's family is the perpetrator of murder or suicide [6].

The statistical analysis on age incidence of dowry deaths reveals the fact that the dowry death is most common in the age group of 21- 30 years. With highest percentage of preponderance being observed in the age group of 21- 25 years (45%), followed by 25.7% cases in the age group of 26- 30 years and 22.3% in the age group of 15 - 20 years, and very less in the age group of 30 - 40 yrs. This suggests that no age group is an exception to harassment for dowry that finally leads to death of the individual. This age group is

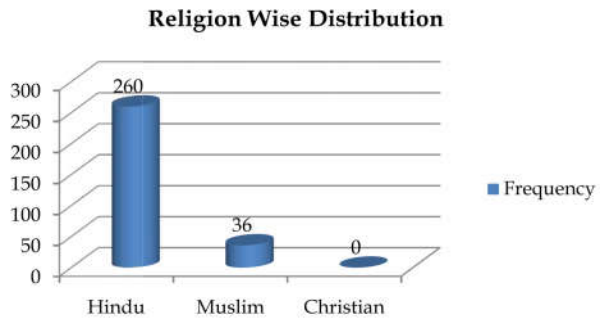

Fig. 2: Religion wise distribution

mostly affected as they are the young females who fall into the marriageable age in India and marital discord, quarrels and dowry demands may cause depression leading to suicidal deaths. Also career oriented women seeking jobs may commit suicide due to frustration.

When dowry deaths are analyzed according to religion Hindu females comprised of an alarmingly large group 87%, while the number of deaths in other religion groups the Muslim (12%) and in Christian community is almost negligible. It may be argued that these religions are minority in India hence low

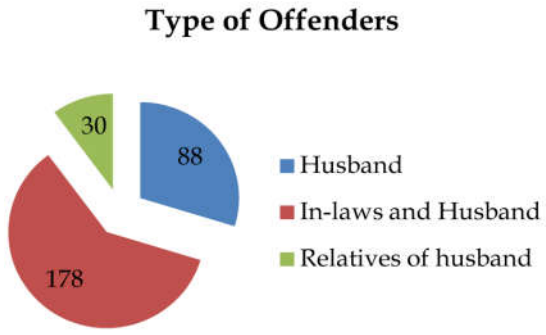

Fig. 3: Dowry deaths - Offenders involved

incidence of dowry death rates in these communities are proportional to their numbers in population. Yet lesser number of dowry deaths in females of Muslim community at Hyderabad is quite surprising since Muslim population is considerable and that too of

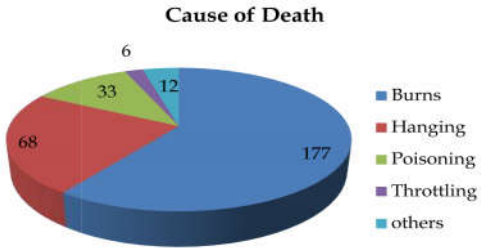

Fig. 4: Causes of dowry deaths

low socio-economic strata.

In the majority of dowry deaths 60.1% in-laws of husband and husband are responsible for killing or forcing the victim to end her life and that husband alone is found to be most common offender responsible for 29.7% all dowry death cases.

The fact and figures in the shows that majority of

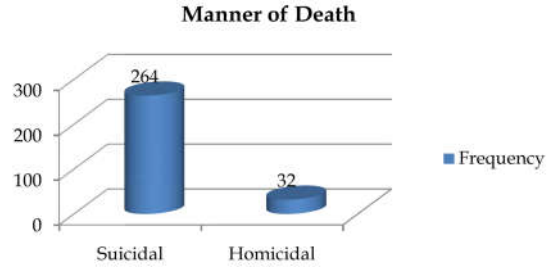

Fig. 5: Manner of death

deaths are due to burns (59.8%), followed by deaths due to hanging (23%), whereas poisoning (11.1%) and other injuries accounts for lowest incidence of deaths (6.1%). Nilesh Kumar et al 2016 [7] supports our study that most common cause of death was burn injury. Roy et al, 2015 [8] also supports our findings and found majority of female deaths were due to burn (66%).

As per fig no 5, it shows that the nature of deaths homicidal or suicidal. Of these cases 89.2% are found to be suicidal, where as 10.8% are homicidal. Shrivastava et al 2007 [9] and Nilesh Kumar et al [7]

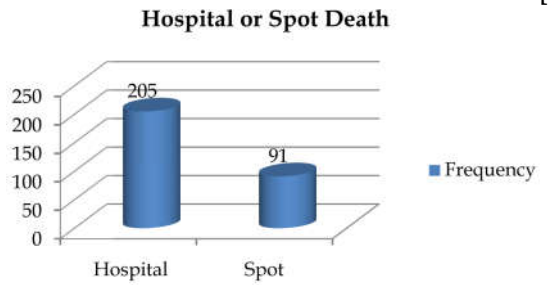

Fig. 6: Hospital or spot death

study support our study most of the deaths were suicidal (50.35%) in nature. The effects of modernization, specifically in India, have led to sweeping changes in the socioeconomic, socio

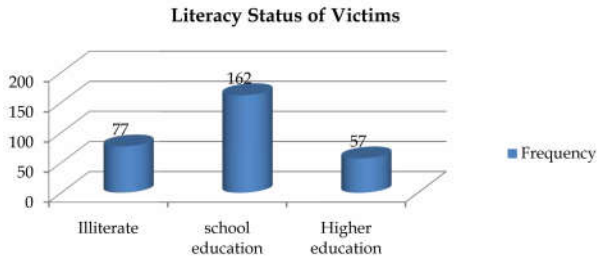

Fig. 7: Literacy status of victim

philosophical and cultural arenas of people's lives, which have greatly added to the stress in life, leading to substantially higher rates of suicide [10].

Regarding hospital and spot deaths shows that majority of deaths happened in hospital (69.3%),

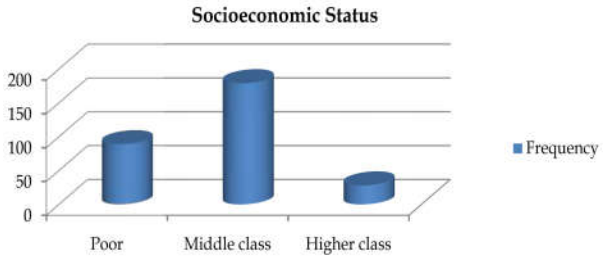

Fig. 8: Socio - economic status of the victim

whereas spot death cases are 30.7%, owing to shifting of the deceased to nearby hospital after the incident. Majority of dowry deaths (80.7%) reported in females who are either illiterate, below metric or matriculate and only few are educationally highly qualified. Shrivastava et al 2007 [9] supports our study that most of the victims were literate up to primary standard.

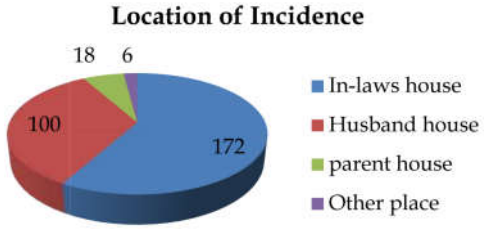

Fig. 9: Location of the incidence – Dowry deaths

Our study highlights that most of the cases (90.5%) in low socio economic and middle class group and 9.5% in high income group. There is a fairly strong association between unemployment rates and suicide, but the nature of this association is complex. Unemployment may drive up the suicide risk through factors such as poverty, social deprivation, domestic difficulties, and hopelessness [11].

Regarding the location of the crime, it is observed that majority of dowry deaths the first and foremost location of incidence is the in-laws house (58.1%), followed by husband's house (33.8%). Even though the Government of India has passed the Dowry Prohibition Act in 1961 1, till today this social evil was not totally eradicated from our society and has become a major issue of unnatural female deaths.

Conclusion

From our study it can be concluded that mostly of the unnatural deaths amongst female within seven years of their marriages are due to dowry and maximum deaths were seen in poorly literate or illiterate victims. These women are dependent on their husbands and in-laws for their survival. A social and public health approach acknowledges that Dowry death is preventable, and promotes a framework in integrated system of interventions across multiple levels within society including the individual, the family, the community and the health care system. This social curse has to be attacked by a multipronged and organized approach by police, women welfare organizations, reputed public servants, and judiciary and by awarding deterrent punishment to all offenders. In our opinion, a rational and practical approach on the above mentioned matter will certainly be helpful.

Legal Aspects

The different legislations to protect females from dowry deaths include Dowry Prohibition Act, 1961 1; Sec. 498 (A) IPC, Sec. 304 (B) IPC, Sec. 113 (A) and 113(B) of IEA9 etc. Constitutionally, women were provided special protection under Article 21 and Article 1410. Supreme Court of India extended the ambit of Article 21 and held that mere existence is not the right to live, it is the right to live with dignity. The Government of India passed a Domestic Violence Bill, 2001, "To protect the rights of women who are victims of violence of any kind occurring within the family and to provide for matters connected therewith or incidental thereto" [12].

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Conflict of Interest

This study is an insight and eye opener of scenario in India and there is no conflict of interest involved so ever.

Source of Funding

The article does not have any funding issue involved in its generations.

Ethical Clearance

The articles do not violate any ethical, moral or legal guidelines pertaining to original scientific work.

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Estimation of Stature from Facial Dimensions

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Abstract

Whenever unknown or decomposed or mutilated dead bodiesor isolated body parts or skeletal remains are found, first step of police investigation is to establish identity of deceased. Determination of stature from dismembered body parts can play vital role for identification of person. Present study was done to derive regression formula and multiplication factor to estimate stature from facial dimensions for population in and around Rajkot region of Gujarat. Total 100male cases and 100 female cases randomly selected from cadavers brought for post-mortem examination at mortuary of P. D. U. Govt. Medical College and Hospital, Rajkot. Stature was measured with measuring tape and Facial dimensions were measured by Spreading caliper after breaking Rigor mortis, if developed.Collected data were statistically analysed using software like Epi info 7 and Microsoft excel. Mean stature as well as mean Facial dimensions were significantly higher for male than for female ($p<0.05$). Regression formula and multiplication factor derived in present study are useful to estimate stature from Facial dimensions for population in and around Rajkot region of Gujarat.

Keywords: Identification; Stature; Facial Height; Facial Breadth.

Introduction

"Everyone has the right to recognition everywhere as a person before the Law." - Article 6 of the Universal Declaration of Human Rights [1].

As stated above, for the existence of society identity is utmost important. Identification is a prime component of Corpus Delicti i.e. essence of crime in medico-legal cases [2]. Identification means determination of individuality of a person. Identification is based on availability of facts about individual. It is known as complete when all facts about individual are available and partial when only some facts about the individual are available [3]. In disastrous conditions such as earthquake, landslides, aircraft-road-railway accidents, explosions, stampede, building collapse, fire, mining accidents etc., isolated body parts are found. Nowadays in events of murders for the purpose to destroy all evidences related to dead bodies, criminals mutilate them and body parts are made isolated. During legal investigations when such isolated body parts are recovered by investigating agencies, the medical professional is often required to give an opinion regarding personal identification of deceased by collecting data for partial identification like race, age, sex, stature etc. which, in the course, help for absolute identification and thus to serve the justice.

Face is the important physiognomic feature in humans. Facial dimensions are among the most important cephalometric parameters used in the descriptions of human morphology, identification of individuals and classification of sex and races. However, different population exhibits variation in their body proportions as they are affected by race, diet, genetics of a person, geographical location and climatic conditions [4]. Due to which, results of a study conducted on one population cannot be applied on other population. Even results of a study

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conducted on one generation of a population cannot be applied on next generation as they are affected by secular changes in physical growth. With this view, present study was carried out to derive regression formula and multiplication factor to determine stature from Facial dimensions for population in and around Rajkot region.

Material and Method

This study was carried out on 100 male cases and 100 female cases randomly selected from cadavers brought for post-mortem examination at mortuary of P. D. U. Govt. Medical College and Hospital, Rajkot during the period of January 2015 to May 2016. Age group selected for the study was 21 years and above.The cadavers with any injury, disease or anomaly that affects Facial dimensions were excluded from the study. The bodies that were decomposed, charred or mutilated were also excluded from the study. Measurements were taken up to nearest 0.1 cm as below after breaking rigor mortis, if developed.

Stature: The body was placed in supine position on a flat, hard surfaced autopsy table. Head was fixed in such way that Frankfort plane remains at right angle to autopsy table. Frankfort plane is defined as plane adjoining the upper margin of the ear openings and lower margin of the orbit of the eyes. Knee and hip joints were kept extended, and the neck and feet were kept in neutral position. If rigor mortis was present, it was broken down. Stature (Total Body Length) was measured between the vertex of the head and the heel using a measuring tape up to nearest of 0.1 cm.

Facial Height: It was measured as straight distance between nasion (the midpoint of the nasofrontal suture) and gnation (in the midline, lowest point on the lower border of the chin) .It was measured by spreading caliper with scale as follows: one tip of the caliper was placed at subject's gnation and the movable part was moved and placed on nasion.

Facial Breadth: It was measured as straight distance between the two zygomatic prominences. It was measured by spreading caliper with a scale as follows: after palpation by fingers to locate the most lateral point of zygomatic arch (arcuszygomaticus) on both sides of the face, the ends of spreading caliper were placed at these points, with enough pressure to feel the bone under caliper.

Statistical Analysis: All the measurements were statistically analysed using software like Epi info 7 and Microsoft Office Excel 2007.The data was analysed for male and female cases separately as well as for total cases i.e. both sexes together. Result of data analysed for total cases can be applied to determine stature from Facial dimensions, when sex is unknown. Pearson correlation coefficient (r) was calculated to assess the correlation of stature with facial dimensions. Independent samples T-test was applied to determine statistical significance of gender differences in stature and facial dimensions. P-value of less than 0.05 was considered significant. Regression formula and multiplication factors were derived to estimate stature from Facial dimensions.

Observation

Table 1 is showing descriptive statistics of all the cases. It is evident from the table that mean of stature and facial dimensionsare higher for male than for female.Gender difference in stature and facial dimensionsarestatistically confirmed by applying t-test as shown in Table 2 ($p < 0.001$).

Table 1: Descriptive statistics (MEAN ± SD)

Parameter	Male	Female	Total Cases
Stature	167.59±4.47	151.39±4.55	159.49±9.28
Facial Height	10.63±0.64	9.52±0.43	10.08±0.78
Facial Breadth	11.55±0.67	10.41±0.49	10.98±0.82

All Measurements are in centimeters

Table 2: Comparison for gender difference in stature and facial dimensions

Parameter	Mean		T Value	p value*
	Male	Female		
Stature	167.59	151.39	25.391	0.000 (S)
Facial Height	10.63	9.52	14.264	0.000 (S)
Facial Breadth	11.55	9.52	13.663	0.000 (S)

* S=Significant

*p Value<0.05 is significant and p Value<0.001 is highly significant.

Table 3: Correlation of facial dimensions with stature

Parameter	Pearson Correlation Coefficient (r)*	
	Male	Female
Facial Height	0.209	0.399
Facial Breadth	0.190	0.167

*p Value is less than 0.05 for all.

Table 3 is showingcorrelation of Facial dimensions with stature. Facial Height and Facial Breadthare showing positive and significant correlation with stature in male as well as female cases.

Simple Regression Formula When Sex is Known:

• *For Male*

1. From Facial Height

Stature= 152.187 + 1.449 x Facial Height

2. From Facial Bredth

Stature= 153.008 + 1.262 x FACIAL BREADTH

• *For Female*

1. From Facial Height

Stature= 111.552 + 4.183 x Facial Height

2. From Facial Breadth

Stature= 112.106 + 3.773 x Facial Breadth

Simple Regression Formula when Sex is Unknown:

1. From Facial Height

Stature= 73.369 + 8.545 x Facial Height

2. From Facial Breadth

Stature= 71.512 + 8.011 x Facial Breadth

Mean Multiplication Factor When Sex is Known:

• *For Male*

1. From Facial Height

Stature= **15.81** X Facial Height

2. From Facial Breadth

Stature= **14.54**X Facial Breadth

• *For Female*

1. From Facial Height

Stature=**15.92** X Facial Height

2. From Facial Breadth

Stature= **14.56** X Facial Breadth

Mean Multiplication Factor When Sex Is Unknown:

1. From Facial Height

Stature=**15.86** X Facial Height

2. From Facial Breadth

Stature = **14.55** X Facial Breadth

Table 4 is showing comparison of stature estimated by regression formula with stature estimated by mean multiplication factor. Standard deviation (SD) measures amount of dispersion from mean value.

Table 4: Comparison of stature estimated by regression formula and by mean multiplication factor (MEAN ± SD)

Parameter	Male	Female	Total Cases
Measured Stature	167.59±4.47	151.39±4.55	159.49±9.28
Stature Estimated by Regression Formula			
Facial Height	167.59±0.93	151.36±1.82	159.49±6.67
Facial Breadth	167.59±0.85	151.39±1.86	159.49±6.55
Stature Estimated By Mean Multiplication Factor			
Facial Height	168.09±10.18	151.62±6.91	159.84±12.37
Facial Breadth	167.95±9.76	151.62±7.18	159.79±11.91

mean multiplication factor (Mean ± SD)
SD=Standard Deviation

From Table 4, it is evident that mean stature estimated by regression formula as well as multiplication factor are very nearer to mean measured stature.

However, SD of stature estimated by mean multiplication factor are higher than SD of stature estimated by regression formula, which means stature estimated by mean multiplication factor is showing more dispersion from its mean value.

So, regression formula measures stature more precisely than mean multiplication factor.

Discussion

The main objective of this study is to find out correlation between Facial dimensions with stature and to use result of this study as a basis for developing stature estimation standards specifically for population in and around Rajkot region of Gujarat. Several such studies have been carried out in past for different population of India.

Swami S et al [5]. studied 800 Hariyanvi adults (400 males and 400 females) of aged above 18 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length (r=0.177 for Male and 0.150 for female, p<0.001). They found positive correlation between stature and facial breadth (r=0.164 for Male and 0.116 for female, p<0.001). They found statistically significant gender difference in stature as well as facial dimensions (p<0.001). They concluded All measurements were found to be more in males than in females, The most reliable facial measurement to estimate stature using regression analysis among males is morphological facial length andEstimation of stature from facial measurements is a supplementary approach when useful samples like extremities and other body parts are not available for examination.

Mounika S et al [6]. studied 30 dental students (11 males and 19 females) belonging to South Indian population of age group between 25 to 30 years. They took facial breadth only for the study. They concluded that there was linear relationship between stature and facial breadth in both sexes in their study (r=0. in males and 0. in females, p<0.05).

Agnihotri AK et al [7]. studied 150 Indo-mauritian adults (75 males and 75 females) of age group between 20 to 28 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length (r=0.164 for Male and female, p<0.001) and facial breadth (r=0.276 for Male and female, p<0.001). They found statistically significant gender difference in stature as well as facial dimensions (p<0.001). They concluded that all measurements were found to be more in males than in females and the most reliable facial measurement to estimate stature using regression analysis among males is morphological facial length and among female is physiognomic facial length.

Krishan K et al [9] studied 996 males of age group between 18 to 30 years from Chandigarh city of north India. They found that age had no correlation with stature. They found positive correlation between facial length and stature (r=0.455, p<0.05). They concluded that, like other parts of human body, the cephalo-facial dimensions can also be used for estimation of stature

Ekezie J et al [9] studied 211 subjects (88 males and 123 females) of age above 21 years to establish anthropometric relationship between stature and facial dimensions. They found positive correlation between stature and facial length in both sexes (r=0.203 for male and r=0.012 in females, p<0.05). They concluded that, like other parts of human body, the cephalo-facial dimensions can also be used for estimation of stature.

From comparison of these studies, it is evident that all the studies have found positive correlation between Facial dimensions and stature, which means Facial Height and Facial Breadth are useful parameter to estimate stature. All the studies show significant gender difference mean stature as well as Facial Height and Facial Breadth. Table 5 shows comparison of mean stature and mean facial height and mean facial breadth with other similar studies.

It is evident from the table that all the studies have found different mean stature as well as mean facial

Table 5: Comparison of present study with other similar studies

Author	Mean Stature* (MEAN ± SD)		Facial Dimensions			
			Mean Facial Height		Mean Facial Breadth	
	Male	Female	Male	Female	Male	Female
Swami S et al.[5]	168.17 ± 5.46	155.18 ± 4.62	11.07 ± 0.70	10.21 ± 0.94	11.45 ± 1.10	10.33 ± 0.75
Mounika S et al.[6]	161.30 ± 10.30		----	---	9.432±5.72	
Agnihotri AK et al.[7]	173.40±7.70	157.36±6.17	11.58±0.71	11.00 ± 0.58	14.39±0.95	14.01±1.00
Krishan K et al.[8]	172.31±6.83	-----	10.81 ± 0.74	----	13.92 ± 0.62	-----
Ekezie J et al.[9]	173.66±7.30	163.17±7.64	14.71±1.57	14.08±1.35	21.69±2.21	24.25±1.43
Present Study	167.59±4.47	151.39±4.55	10.63±0.64	9.52±0.43	11.55±0.67	10.41±0.49

height and mean facial breadth. This findingsubstantiate well known fact that different population shows difference in stature as well as in body proportions, so population and sex specific regression formula and multiplication factor are required for accurate stature reconstruction from facial dimensions.

Conclusion

In present study, mean stature estimated from regression formula as well as multiplication factor are similar to mean measured stature in both sexes, however, regression formula measures stature more precisely than mean multiplication factor. So, regression formula and multiplication factor derived from present study can be used to determine stature of deceased person from facial dimensionswhen mutilated head is found.

Mean stature as well as mean facial height and mean facial breadth are significantly higher for male than for female, so sex specific regression formula and mean multiplication factor should be derived. Present study has derived regression formula and multiplication factors for male and female cases separately as well as for total cases i.e. both sexes together. Regression formula and multiplication factor derived for total cases can be applied to determine stature from facial dimensions, when sex is unknown. However, sex specific regression formula and multiplication factors can estimate sex more accurately.

Asdifferent population show difference in stature as well as in body proportions, results of present study are applicable to population in and around Rajkot region.

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Establishment of Sex in Adolescents from Inter Digit Ratios

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Abstract

Background: Establishment of sex is an important aspect of forensic medicine. Previously conducted studies have shown that differences exist between male and female index and ring finger ratios. *Aim:* The purpose of the present study is to evaluate sexual dimorphism of index and ring finger in adolescents in the western part of the Indian population. *Material and Method*: The study was carried out on a cross sectional sample of 103 adolescents; out of which 50 of the respondents were males and the remaining 53 were females. Data on age, sex, and handedness was collected through a structured paper questionnaire as primary data collection and the anthropometric measurements as secondary data collection. *Result:* The result of the present study shows that the mean age of male population is 13.74 years while the mean age of female population is 14.91 years. Statistically significant difference ($p < 0.05$) between index and ring finger ratios in male and female are observed. *Conclusion:* The present study suggests that the ratio of less than 0.99 suggests male sex while a ratio of 0.99 or more suggests female sex. The findings of present study can be utilized to establish sex especially in circumstances where body was mutilated or only remains were brought or in cases of mass disaster.

Keywords: Identification; Sex Difference; Index Finger; Ring Finger; Anthropometry.

Introduction

Identification is a key aspect of medico legal studies and forensic medicine. While a number of factors play a role in the identification of an individual, the establishment of sex has great forensic implications. It assumes greater significance when only mutilated body parts or dismembered body parts are to be examined. In catastrophic events like earthquakes or bomb explosions, establishment of sex helps in assessing the magnitude of casualties.

Previous studies have indicated that sexual dimorphism exists as far as the hand is concerned. The differences in the lengths of the second digit (2D) and the fourth digit (4D) can be used as a useful indicator to ascertain the sex of an individual. The difference between the index finger and the ring finger has been studied previously in various communities and populations [1-6]. Ethnic differences have been observed, probably due to prenatal influences; however, the causes have not been demonstrated yet. A correlation has been established in the adult and neonatal populations and a hormonal basis has been suggested [7-9]. However, such studies are not available for the age group which boasts of hormonal instability, i.e. adolescence. This study aims at evaluating the relationship between the index and ring finger lengths in the adolescent population of western India.

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Material and Method

Sample Size and Sampling Techniques

The present prospective study consists of adolescents aged 10 to 19 years (according to the WHO definition of an 'adolescent' individual [27]), from the visiting population of Government Medical College and Hospital, Miraj. The participants were

randomly selected from the population, the excluding criteria being the age limit of 10 – 19 years, any gross physical deformity or injury of the hands and any growth disorder. The study was carried out on a cross sectional sample of 103 individuals, of which 53 were females and the remaining 50 were males. Data on their age, sex, address was collected through a structured paper questionnaire as the primary data collection and the anthropometric measurements as the secondary data collection. The lengths of the second digit (2D) and the fourth digit (4D) were measured with a clear, transparent 12 inch plastic ruler, from the tip of the finger to the ventral proximal crease. Where the line was replaced by a band of crease, the most proximal crease was used. The subjects were asked to extend their digits fully when the readings were taken. All the measurements were made in centimetres to the nearest millimetre.

Instrumental Design

The instrument in the study was a structured questionnaire titled "Determination of sex on the basis of the measurement of the index finger and the ring finger". The questionnaire consisted of personal demographic data such as age, handedness of the volunteer, sex and the address as the primary information. The anthropometric values were included in the secondary questionnaire.

Method of Validation

Careful and appropriate steps were taken to protect the rights of the respondents. Potential participants were duly informed that the survey was completely voluntary and all the data taken was confidential.

Statistical Analysis

Data was expressed as Mean ± Standard deviation (± SD). Descriptive statistics and Students'- t test were used to analyse and determine the parameters studied in both males and females. Statistical significance was accepted at P value less than or equal to 0.05 ($P<0.05$). 2D:4D ratio was calculated on both hands of each individual. The relationship between the parameters studied was established using Pearson correlation to establish the strength of the relationship between the lengths of second and fourth digits (2D&4D), the digit ratios and the other anthropometric variables in both sexes. The sectioning point was calculated for sex differentiation from the index and ring finger ratios as the average of the mean male ratio and mean female ratio. (Mean male ratio + mean female ratio ÷ 2)

Results

The result of the present study shows that the mean age of the female population is 14.91 years while the mean age of the male population is 13.74 years. The mean lengths of the index and ring finger in females are 6.440 cm and 6.349 respectively in the right hand while and 6.457cm and 6.342cm respectively in the left hand (Table 1 and 2). The mean lengths of the index and ring finger in males are 6.316cm and 6.544 in the right hand while 6.320 cm and 6.572cm However, no significant differences exist between the lengths of index and ring finger in right and left hand in both sexes. In females, the mean difference between index and ring finger in right hand is 0.091 ± 0.185 cm and in left hand it is 0.115 ± 0.204 cm. In males, the mean difference between index and ring finger in right hand is 0.228 ± 0.197 cm respectively and in the left hand it is 0.252 ± 0.216 cm (Table 3 and fig 1). Statistically significant differences ($p < 0.05$) between 2D:4D ratios in male and female are observed (Table 2). In females, the mean 2D:4D ratio in right and left hand is 1.015 and 1.018 respectively while in female the mean 2D:4D ratio in right and left hand is 0.965 and 0.963 respectively.

A sectioning point was calculated for the index and ring finger ratios (2D:4D) by calculating the average of the mean 2D:4D ratios of males and females; which is 0.990. A ratio of 0.990 or more is suggestive of female sex while ratios less than 0.990 suggest male sex. With this sectioning point, we could predict 92.45% females from right hand and 88.67% females from left hand. Similarly, with a value of 0.99 or less we could predict 84% males from right hand and 88% males from left hand.

Table 1: Showing age related descriptive data

Parameter	Females				Males			
	Min	Max	Mean	SD	Min	Max	Mean	SD
AGE	10	19	14.91	2.691	10	19	13.74	2.791

Table 2: Showing the descriptive statistics of male and female index and ring finger measurements (in cm)

Sex	Parameters	Min	Max	Mean	SD	Significance
Male	R2D	4.3	7.5	6.316	0.72	p<0.05
	R4D	5.1	8	6.544	0.732	
	L2D	5	7.6	6.32	0.698	p<0.05
	L4D	5.2	8	6.572	0.754	
Female	R2D	5.4	7.8	6.44	0.514	p<0.05
	R4D	5.2	7.5	6.349	0.511	
	L2D	5.3	7.8	6.457	0.54	p<0.05
	L4D	5.1	7.5	6.342	0.508	

Table 3: Showing the difference between male and female index and ring fingers (in cm)

Parameters	Male Mean±SD	Female Mean±SD
R2D-R4D	0.228 ± 0.197	0.091 ± 0.185
L2D-L4D	0.252 ± 0.216	0.115 ± 0.204

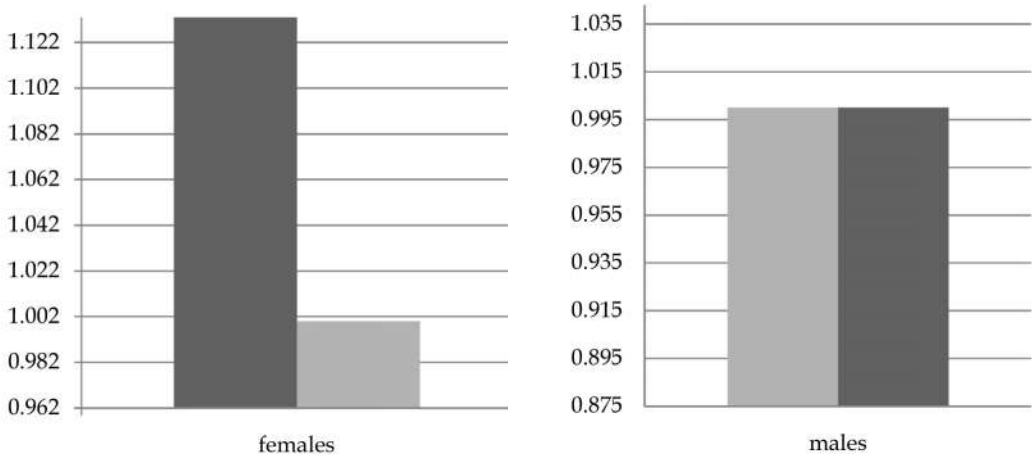

Chart 1: Showing differences in the male and female ratios.

Discussion

Inter digit ratios have been increasingly considered as a fairly reliable indicator for the establishment of sex [1-8]. In humans, the index finger and the ring finger are considered to be symmetrical about the axis of the middle finger. However, there is considerable difference between the lengths of the index finger and the ring finger.

In the present study, a statistically significant difference has been observed between the two fingers. In males, this difference is due to greater ring finger length as compared to the index finger. Hence, in males, the 2D:4D ratio is usually lower as compared to females. In females, it has been observed that the index finger is longer than the ring finger, which accounts for the higher 2D:4D ratios.

This morphological difference is considered to be established prenatally, as early as the 14th week of gestation [7]. The 2D:4D ratio is said to be predefined intranatally due to exposure to prenatal hormones likes testosterone and oestrogen. Subsequently, a greater exposure to testosterone has been linked to a lower 2D:4D ratio, corresponding to the inter digit ratios observed in males [6]. Adolescence is a period during which there is considerable exposure to the hormones in greater amounts, and this study aimed to highlight any alterations in the observed phenomenon brought about by this sensitive period of hormonal instability. However, it has been demonstrated in the study that a greater inter digit ratio is suggestive of the female sex, while a lower inter digit ratio is suggestive of the male sex; the sectioning point being 0.99 cm.

As indicated in other studies conducted on the same subject, the 2D:4D ratio can be used as the basis for identification of sex, across various age groups. This study provides substantial basis for its usage in the establishment of sex in adolescents as well [3]. It can have great implications in medico legal cases in which mutilated bodies or parts of bodies are

involved. With further exploration, it can also be used as a diagnostic aid for certain diseases in which a hormonal imbalance is a manifest feature. An unusually high or low inter digit ratio as per the sex of the individual, could be one of the first indicators of the possibility of certain corresponding diseases. For example, a high 2D:4D ratio may indicate high oestrogen levels and thus, the possibility of breast cancer, while a low 2D:4D ratio may suggest high testosterone levels, and thus a greater possibility of prostatic cancer.

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Estimation of stature from the length of sternum

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Abstract

The role of Forensic anthropology to derive alternative and newer modes of identification is increasing every day. Estimation of stature is one of the important initial steps during forensic analysis of human skeletal remains. The aim of the present study was to derive a linear regression formula for estimating stature of adult Indian males from the length of the sternum. The study included 100 male & female sternums of Indian origin dissected from cadavers during medico-legal autopsies. Regression equation derived for both sexes collectively was "Stature=94.228 + 4.474 × (Combined Length of manubrium and body of sternum)", with Standard Error=3.901cm and strength of association=0.858. This preliminary study concludes that the length of the sternum can be used as a tool for stature estimation in adult Indian males.

Keywords: Forensic Anthropology; Stature Estimation; Sternal Length; Linear Regression.

Introduction

For medicolegal studies, examination of human skeleton has obviously an utmost importance for the identification purpose. The experts are always facing a problem in identifying whether skeleton remains are of human being or not as well in estimating correct age, sex and stature of the specimen available. According to krogman, if the entire skeleton is available for examination, sexing of the adult skeleton can be done with 100% both skull and pelvis are accuracy, with the help of skull up to 90%, with the help of pelvis up to 95%, with the help of the long bones up to 80%, and when available then up to 98% [1].

Sternum as an individual parameter for the determination of sex was first studied in 1788 by Wenzel [2]. He described the difference in ratio between the length of manubrium and body of sternum in both sexes. The study opened vast avenues for Feigal (1837) [3], Hyrtl (1788) [4], Dwight (1881) [5]; Strauch (1881) [6] which was followed by Patermollar (1890) [7] and Paterson (1905) [8]. All these workers studied the old parameters of sternum and also tried some new optometric parameters, but could not establish any new parameter.

Stature provides one aspect of an individual's physiognomy, and its determination is one of the important initial steps during forensic analysis of skeleton remains [9]. Stature may be estimated by means of various anthropometric measurement of the skeleton. Such estimation is based on the relations between skeleton elements and stature [10]. It is an established fact that stature bears a direct relation to the length of various bones. The examination of long bones provides the most accurate stature estimation potential. However, long bones may not be present in every instance, necessitating the possible use of other skeleton elements such as sternum when present [11,12,13]. Telkka opined that racial or ethnic group would need different studies to be done over sternum to derive specific result applicable to that particular racial or ethnic group as racial or ethnic variations arise in different geographic regions [14].

The present study is an attempt to study the

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sternum in the purview ofto derive regression formula for the estimation of stature for the both sexes separately and for both sexes collectively.

The result achieved by the existing parameter and those achieved by this study are tabulated and graphically plotted for study. All the measurements and the indices are statistically exercised for the accuracy and reliability for the future use.

Aims and Objectives

1. To derive regression formula for the estimation of stature.
2. To compare the results of this study with other workers

Material and Method

The present study of 100 cases was conducted at mortuary of P.D.U. Hospital and Medical College, Rajkot during the period of 6th January 2010 to 20th August, 2011.

The materials for the present study consist of sternum bones obtained from the cadavers brought for the post-mortem examination at Rajkot after taking necessary consent from the relatives and police.

All autopsies of medico-legal cases of both sexes, having age above 17 years were included in the study.

The cases from both urban and rural areas were included in the study.

The bodies that were decomposed, charred, mutilated and with physical anomalies affecting the study were excluded from the study.

The information about the age of the deceased was obtained from the nearest relatives and investigating officer and was verified by necessary documents. The age of the deceased was rounded off to full figures. Despite of stringent rules on compulsory birth and death registration, there are many cases which do not have a birth certificate today were being excluded from the study.

The dead body was examined externally for various signs of congenital abnormality. History of dietary habits and any hormonal or metabolic disorder was enquired from close relatives of deceased.

The body was placed in supine position on a flat, hard surfaced autopsy table, with the knee and hip joints extended, and the neck and feet in neutral position. The cadaveric length (stature) was measured between the vertex of the head and the heel using a measuring tape.

After removing from cadaver, soft tissues and muscles were removed from the bones as much as possible. The collected sternum bones were tagged and put in a solution of sodium chloride for a week for maceration. These were cleaned and soft tissues were removed and than bones were put in to the solution of hydrogen peroxide for cleaning.

All the required measurements were taken with Baker's Digital Calliper having reading accuracy of 0.01mm/0.0005 inches and with measuring range of 0-300 mm/0-12 inches. A rectangular wooden board was taken; all four borders of the wooden board were thicker than then the rest of the board so that while taking measurements sternum remain in contact with two thicker borders placed at 90 degree with each other . This will confirm the position of the sternum and it will not move while taking the measurement with calliper. The sternum bone taken for measurement was placed on this board in such a way that the posterior surface of the sternum was in contact with the surface of the board. This was further supported with the hand at the xiphoid region during the examination. The sternum placed in such a way was practically immovable during the examination. After proper positioning, following measurements were taken by digital calliper.

1. *Length of Manubrium (M):* It is the distance from suprasternal notch to sternal angle in midline.
2. *Length of Body of Sternum (B):* It is the distance from sternal angle to the junction of body of sternum to xiphoid process in the midline.
3. *Combined Length of Manubrium and Body of Sternum (M+B):* It is the distance from suprasternal notch to junction of body of sternum to xiphoid process in the midline.

The data obtained were analysed statistically to find out the mean and standard deviation for each of the above measurements and indices in both the sexes. The P value was determined to find out whether the sexual difference between means were significant or not. The data was also analysed statistically to find out the number of cases lying in overlapping zones and to find out reliability of each and every parameter separately. The bar diagram of each parameter was plotted taking measurement on X axis and number of cases on Y axis. From bar diagram the overlapping zone, identification point and percentage of cases beyond the identification point were determined for each parameter.

For determining the stature all the above parameters were taken into consideration.The data

were analyzed using statistical programme for social science (SPSS) Version 17 and Microsoft Excel to derive a linear regression equation for stature estimation. To assess the correlation between stature and the length of the sternum, Pearson's correlation coefficient was calculated and its significance was tested by independent t test. P-value of less than 0.05 was considered significant.

Observations and Discussion

Table 1 shows sex wise distribution of stature, which suggests that the maximum number of total cases were in range of 156-160(24%), followed by stature range of 151-155 (21%). Lowest numbers of total cases were found in range of 135-140 (1%).

Highest numbers of male cases were found in stature range of 156-160 (18%) while highest numbers of female cases were found in range of 146-150 (9%).

Table 2 shows descriptive statistics of study sample .Mean age and mean stature of male were higher than female. Mean values of all the parameters in male were higher than female except for two parameters i.e. sterna index and width index.

Table 3 shows that Correlation coefficient of stature of both male and female subjects collectively with all the parameters were obtained and it was found significantfor all the parameters ($P<0.05$) except for width index ($P=0.131$).

The correlation coefficient indicates the strength of association between stature and various parameters used in present study and it varies from -1 (negative correlation) to +1 (positive correlation) [53].

In the present study, correlation coefficient for combined length of manubrium and body of sternum (L1+L2) (0.858) was found higher than other parameters which suggested combined length had maximum strength of association with stature.

Table 4 shows that Correlation coefficient of stature of male subjects with all the parameters were obtained and it was found significant for length of manubrium (L1), length of body of sternum (L2), combined length of manubrium and body of sternum (L1+L2) and width of manubrium (W) ($p<0.05$).

In the present study, it was observed that correlation coefficient for combined length of manubrium and body of sternum (L1+L2) (0.650) was found higher than length of manubrium (L1) (0.408), length of body of sternum (L2) (0.612) and width of manubrium (0.271) which suggested combined length had maximum strength of association withstature.

Table 5 shows that Correlation coefficient of stature of female subjects with all the parameters were

Table 1: Sex wise distribution of the stature

Stature (In cm.)	Male (%)	Female (%)	Total (%)
135-140	00(0%)	01(1%)	01(1%)
141-145	00(0%)	04(4%)	04(4%)
146-150	02(2%)	**09(9%)**	11(11%)
151-155	13(13%)	08(8%)	21(21%)
156-160	**18(18%)**	06(6%)	**24(24%)**
161-165	16(16%)	01(1%)	17(17%)
166-170	16(16%)	00(0%)	16(16%)
171-175	06(6%)	00(0%)	06(6%)
TOTAL	**71(71%)**	**29(29%)**	**100(100%)**

Table 2: Descriptive statistics of the study sample

Parameter	Male			Female		
	Min.	Max.	Mean	Min.	Max.	Mean
Age(years)	17	80	37.94±17.47	17	70	32.37±14.67
Stature(cm.)	150	173	161.35±6.30	135	164	151±6.35
Length of Manubrium(L1)	40.55	66.87	48.60±4.97	27.04	56.72	44.41±5.89
Length of Body of Sternum(L2)	74.57	111.58	93.63±8.35	61.05	84.49	74.30±7.16
Combined length(L1+L2)	126.27	159.40	142.24±8.95	100.31	135.85	118.71±10.44
Width of manubrium(W)	42.95	66.17	54.24±5.23	41.49	64.15	50.73±7.08
Width of first sternebra(W1)	18.92	36.10	26.68±3.63	16.63	39.42	23.58±4.92
Width of third sternebra(W3)	22.37	50.55	31.91±4.84	21.29	37.25	26.98±4.16
Sternal Index	39.33	73.51	52.39±7.70	36.70	80.17	60.12±8.63
Width Index	57.151	110.94	84.63±12.60	61.94	121.51	87.46±11.62

Table 3: Level of significance of differentmeasurements for both sexes

	L1	L2	L1+L2	W	W1	W3	Sternal Index	Width Index
Pearson Correlation Coefficient	0.451	0.815	**0.858**	0.300	0.236	0.359	-0.366	-0.152
P value	0.000	0.000	0.000	0.002	0.018	0.000	0.000	0.131

Table 4: Level of significance of different measurements for male subjects

	L1	L2	L1+L2	W	W1	W3	Sternal Index	Width Index
Pearson Correlation Coefficient	0.287	0.720	0.832	0.271	0.067	0.150	-0.221	-0.132
P value	0.015	0.000	0.000	0.022	0.576	0.212	0.063	0.272

Table 5: Level of significance of different measurements for female subjects

	L1	L2	L1+L2	W	W1	W3	Sternal Index	Width Index
Pearson Correlation Coefficient	0.408	0.612	**0.650**	0.023	0.018	0.093	-0.050	-0.054
P value	**0.028**	**0.000**	**0.000**	0.904	0.927	0.632	0.798	0.780

Table 6: Multilinear regression equation for estimating stature

Sex	Equation	SE(cm.)	R
Both sex	S=94.228+(4.474)×CL	3.901	0.858
Male	S=78.027+(0.586)×CL	6.706	0.832
Female	S=104.07+(0.395)×CL	10.612	0.650

*S= Stature, *SE= Standard Error, *R=Strength Of Association
*CL= Combined Length Of Manubrium And Body of sternum (L1+L2)

obtained and it was found significant for length of manubrium (L1), length of body of sternum (L2) and combined length of manubrium and body of sternum (L1+L2) ($p<0.05$).

In the present study, it was observed that correlation coefficient for combined length of manubrium and body of sternum (L1+L2) (0.650) was found higher than length of manubrium (L1) (0.408) and length of body of sternum (L2) (0.612) which suggested combined length had maximum strength of association with stature.

Table 6 shows that The multilinear regression was applied for all the subjects collectively as well as for male and female subjects separately considering all the parameters in statistical programme for social science (SPSS) Version 17 and Microsoft Excel. On applying multilinear regression with backward method maximum association of stature was found with combined length out of all significant parameters. Regression equation for both sexes collectively as well as for both sexes separately was obtained.

Maximum strength of association of equation with the stature was found for both sexes (0.858) followed by for male (0.832) and for female (0.650).

Summary and Conclusion

- Regression equation derived for both sexes collectively was "Stature=94.228 + 4.474 × (Combined Length of manubrium and body of sternum)", with Standard Error=3.901cm and strength of association=0.858.
- Regression equation derived for male sex was "Stature=78.027 + (0.586) × (combined length of manubrium and body of sternum)", with Standard Error=6.706cm and strength of association=0.832.
- Regression equation derived for female sex was "Stature=104.07 + (0.395) × (Combined Length of manubrium and body of sternum)", with

Standard Error=10.612cm and strength of association=0.650.

It is also evident from above findings that out of all the parameters used in the study for estimation of stature, combined length of manubrium and body of sternum is most reliable.

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Original Article

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A Clinicopathological Study of Extrapulmonary Tuberculosis at a Tertiary Hospital, Narayana Medical College and Hospital, Nellore

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Abstract

Introduction: Tuberculosis is the most common health problem caused by Mycobacterium, a non-motile, non spore forming aerobic acid fast bacilli. It is of two types, pulmonary and extrapulmonary. Extrapulmonary tuberculosis is the isolated occurrence of tuberculosis in any part of the body other than lungs like lymph nodes, neck, bones and serous membranes. We have undertaken this study to evaluate the clinicomorphological features of extrapulmonary tuberculosis. *Materials and Methods:* A prospective study was done in the Department of Pathology, Narayana Medical College, Nellore, for 2 years from 2014 to 2016. Extrapulmonary tuberculosis were identified constituting 125 cases (11%) of the total cases. Clinical data was recorded and the biopsy specimens were processed in our department and the data was analysed. *Results:* Cervical lymph node was the most common site involved by extrapulmonary tuberculosis in our study. The most common age group involved was 20-30 years with loss of weight being the most common presenting feature in these cases. Most of the cases were negative for AFB in both sputum and culture. Histopathological examination which is the gold standard for diagnosis proved to be positive in 72% of the cases. *Conclusion:* Our study on extrapulmonary tuberculosis has been done to review the various clinico-morphological aspects of the disease. Cervical lymph nodes were the most common site involved, 60 cases (18.3%) followed next by the osteoarticular system, 19 cases (18.3%).

Keywords: Extrapulmonary; Lymph node; Tuberculosis.

Introduction

Tuberculosis is an ancient disease with protean manifestations.Though it is a relatively indolent disease, death occurs through rapid dissemination [1,2]. It remains a major public health problem and it is estimated that about 1/3rd of the world's population is infected with Mycobacterium tuberculosis [3,4]. The genus Mycobacterium consists of non-motile, non spore forming aerobic acid fast bacilli whose cell wall is lipophilic and resistant to common disinfectants [5]. Mycobacterium tuberculosis complex consists of Mycobacterium tuberculosis, Mycobacterium bovis and Mycobacterium africanum. Species other than those of the complex are called non mycobacterium.

Tuberculosis infection can be pulmonary or extrapulmonary. Extrapulmonary tuberculosis is defined as the isolated occurrence of tuberculosis in any part of the body other than lungs [7]. Lymph nodes, neck, bones, serous membranes are the most common sites of extrapulmonary tuberculosis [8,9].

Materials and Methods

A prospective study was undertaken in the Department of Pathology, Narayana Medical College, Nellore, for a period of 2 years from 2014 to 2016. All the new cases of tuberculosis were identified out of which extrapulmonary tuberculosis constituted 125 cases accounting for 11% of the total cases.

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Inclusion Criteria

1. Newly confirmed cases of extrapulmonary tuberculosis.

2. Only HIV negative cases.

Exclusion Criteria

1. Pulmonary tuberculosis.

2. HIV positive cases.

The clinical data was collected and the relevant laboratory investigations were done for all the cases. The biopsy specimens were received in our department and were processed. Slides were reviewed and the data was analysed.

Results

All the cases in our study were analysed with regard to age and sex distribution, site of the lesion, clinical signs and symptoms and lastly investigations.

Both males and females were most commonly affected (Figure 1).

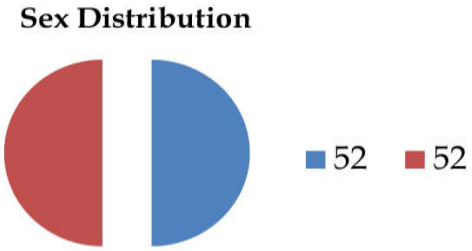

Fig. 1: Sex distribution

Table 1: Age distribution

Age Group	Number of Cases	% of Cases
10-20 years	06	5.8
20-30 years	28	26.9
30-40 years	20	19.3
40-50 years	16	15.3
50-60 years	16	15.3
60-70 years	06	5.8
70-80 years	06	5.8
80-90 years	06	5.8

Table 2: Clinical presentation in extra-pulmonary tuberculosis

Symptom	Number of Cases
Loss of weight	43
Cough	42
Fever	37
Pain	22
Dyspnoea	13
Haemoptysis	08
Dysphagia	01

Table 3: Sites of involvement by extrapulmonary tuberculosis

Site	Number of Cases	% of Cases
Lymph nodes	60	57.6
Osteoarticular	19	18.3
Genitourinary	12	11.5
Gastrointestinal tract	10	9.7
Mediastinum	01	0.9
Breast	01	0.9
Brain	01	0.9

The most common age group affected by extrapulmonary tuberculosis in our study was 20-30years, 28 cases accounting for 26.9% of the total cases and next common age group involved was 30-40 years, 20 cases accounting for 19.3% of the total cases (Table 1).

In our study the patients presented with a variety of clinical symptoms like loss of weight,cough, fever, pain, dyspnoea, hemoptysis and dysphagia. The

most common clinical presentation in our study was loss of weight, seen in 43 cases (Table 2).

In our study, the most common site involved was lymph nodes accounting for 57.6% of the total cases followed by osteoarticular region accounting for 18.3% of the total cases (Table 3).

Table 4: Investigations done in our study

Erythrocyte Sedimentation Rate			Chest X-ray			Sputum for AFB			Culture for AFB		
	Number	%		No	%		No	%		No	%
Elevated	78	62.4	Normal	24	39.2	Positive	29	43.2	Positive	26	40.8
Normal	22	37.6	Abnormal	76	60.8	Negative	71	56.8	Negative	74	59.2

days in all the patients. AFB and culture was done. In majority of the cases, 71 cases (68.26%), sputum for AFB was negative and the culture was negative in majority of the cases, 74 cases (71.2%).

Histopathological examination was done and 72% of the cases (75 cases) were positive.

Discussion

The incidence of extrapulmonary tuberculosis varied from region to region. In our study, it constituted 11% of all the cases. In the study done by Nissaportin et al [10] and Noor Hayati et al [11], similar findings were seen. In the studies done by Dolberg et al and Fernandez et al, the reported figures were higher and this difference may be due to the variations in reporting of the cases to the hospital and other regional factors.

The sex distribution was 1:1 in our study with 52 males and 52 females. In the study done by Noor et al [11], the sex ratio was same as in our study.The sex ratio was 1:3 in the study done by Subhash Chandir et al [14] with a predominance of females.

The most common age group of the cases involved in our study was between 20 – 30 years. Findings were similar in the studies done by Nissaportin et al [10], Noor Hayati et al [11], and Subhash Chandir et al [14] with the mean age being around 32 years.

The most common site involved in extrapulmonary tuberculosis in our study was lymph nodes, constituting 57% of the cases followed next by osteoarticular region, constituting 18% of the total cases. The site of involvement was the same region in most of the other studies done by Nissaportin et al [10], Noor Hayati et al [11], Subhash Chandir et al [14] and Abdul rahman et al [15]. Central nervous system was the most common site involved in the study done by Mokhtar et al [16].

A battery of investigations were done starting from a basic ESR to tissue biopsy which is considered as the gold standard for the diagnosis.

Erythrocyte sedimentation rate was elevated in 78 cases, (75%) of the total cases. Chest X-ray showed normal finding in majority of the cases, 76 cases (73% with abnormalities detected only in 19 (18%) of the cases. Sputum was collected for three consecutive

Clinically, ESR was elevated in 75% and Chest X-ray revealed significant changes only in 19% of the total cases in our study.Sputum for AFB and culture were positive in 7% and 10% respectively among the total cases in our study. These findings were similar to those in the studies done by Nissaportin et al [10].

Tissue biopsy proved to be the gold standard and 72% of the total cases were positive in our study. Extensive areas of necrosis were seen along with granulomas composed of epithelioid cells, Langhan's type of giant cells and mature lymphocytes. 52% of the cases were positive in tissue biopsy in the study done by Nissaportin et al [10].

Summary

Extrapulmonary tuberculosis is an important clinical problem particularly in multidrug resistant TB cases. Early identification of these cases by clinical examination and investigations proves to be useful to assess the global burden of this rampant disease.

Conclusion

Patients presenting with loss of weight should thoroughly investigated for any evidence of tuberculosis infection as this was the most common presentation in out study. Younger age group(20-30years)were the most common category involved by extrapulmonary tuberculosis in our study and the most common organ involved was lymph nodes.

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Study of Burn Cases during Autopsy in Relation to Manner of Death

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Abstract

Background: Burn has tremendous importance in medico legal point of view as it is one of common cause of unnatural death and a major health problem in India. Setting of fire to self (*self-immolation*) in public is done to attract the attention of government and media regarding political affairs, personal problem. Sometimes people resort criminal act like murder, rape and for concealing the fact they want to burn the body of crime. Most often circumstance of burn is mysterious, obscurity and even untruthful statement. *Materials used*: Only those cases of burn which are ante-mortem and are confirmed to be so, after autopsy. *Observation*: The highest incidence occurred in the age group of 21-30 years (44%). About 70% of thermal burn incidence occurred in the kitchen. Most of the burn injuries are accidental in nature (70.67%). In suicidal and alleged homicidal majority of them are female. Major cases of accident burn are due to burst of kerosene stove (92%). Abdomen was frequently involved followed by extremities. Scalp hair, eye brow and eye lashes are involved in nearly 100% cases of suicidal and alleged homicidal burn but in accidental cases scalp hair is involved in (83.01%) and eye brows, eye lashes in 79.99% cases. Blackening of skin (20%), Heat rupture (0.67%) and pugilistic attitude was found in (3.33%) of cases. Soot in trachea is found in 20% of cases, Glottis edema in 2%, generalized congestion in 94.66% and generalized pallor in 5.34% cases. *Conclusion:* Awareness should be made to avoid such deaths. The extreme method of suicide can be avoided by proper counseling.

Keywords: Ante-Mortem Burn; Awareness; Education; Manner of Death.

Introduction

Burn has tremendous importance in medico legal point of view as it is one of common cause of unnatural death and a major health problem in India. Setting of fire to self (self-immolation) in public is done to attract the attention of government and media regarding political affairs, personal problem. Female mostly suffer accidental burn because of nature of work of women in society. Large portion of burn injuries are related to the nature of domestic appliances used in our country. Socio-cultural factors like use of crackers in festivals, use of diyas for offering puja, custom of wearing saree and dupatta, huge social, cultural and religious gathering are also contributing factor.

Homicidal burning of married women in our country is major concern for the police, government and forensic experts. Sometimes people resort criminal act like murder, rape and for concealing the fact they want to burn the body of crime. Only by conducting post-mortem meticulously we can arrive at proper diagnosis whether it is postmortem or antemortem burn. Most often circumstance of burn is mysterious, obscurity and even untruthful statement. Investigations of such cases are difficult because of false statement and counter allegation from complainant and accused person.

There is no clear cut demarcation between accidental, suicidal, and homicidal burn. To prove or disprove detail study of burn injury is necessary which will throw light on manner of death. Sometimes we are facing legal problem while

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attending in court of law which demands clear cut knowledge between homicide from suicidal and accidental burn. Hence our study may solve some of the purpose.

Material & Methods

The study was undertaken in the Department of FMT, S.C.B. MCH Cuttack, Odisha during the period from December 2009 to November 2011. The case of autopsy with the death of thermal burn either due to flame and scald was taken into account in this study.

Inclusion Criteria

Only those cases of burn are included in the study those who were ante-mortem and were confirmed to be so, after autopsy.

Exclusion Criteria

Alleged Post mortem burn cases, lightening, decomposed, electrocution were excluded.

After detail observation of the victim the findings were expressed in tabular form with respective to age, sex, marital status etc. The findings were analyzed and different inference is drawn with this observation.

Result & Discussion

Causative Agent According to the Manner of Death

Kerosene (22%) was the major agent found in burn followed by L.P.G gas (4%) and petrol (0.67%).

Singh D. [1] observed that Kerosene (76%) was most common factor in burn death. 11% of death occurred due to Stove bursting and 27% of death occurs due to leakage of oil from stove. Kumar V. [2] studied 152 cases and observed that smell of kerosene was found in 41 (26.9%) of burnt married female. Among homicide 20(42.55%) cases were found to have odor of Kerosene in clothes and tuft of hair. In 21(62.62%) of suicidal cases kerosene oil is found on clothes and hairs.

Virendra K., Tripathi C.B. [3] reported on their study that 57.44% of homicidal burnt wives have smell of kerosene either on their scalp or on clothing's. Ambade V.N., Godbole H.V.[4] reported in their study that kerosene was main causative factors for burning. Shaha K.K., Mohanty S. [5] in their study revealed that Kerosene was main factor for homicide burn.

Hosseini R.S. [6] in their study found that out of 167 cases, 130 (77.8%) burnt cases were caused by oil and gasoline 28 (16.8%) by gas explosion. 9 (5.4%) by clothing's catching fire. Chawla R. et al. [7] studied 50 cases and found that in 4% of cases smell of kerosene is present.

Kerosene is the inflammable substance most frequently found in my study because it is easily available in every household kitchen.

Marital Status According to Manner of Death

Most number of victims died were accidental (70.67%) in nature, follows suicidal (17.33%) and alleged homicidal (12%). Maximum married female (62.26%) victims died accidentally, followed by unmarried female (19.81%), unmarried male (11.32%) and married male (6.60%). Most of suicidal burn victims were married female (69.23%) followed by unmarried female (23.07%), male (7.68%). All the victims of alleged homicidal are married female.

Subrahmanyam M. [8] studied 175 cases and reported that 79.4% of burns were accidental in nature. Singh D. et al (1998) reported that (80%) of cases were accidental in nature followed by (16.2%) cases were suicidal and (4.1%) were homicidal burn.

Kumar V. et al [2] analysed 152 cases and found that 70(46.05%) died accidentally, 47(30.95%) died due to homicidal burn, 32(21.05%) died due to suicidal burn and rest 3% unknown. Kulshrestha P. et al[9] studied 117 cases and reported that 69(58.97%) of married female were accidental death followed by 35(29.91%) which are suicidal and 6(5.12%) are homicidal death.

Batra A.K.[10] in a study observed that (50.7%) of cases are accidental, (47.8%) are suicidal and 15% of cases are homicidal in nature. 60% of female adopted suicide by burn. Subrahmanyam M., Joshi A.V.[11] in their study reported (82.6%) of cases as accidental in nature, (15%) of cases as suicidal and (2.4%) as homicidal.

Virendra K, Tripathi C.B. [3] reported in their study that out of 152 burnt wives 31% were homicidal burn. Ambade V.N, Godbole H.V. [4] is their report found that (75%) of death are due to accidental burn followed by suicidal and homicidal burn.

Kumar V. et al [12] in their study revealed that majority of burn incident were accidental (75.8%) followed by suicidal (11.5%) and homicidal (3.1%). Srivastava K., Arora P.[13] observed in their study that (44.06%) of death is due to burning in married female about 11.89% were suicidal 9.09 are homicidal

and 23.08% are accidental deaths.

Mangal H.M. et al [14] in their study observed that (61%) of cases are accidental death followed by (35%) of cases are suicidal and (4%) are homicidal death. Menchoubi Ph., Nabachandra H.[15] in their study observed that (35.38%) of death are accidental in nature, (29.23%) of death are homicidal and (24.6%) of cases are suicidal in nature.

Palimer V. et al [16] in their study reported that (92.8%) 39 cases are accidental death. Shirkhoda M. et al [17] and others in their study found that out of 303 cases. 165 deaths are accidental, 138 cases are suicidal in nature.

In the present study it shows that in all manner of death married women were mostly affected because of lack of safety measures, torture, dowry demand, mental instability, domestic disharmony, mal-adjustment and heavy and loose clothing's.

Age Wise Distribution According to the Manner of Death

It is observed that majority of accidental victims belong to 11-40 years (84.06%), out of which most of them were 21-30 years group (42.45%), least victim belongs to <10 yrs, 71-80 yrs, >80 yrs age group (1.87%) each.

Most of the suicidal victim belongs to 11-40 years age group, out of which (50%) belongs to 21-30 years group, least number of victims belong to 41-50 years (7.70%). Alleged homicidal victim belongs to age group of 11-30 years (88.88%), least victim belong to 31-40 years age group (11.12%).

Majority of victims belong to 21-30 years group because around half of the day is spent in kitchen, most of them were married, lack of awareness, maintaining low standard of safety measure. This age group is generally more active and exposed to hazardous atmosphere. Suicidal burn is more in this age group because of marital disharmony, mal-adjustment in initial year of marriage. Alleged homicidal burn was mainly due to torture and demand of extra dowry.

Place of Incidence According to Manner of Death

Highest number of accidental (69.82%), suicidal (61.54%) and alleged accidental (83.33%) burn injury occurred in kitchen followed by (16.04%) accidental, (34.62%) suicidal occurred in living room. (7.54%) of accidental burn occurred in open space. Least number of burn injury occurred in living room cum kitchen. No cases of suicidal, alleged homicide were recorded in open space.

Most of the accidental death occurred in kitchen because of wearing loose clothing, using defective kerosene stove, cooking in conventional Chula, and lack of awareness and safety measures. Suicidal and alleged homicidal death occurs because it is a secluded place, no one can know what had actually happened and lot of things can be concealed and falsely alleged.

Body Surface Involved According to Manner of Death

In accidental burn wide range of involvement of body surface area is found i.e. 41- 100%. But in suicidal and alleged homicidal it involves >90% of total body surface area. Among suicide and alleged homicide victim if meticulous observation is done we find that in suicide case involvement of body surface is > 90% where as in alleged homicide cases the body surface area involved is >80%.

Present observation have similar finding with Kumar V. et al [2], and Shaha K.K. et al [5].

In accidental cases there shows wide range of involvement of body surface because victim tries to save therefore less area is involved. But in cases of suicide victim's intention is to die so maximum area is involved. In alleged homicide cases victim is unable to escape.

Involvement of Body Hair According to the Manner of Death

Scalp hairs (87.33%) were more involved in burn injury than eye brow/ eye lashes (84%) and pubic hair (66.67%). Scalp hair is involved mostly in suicidal burn injury (100%) than in alleged homicidal (94.4%) and accidental case (83.01%). Eye brow and eye lashes are mostly involved in suicidal (100%) burn injury then in alleged homicidal (88.88%) and accidental (79.24%). Pubic hair is mostly involved in alleged homicide (83.33%) than in suicide (80.77%) and accidental (60.34%).

Kumar V. et al [2] studied 152 cases and observed that generalized congestion of viscera is found in large majority of cases 112 (73.68%), out of which 40 (57.14%) were homicidal, 41 (58.57%) were suicidal, 28(87.5%) were accidental. Generalised pallor was found in 39(23.64%) cases out of which most of them were accidental in nature. The present study is similar with Kumar V. et al [2].

All hairs are involved because intention is clear to die; fire is spread in fraction of minute as a result of

inflammable substance and engulfs the whole body.

External Findings According to Manner of Death

Blackening of skin is found in (33.34%) of burn injury, pugilistic attitude is found in (3.33%) and heat rupture is found in (0.67%) of victims. Blackening of skin is widely present in alleged homicidal (50%) burn injury then in suicidal (42.30) and accidental (9.43%). Pugilistic attitude is found in suicidal (7.69%) victims and alleged homicidal (5.55%) burn injury victim and least in accidental (1.88%) victims. Heat rupture was found only on accidental victim (0.94%).

Kumar V. et al [2] studied 152 cases and observed that in 102 (67.10%) of cases there is singeing of hair, it is more found in suicidal cases 93.75%, sooty blackening is found in 86(56.57%) cases, pugilistic attitude is found in 24(15.78%) cases, heat rupture is found in 23(15.15%) cases and heat fracture is found in 2(1.31%) cases

Present series of findings is nearly corresponding with Kumar V. et al [2] and other findings are due to prolong exposure to heat. Blackening of skin is due to inflammable substance used in burning.

Internal Findings According to Manner of Death

Soot in trachea was found in (20%) of burn injury, glottis edema is observed in (2%) of victim. Generalised congestion, generalised pallor, cherry-red color blood, pleural effusion, ascitic fluid, pleural effusion & ascitic fluid is found in (94.66%), (5.34%), (16.67%), (18.67%), (2%), (15.33%) respectively.

Soot particle are more found in alleged homicidal (44.44%) than suicidal (30.76%) and accidental (13.20%). Generalised congestion was commonly observed in suicidal (100%) and alleged homicidal (100%) victims than in accidental (91.50%) burn injury. Cherry-red color of blood was maximally present in alleged homicidal victims (44.44%) followed by suicidal (30.76%) and accidental (8.50%) victims. Effusion of fluid was mostly found in accidental burn injury. Present observation shows nearly similar finding with Kumar V. et al [2].

Generalised congestion is due to bacterial toxins, absorption of toxic substance like CO_2, CO etc. Generalised pallor is due to prolong illness, superimposed by infection, anemia, and severe pain. Carbon soot particles are more found in homicidal and suicidal burn. It is not detectable in large number of cases because of hospitalisation, it gets washed away or the victim did not get sufficient time to inhale carbon particles.

Table 1: Causative agent according to the manner of death

Agents found	Accidental		Suicidal		Alleged Homicidal		Total
	Male	Female	Male	Female	Male	Female	
Kerosene	1 (0.94)	9 (8.94)	0	12 (46.15)	0	11 (61.11)	33 (22%)
Petrol	1 (0.94)	0	0	0	0	0	1 (0.67%)
LPG	2 (1.89)	4 (3.77)	0	0	0	0	6 (4%)
Total	4	13	0	12	0	11	40

Table 2: Marital status according to manner of death

Manner of Death	Male		Female		Total
	Married	Unmarried	Married	Unmarried	
Accidental	7 (6.60%)	12 (11.32%)	66 (62.26%)	21 (19.81%)	106 (70.67%)
Suicidal	1 (3.84%)	1 (3.84%)	18 (69.23%)	6 (23.07%)	26 (17.33%)
Alleged Homicidal	0	0	18 (100%)	0	18 (12%)
Total	8 (5.33%)	13 (8.66%)	102 (68%)	27 (18%)	150 (100%)

Table 3: Age wise distribution according to the manner of death

Age in Yrs	Accidental	Suicidal	Alleged Homicide	Total
<10	2(1.89)	0	0	2(1.33)
11-20	23(21.70)	5(19.23)	8(44.44)	36(24)
21-30	45(42.45)	13(50)	8(44.44)	66(44)
31-40	21(19.81)	06(23.07)	02(11.12)	29(19.33)
41-50	05(4.72)	02(7.70)	0	07(4.67)
51-60	03(2.83)	0	0	03(2)
61-70	03(2.83)	0	0	03(2)
71-80	2(1.87)	0	0	02(1.33)
> 80	2(1.87)	0	0	02(1.33)
Total	106(70.67)	26(17.33)	18(12)	150

Table 4: Place of incidence according to manner of death

Place of Incidence	Accidental	Suicidal	Alleged Homicide	Total
Kitchen	74 (69.82%)	16 (61.54%)	15 (83.33%)	105 (70%)
Living Room	17 (16.04%)	09 (34.61%)	01 (5.55%)	27 (18%)
Living Room cum Kitchen	06 (5.66%)	01 (3.85%)	02 (11.12%)	09 (6%)
Open Space	08 (7.54%)	0	0	08 (5.33%)
Industries	01 (0.94%)	0	0	01 (0.67%)
Total	106 (70.67%)	26 (17.33%)	18 (12%)	150 (100%)

Table 5: Body surface involved according to manner of death

Manner of death	< 30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%	Total
Accidental	1	3	12	8	12	13	20	37	106
Suicidal	0	0	1	1	1	0	9	14	26
Alleged Homicidal	0	0	0	1	0	2	4	11	18

Table 6: Involvement of body hair according to the manner of death

Manner of death	Scalp Hair		Eye brow/Eye lashes		Pubic Hair	
	Involved	Spared	Involved	Spared	Involved	Spared
Accidental	88 (83.01%)	18 (16.99%)	84 (79.24%)	22 (20.76%)	64 (60.34%)	42 (39.62)
Suicidal	26 (100%)	0	26 (100%)	0	21 (80.77%)	5 (19.23)
Alleged Homicidal	17 (94.4%)	1 (6.6%)	16 (88.88%)	2 (11.12%)	15 (83.33%)	3 (16.67%)
Total	131 (87.33%)	19 (12.67%)	126 (84%)	24 (16%)	100 (66.67%)	50 (33.33%)

Table 7: External findings according to manner of death

External Findings	Accidental	Suicidal	Alleged Homicide	Total
Blackening of skin	10 (9.43%)	11(42.30%)	9 (50%)	45 (33.34%)
Pugilistic attitude	2 (1.88%)	2 (7.69%)	1 (5.55%)	5 (3.33%)
Heat rupture	1 (0.94%)	0	0	1 (0.67%)
Total	13	13	10	36

Table 8: Internal findings according to manner of death

Internal Findings	Accidental	Suicidal	Alleged Homicide	Total
Soot in trachea	14(13.20%)	8 (30.76%)	8 (44.44%)	30 (20%)
Glottis edema	2 (1.88%)	2 (7.69%)	1 (5.55%)	3 (2%)
Generalised congestion	97 (91.51%)	12 (100%)	18 (100%)	142 (94.66%)
Generalised Pallor	8 (7.54%)	0	0	8 (5.34%)
cherry red Color blood	9 (8.90%)	8 (30.76%)	8 (44.44%)	25 (16.67%)
Pleural Effusion (P.E)	22(20.75%)	4(15.38)	2(11.11%)	28(18.67%)
Ascitic Fluid (AS.)	2(1.87%)	0	1(5.55%)	3(2%)
P.E + AS.	19(17.92%)	3(11.53%)	1(5.55%)	23(15.33%)

Cherry-red color of blood is due to CO poisoning. Effusion of fluid occurs due to increase permeability of fluid as a result of inflammation by thermal burn.

Conclusion

Female are more prone to burn injury in all manner of death. Awareness should be made to avoid such deaths. The suicidal rate in female is more than other two manner of death. This is because of mal-adjustment in family life like torture for dowry. Accidental nature is more common than suicide and homicide due to unawareness and carelessness. Hence education regarding use of such modern equipment should be imparted before using it. For avoiding accidental fire kitchen and living room should be well ventilated. Next more common nature is suicide and alleged homicide. The extreme method of suicide can be avoided by proper counseling. In modern democratic society self immolation is also a political cause. Police protection help a lot for avoiding such cases.

Alleged homicide is not uncommon now a day due to mal-adjustment of bride with in laws. The evil of dowry was almost in all cases, either pure suicide or alleged homicide in our series. Hence proper education should be imparted to the people and legal

aspects should be widely explained to all people to avoid such unfortunate death. Kerosene being a sole agent found in this series should be kept in proper place and out of reach from children. Crackers should be stored in away from the crowd and should be used under the guidance of elders.

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Original Article

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Estimation of Stature by Per-Cutaneous Measurements of Distal Half of the Upper Limb

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Abstract

Background: Stature of a person is one of the vital parts of identification. Assessment of height from different parts of the body by anthropometric study of skeleton is an area of interest to anatomist, anthropologist and forensic experts. *Objective:* This study aims to find the relationship between stature and forearm lengths and set regression equations for estimation of stature from radius and ulna length for Telangana population. *Study Design:* Descriptive cross sectional study. *Material and Method:* In the present study, stature and per cutaneous Forearm length measurements of 164 college students of ages 19- 27 years were done. The data for the present work was collected from the various senior secondary schools and colleges of Karimnagar area of Karimnagar District of Telangana State of India. *Observation and Discussion:* In the present study, regression equations have been formulated with the standard error of estimate (SEE) ranging from ±5.1892 cm to ± 5.5292 cm. For females the standard error of the estimation is observed in Left Ulna length (SEE = ± 5.1311 cm) and the Left radial length (SEE = ± 5.1092cm). For Males the standard error of the estimation is observed in Left Ulna Length (SEE = ± 5.5292 cm) and the Right radial length (SEE = ± 5.4395 cm). *Conclusion:* The Multiple regression equations provide slightly better results than the linear regression equations. The results in the present study indicate that the length of forearm can be efficiently used for stature estimation.

Keywords: Per-Cutaneous Forearm Length; Forensic Anthropology; Stature; Multiple Regression Analysis.

Introduction

Anthropometry is often viewed as a traditional and perhaps the basic tool of biological anthropology, but it has a long tradition of use in forensic sciences and it is finding increased use in medical sciences especially in the discipline of Anatomy & Forensic Medicine.

Pearson K, et al. (1898) [1] fist introduced the co-relational calculus into the field of work for the prediction of the stature from the measurement of the long bones. Height is one of the factors in the description of impressiveness of an individual and it varies with race, age sex, heredity, climate and nutritional status. Telekka et al. (1950) [2] worked on the bones of the limbs and expressed the opinion that each racial group needs a separate formula for the estimation of stature. Many of the previous workers worked on cadavers or on skeletal remains [3, 4]. But cadavers cannot be the representatives of the population; because the cadavers are largely of persons who are aged, and they may have suffered from chronic debilitating diseases. It may be likely that they had been lying in an abnormal posture and it may not have been possible to straighten the body to get the accurate stature measurement. Again, according to Trotter M et al. (1952) [5], there is an increase in the height of 2.5 cm after death, when the measurement is taken in the recumbent posture. Lundy JK (1985) [6] discussed the regression equation and the mathematical and the anatomical method of estimating the living stature from the long limb bones. The hand lengths can be used as a basis for estimating age- related loss in stature and as an alternative measure to stature when stature cannot

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be measured directly due to deformity like kyphosis, lordosis and scoliosis, contracture or missing legs.

Objectives

This study aims to find the relationship between stature and forearm lengths and set regression equations for estimation of stature from radius and ulna length for Telangana population.

Material and Method

In the present study, stature and per cutaneous Forearm length measurements of 164 college students (74 male & 90 female) of ages 19- 27 years were done. The data for the present work was collected from the various senior secondary schools and colleges of Karimnagar area of Karimnagar District of Telangana State of India. The study was a predominantly descriptive cross sectional study with analytical and comparative components. Sufficient permissions and consents are procured before the measurements of the students are taken and clearance from the Institutional Ethical committee is obtained in advance. Stature; using the stadio-meter, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

The forearm measurements were taken using a sliding caliper. The ulna length was measured as the distance from the distal tip of Olecrenon process to the tip of ulna styloid process (the elbow to the wrist of forearm) and the radial length was measured as the distance from the distal tip of ulna head to the tip of radial styloid process. The subject's elbow was flexed at 90° to 110° with fingers extended in the direction of the long axis of the forearm. All measurements were recorded to the nearest millimeter.

Exclusion Criterion

Students morphologically showing the congenital malformations, Dwarfism / Achondroplasia, features of nutritional deficiencies and injuries to extremities, using medication thought to alter growth, neuromuscular weakness or abnormal tone or with any other major medical illnesses or growth disturbance were excluded from the study.

Data Analysis

In vernier caliper, Length = reading of the main scale + vernier coincidence x vernier constant + mechanical error. (Here vernier constant = 0.01 and mechanical error = 0) Calculation of stature using regression equation: Stature = value of constant + regression coefficient x Per-cutaneous Radial ulnar Length. Value of the constant and regression coefficient was calculated using SPSS Version 19 program. Descriptive statistics of stature and forearm (ulna and radial) measurements were calculated for both males and females. T-test was utilized to examine statistical significance in bilateral asymmetry in forearm measurements of males and females. Statistical significance was considered at P-value < 0.05. The Pearson's correlation coefficient was calculated. Simple linear and multiple regression analyses were performed to derive regression equations for estimation of stature from forearm measurements for males and females.

Observation

Descriptive statistics, the descriptive statistics for stature and forearm measurements in males and females (the minimum values, maximum values, means, and standard deviations) are shown in Table 1.

Bilateral asymmetry

Table 2 presents the results of paired samples t-tests; the statistical significance of bilaterally asymmetry in forearm lengths of both sexes is represented by t and p values.

It is observed that bilateral asymmetry in the right

Table 1: Descriptive Statistics for stature and forearm measurements in male and female (n = 164)

Measurement	Side	Male (n= 74)				female (n= 90)			
		Min	Max	Mean	S.D.	Min	Max	Mean	S.D.
Age		19	27	22	1.7	19	26	21	1.1
Height		151	181	169.054	7.1393	148	179	162.789	7.2134
Ulna length	Left	23	29	26.476	1.3692	23	28	25.192	1.9567
	Right	23	29	26.405	1.4064	23	28.5	25.079	1.2664
Radial Length	Left	23	29	26.453	1.3284	22.5	28.2	25.427	1.2837
	Right	23	29	26.434	1.3254	22.5	28	25.397	1.3011

Table 2: Bilateral differences in forearm measurements in male and female (n= 164)

Measurement	Male (n= 74)				female (n= 90)			
	Mean diff. (left-Right)	S.D.	t-value	P- value	Mean diff. (left-Right)	S.D.	t-value	P- value
Ulna length	0.07027	0.20777	2.88962	0.00508	0.11333	0.30594	3.49474	0.00074
Radius length	0.01892	0.16413	0.98484	0.32796	0.03176	0.17285	1.63735	0.10509

and left ulna length of both sexes is not statistically significant. Similarly, the bilateral asymmetry in radial length of females is not statistically significant. On the other hand, bilateral asymmetry in radial length of males is statistically significant.

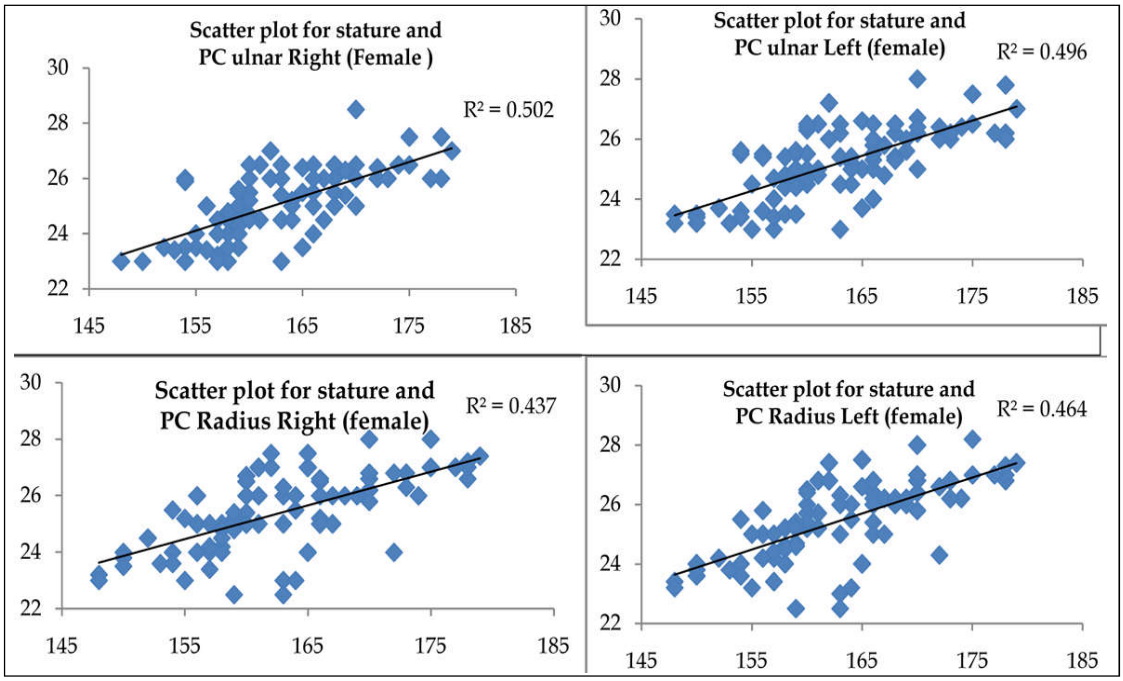

Fig. 1: Scatter plot for stature, Radius and Ulna for Female

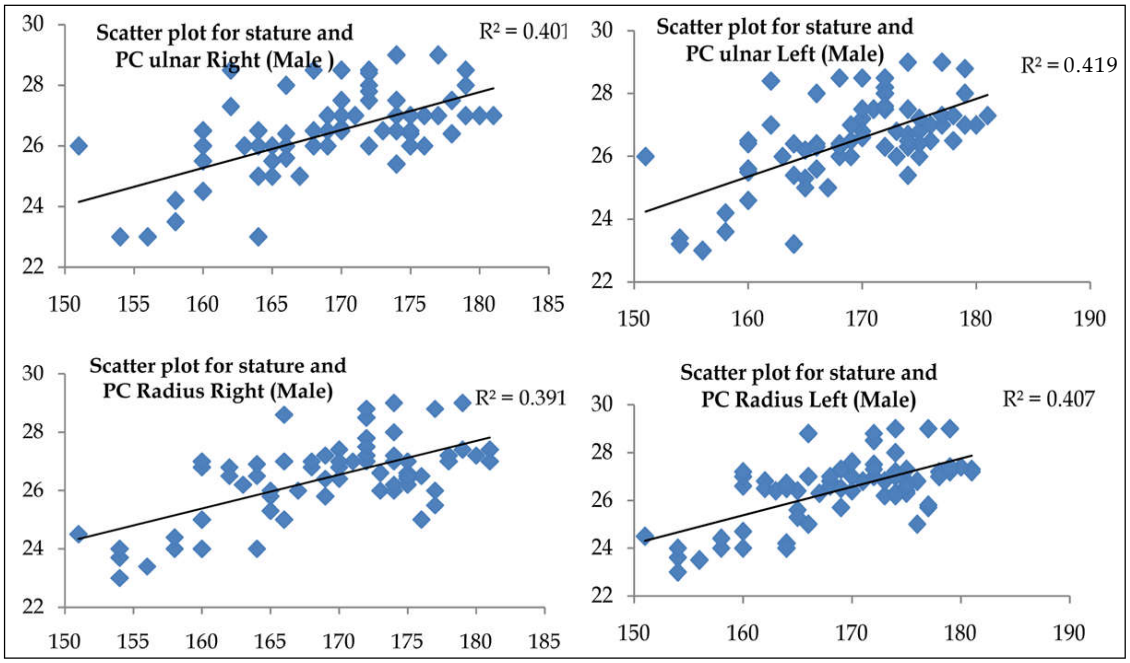

Fig. 2: Scatter plot for stature, Radius and Ulna for Male

Pearson's Correlation Coefficients

The results of the correlation coefficients between stature and forearm measurements are shown in Table 3. All forearm measurements exhibit statistically significant correlation coefficients with stature (p-value < 0.001). The correlation coefficient between stature and forearm length (ulna and radial) was higher in the female group. For females, the highest correlation is exhibited by the right ulna length (r = 0.7085, SEE = ±5.1311), and the lowest by both sides of radial length (r = 0.6253, SEE = ±5.1092 cm for left side and SEE = ±5.1311 for right side). For males, the highest correlation is exhibited by the Left Ulna length (r = 0.6473, SEE = ±5.4395), and the lowest by both sides of right radial length (r = 0.6253, SEE = ±5.5292 cm for right side and SEE = ±5.4395 for left side).

Table 3: Pearson's correlation coefficient between stature and forearm length

Measurement	Side	Male (n = 74)		Female (n = 90)	
		R	P	R	P
Ulna Length	Left	0.6473	0.0000	0.7043	0.0000
	Right	0.6332	0.0000	0.7085	0.0000
Radius Length	Left	0.6380	0.0000	0.6812	0.0000
	Right	0.6253	0.0000	0.6611	0.0000

The results of linear regression equations of different parameters were obtained as follows:

Male :	Stature (cm) = 79.6 + (3.38 x PC Ulnar Left)	(cm)
	Stature (cm) = 84.1 + (3.22 x PC Ulnar Right)	(cm)
	Stature (cm) = 78.3 + (3.43 x PC Radius Left)	(cm)
	Stature (cm) = 80.0 + (3.37 x PC Radius Right)	(cm)
Female :	Stature (cm) = 55.7 + (4.25 x PC Ulnar Left)	(cm)
	Stature (cm) = 61.5 + (4.04 x PC Ulnar Right)	(cm)
	Stature (cm) = 65.5 + (3.83 x PC Radius Left)	(cm)
	Stature (cm) = 69.6 + (3.67 x PC Radius Right)	(cm)

In the present study, regression equations have been formulated with the standard error of estimate (SEE) ranging from ± 5.1892 cm to ±5.5292 cm. For Females the standard error of the estimation is observed in Left Ulna length (SEE = ±5.1311 cm) and the Left radial length (SEE = ±5.1092cm). For Males the standard error of the estimation is observed in Left Ulna Length (SEE = ±5.5292 cm) and the Right radial length (SEE = ± 5.4395 cm)

Multiple Regression Equations

The multiple regression equations for estimation of stature from different combinations of forearm measurements for males and females are presented in Table 4.

Table 4: Multiple regression equations for stature estimation from forearm measurements in cm

(n = 164)

Sex	Side	Equations	r	R^2	SEE
Male	Left	S=72.7 + (1.98 x LUL) + (1.66 x LRL)	0.6656	0.4430	5.4395
	Right	S=76.2 + (a1.87 x RUL) + (1.65 x RRL)	0.6512	0.4240	5.5292
Female	Left	S=52.8 + (2.79 x LUL) + (1.56 x LRL)	0.7176	0.5150	5.1092
	Right	S=58.5 + (3.12 x RUL) + (1.02 x RRL)	0.7148	0.5110	5.1311

It is observed that the correlation coefficients, the coefficients of determination, and standard errors of the estimate of the multiple regression equations are better than those of the linear regression equations. For males, the Left side of forearm measurements shows the highest correlation coefficient with stature (r = 0.6656) and the lowest standard error of the estimate (SEE = ± 5.4395 cm). For females, the Left side of forearm measurements exhibits the highest correlation coefficient with stature (r = 0.7176) and the lowest standard error of the estimate (SEE = ± 5.1092 cm).

Discussion

In our study, stature and forearm lengths were measured from a total of 164 (74 males and 90 females) students in Karimnagar region of Telangana state.

The results show that the mean stature and all forearm lengths of females are higher than those of males. Similar findings were observed in previous studies [7]. Nishat Ahmed Sheikh *et al.* (2014) estimated stature from forearm length, the ratio fall between 3.49 and 3.88 for boys with a mean of 3.67 and SD + 0.090; and between 3.45 and 3.88 for girls with a mean of 3.68 and SD 0.093 [8]. The results of paired samples t- tests show no significant bilateral asymmetry in ulna length in both sexes (mean difference = 0.07027, p-value = 0.00508 for males and mean difference = 0.11333 , p-value = 0.00074 for females). Similarly, no significant bilateral asymmetry in radial length is observed in females (mean difference = 0.03176, p-value = 0.10509). This result is supported by the study of Arun Kumar Agnihotri (2009) [9] that showed no significant bilateral asymmetry in forearm bones of Indo Mauritian populations.

Nishat A Sheikh [10 & 11] et. al studied Regression equation for estimation of stature from foot length for both sex Y= 82.934+ 3.404 x Foot length, for individual male sex Y= 138.59 + 1.35 x Foot length and for Female sex Y= 119.50 + 1.604 x Foot length. The correlation coefficient between height & foot length is + 0.688 in Male & +0.587 in female which is highly significant. Therefore, we can use either side of ulna for both sexes and either side of radius for females in constructing models. This is supported by another study on limb bilateral asymmetry (Freedman, Edwards, Willems, & Meals, 1998). On the other hand, bilateral asymmetry in radial length of males was significant (mean difference = 0.01892, p-value = 0.32796), which may be due to the regularly use of both left and right side of forearms. Growth usually indicates physical changes in height, weight and other limbs of the body. It means the increase and enlargement of the body or different parts of the body making it heavier and larger. Seema S Sutay & Nishat A Sheikh [12, 13] et.al. Studied regression equation for estimation of stature from Per-cutaneous ulnar length for both sex Y= 64.36+ 3.82 x PC ulnar Length, for individual male sex Y= 130.10 + 1.57 x PC ulnar Length and for Female sex Y= 75.94 + 3.21 x PC ulnar Length. Variety of factors such as age, race, gender and nutritional status affect human development and growth. Therefore, different equations may be required for different populations.

Conclusion

The Multiple regression equations provide slightly better results than the linear regression equations. The results in the present study indicate that the length of forearm can be efficiently used for stature estimation. This reasonable exercise may be useful in all medico-legal examinations and anthropometry procedures. We conclude that the multiple regression equations presented here can be used to estimate ante-mortem stature, with reasonable accuracy, of unknown human forearm remains from per-cutaneous lengths of radius and Ulna in medico-legal cases, particularly from Telangana state of South India.

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Conflict of Interest

No conflict.

Ethical Clearance

The articles do not violate any ethical, moral or legal guidelines pertaining to original scientific work.

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Pancytopenia: A Tertiary Care Institutional Study

Rajesh Para*, Shailaja Para**

Abstract

Background: Pancytopenia means decrease in all three cell lines .It is the striking feature of many illness ranging from megaloblastic anaemia to leukaemias. The underlying pathology of pancytopenia will determine the management and prognosis. *Objective:* To identify the various etiologies of Pancytopenia. *Materials and Methods:* The present study was undertaken at BRIMS Bidar. *Results:* 100 cases were studied, 57 males and 43 females with age ranging from 3 yrs to 90 yrs .Most of the cases presented with generalized weakness, followed by pallor, hepatosplenomegaly and bleeding manifestations. *Conclusion:* The present study were helpful in understanding the various causes of diseases process with bone marrow aspiration done in few of the pancytopenic patients along with support of biochemical investigations which were helpful in planning further investigations and management .

Keywords: Pancytopenia; Bone Marrow Aspiration; Megaloblastic Anaemia; Leukaemia.

Introduction

The hypoproliferative anemias are normochromic, normocytic,or macrocytic and are characterized by a low reticulocyte count. Hypoproliferative anemia is also a prominent feature of hematologic diseases that are described as bone marrow failure states; these include aplastic anemia, myelodysplastic syndrome (MDS), pure red cell aplasia (PRCA), and myelophthisis. Anemia in these disorders is often not a solitary or even the major hematologic finding. More frequent in bone marrow failure is *pancytopenia*: anemia, leukopenia, and thrombocytopenia. Low blood counts in the marrow failure diseases result from deficient hematopoiesis, as distinguished from blood count depression due to peripheral destruction of red cells (hemolytic anemias), platelets (idiopathic thrombocytopenic purpura [ITP] or due to splenomegaly), and granulocytes (as in the immune leukopenias).

Marrow damage and dysfunction also may be secondary to infection, inflammation, or cancer.

Hematopoietic failure syndromes are classified by dominant morphologic features of the bone marrow Although practical distinction among these syndromes usually is clear, some processes are so closely related that the diagnosis may be complex. Patients may seem to suffer from two or three related diseases simultaneously, or one diagnosis may appear to evolve into another. Many of these syndromes share an immune-mediated mechanism of marrow destruction and some element of genomic instability resulting in a higher rate of malignant transformation.

Pancytopenia is an important clinico-hematological entity encountered in our day to day clinical practice. It is a disorder in which all three major formed elements of blood (red blood cells, white blood cells and platelets) are decreased in number [1]. It is not a disease entity but a triad of findings that may result from a number of disease processes – primarily or secondarily involving the bone marrow [2]. There are varying trends in its clinical pattern, treatment modalities and outcome [3]. The severity of pancytopenia and underlying pathology determine the management and prognosis of the patients [4] . In present study we have evaluated the various

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causes of pancytopenia with peripheral blood , bone marrow findings along with Vit B12 and Lactate Dehydrogenase levels (LDH) .

There are incidences of pancytopenia which are a direct result of drug intake. All patients do not respond to this in a similar manner. One of the most extensively studied phase II polymorphisms is the PM trait for thiopurine S-methyltransferase (TPMT). TPMT bioinactivates the antileukemic drug 6-mercaptopurine. Further, 6-mercaptopurine is itself an active metabolite of the immunosuppressive azathioprine. Homozygotes for alleles encoding the inactive TPMT (1 in 300 individuals) predictably exhibit severe and potentially fatal pancytopenia on standard doses of azathioprine or 6-mercaptopurine. On the other hand, homozygotes for fully functional alleles may display less anti-inflammatory or antileukemic effectwith the drugs.

Materials and Methods

100 patients of pancytopenia patients were evaluated with bone marrow aspiration in Private lab. Patients from all age groups from both sexes were included. Inclusion criteria was hemoglobin < 10 g/dl, total leukocyte count (TLC) < 4000 / µl, platelet count < 100,000/ µl. [5].

Patients blood was collected in EDTA (ethylene diamine tetra–acetic acid) and processed through Sysmex automated hematology analyzer. Peripheral smear was stained with Giemsa stain for all cases and examined thoroughly. Bone marrow aspiration was done in 26 patients after taking written consent and VitB12 and LDH levels in 35 cases.

All the statistics were done using the latest SPSS software 2015 (California).

Results

A total of 100 patients who presented with pancytopenia were studied. They consisted of 57 males and 43 females with male to female ratio of 1.3:1. The age of patients ranged from 3yrs to 90 yrs.

The commonest mode of presentation was generalized weakness followed by pallor. Hepatosplenomegaly was seen in subleukaemic leukemia of myeloid type.

Megaloblastic anaemia was seen as main cause of

Table 1: Presenting complaints and physical findings

Sl. No	Presenting complaints and physical findings	No. of cases	Percentage
1	Generalized weakness	52	52
2	Dyspnea	3	3
3	Fever	2	2
4	Bleeding manifestations	2	2
5	Weight loss	7	7
6	Pallor	26	26
7	Splenomegaly	7	7
8	Hepatomegaly	7	7
9	Fatigue	7	7

Table 2: Test for Significance. Association of complaints

Complaint	P – value (< 0.05)	Significance
Generalized weakness	0.0041	Significantly associated
Pallor	0.078	Significantly associated

Table 3: Distribution of various causes of Pancytopenia

Causes of Pancytopenia	No. of cases	Percentage
Megaloblastic anaemia	47	47
HIV	17	17
Malaria	9	9
Dengue	9	9
Subleukemic leukemia	2	2
Iron deficiency anaemia	5	5
Idiopathic thrombocytopenic purpura	2	2
Aplastic anaemia	9	9

pancytopenia in 47cases (47%). The peripheral blood picture showed macrocytes , macro ovalocytes ,hyper segmented neutrophils, and bone marrow showed erythroid hyperplasia megaloblastic type (Figure 1). In our study we saw in 20 cases of megaloblastic anaemia, LDH (lactate dehydrogenase) was raised and Vit B12 was reduced. In all cases of megaloblastic anaemia patients improved with vit B 12 and folic acid therapy.

Malaria was observed in 9 cases (9%) presenting with pancytopenia, it was P. Falciparum species.

We also came across 9 cases (9%) of Dengue who presented with pancytopenia in our study.

Sub leukaemic leukemia was seen in 2 cases (2%), out of which after bone marrow aspiration we came to a conclusion of acute myelocytic leukaemia in 2 cases (2%).

Iron deficiency anaemia seen in 5 cases (5%) having microcytic hypochromic anaemia along with tear drop cells in peripheral smear and showed micronormoblastic hyperplasia in bone marrow aspirations .

Idiopathic thrombocytopenic purpura seen in 2 case (2%) and bone marrow showed increased megakaryocytes with hypolobulated and hypogranular appearance.

HIV was the cause of pancytopenia in 17 cases (17%). Bone marrow aspiration was not done in these patients.

Aplastic anaemia were seen in 9 cases (9%).

Discussion

A total of 100 cases were studied. We did a detailed study of patients of Pancytopenia . Peripheral smear in 100 cases, bone marrow aspirations for 26 cases and LDH and Vit B12 for 35 cases were done. Age, gender –wise incidence, presenting complaints were studied and compared with other studies.

The age of patients ranged from 3 yrs to 90 yrs. Male to female ratio was 1.3:1. Age and sex distribution were studied and we compared it with study of other authors in Table 3.

Table 4: Age, sex distribution in various studies

Sl. No.	Authors	No. of Cases	Age Range(y)	M:F
1	KhungerJM et al.[6](2002)	200	2-70	1.2:1
2	Kumar R et al.[5](2001)	166	12-73	2.1:1
3	Khodke K et al.[7](2001)	50	3-69	1.3:1
4	Tilak V et al.[4](1999)	77	5-70	1.14:1
5	Phurailatpam Madhubala Devi et al.[10] (2008)	50	3-80	1.5:1
6	Soma Yadav et al.[9] (2013)	60	<30	1:1.2
7	S Pudasaini et al.[8](2012)	57	9 mon-75y	1:1.1
8	Present study	100	3-90	1.3:1

The commonest cause of pancytopenia in our study is megaloblastic anaemia. Most of studies we compared which had same findings.Incidence of megaloblastic anaemia was 47% in our study as compared to 72% reported in Khunger JM et al, 22.2% in Kumar R et al, 68% in Tilak V et al, 44% in Khodke K et al, 12.3% in S Pudasaini et. al, 27.7% in Soma Yadav et al and18% in Phurailatpam Madhubala Devi et al [4-10] study. In our study we saw in 35 cases of megaloblastic anaemia, LDH (lactate dehydrogenase) was raised. All cases of megaloblastic anaemia patients improved with vit B 12 and folic acid therapy. In Eivazi-Ziaei J et al [11] study also observed increased LDH in megaloblastic anaemia . The expected increased LDH activity is the result of an an accelerated turnover of bone marrow cells implying the release of this enzyme from dividing and/or decaying cells [11]. In 35 cases Vit B12 were also reduced. Our study had 9 cases (9%), as compared to 1% in Khunger JM et al ,3% in Kumar R et al and 3.9% in Tilak V et al.

We have observed in 2 cases (2%) of acute myeloid leukemia .This diagnosis was based on bone marrow aspiration . Khodke et al [7] reported a single case of AML –M2 out of 50 cases of pancytopenia. Kumar R et al reported 5 cases of all, 13 cases of of AML , 2 cases of hairy cell leukemia out 166 cases of pancytopenia over a 6 year study [5]. S Pudasaini et al [8] reported 10.5% AML and 1.8% of AML. Phurailatpam Madhubala Devi et al [10] saw 14% of acute leukaemia and Soma Yadav et al [9] had 13.3% of acute leukaemia cases. The patho physiology of pancyopenia in acute leukemia is unclear but is probably related to a combination of suppression of normal haematopoesis and replacement of bone marrow by leukemic cells resulting in pancytopenia and immunosuppression [9]. 5 cases (5%) of Iron deficiency anaemia were reported in our study who

presented with pancytopenia. Phurailatapam Madubala Devi et al study [10] also 8% and S Pudasaini et al [8] study had 7% who presented with Pancytopenia as a cause of Iron deficiency disease.

Incidence of Aplastic anaemia in present study was 9 cases (9%) and it was 4% in Khodke et al and Khugner et al [6,7] but it was more that is 29.5% in Kumar et al study [5] and 38.3% in Soma Yadav et al [9] study .

HIV was one of the important cause of pancytopenia in our study having 17cases (17%) , it was 1.6% Soma Yadav et al [9] study in 2% in Khodke et al study [7] and 6% in Phurailatpam Madhubala Devi et al study [10]. Virtually all patients with advanced AIDS have pancytopenia as a rule, the causes are production of the antibodies which might be triggered by exposure of crypt antigens as a consequence of infection related damage of blood cells especially platelets and granulocytes. The haematopoietic cells especially platelets and granulocytes are antigenically similar to agents like HIV and other microorganisms infecting the patients. These antibodies could interact with tissue antigens. Third possibility is that HIV act as direct inducer of autoimmunity [9].

Present study revealed 2 cases (2%) having Idiopahic Thrombocytopenic Purpura as compared to 10.5% observed in S Pudasaini et al study [8].

Conclusion

In our study we have encountered, other than common reasons like megaloblastic anaemia, HIV infection etc. Presenting as Pancytopenia , even, Iron deficiency anaemia, subleukemic leukemia, Dengue and Malaria also had presented with pancytopenia. Bone marrow aspiration supported with biochemical profile is very important for confirmation of cause of pancytopenia. Proper diagnostic work up is essential before use of hematinics and blood transfusion in all patients presenting as pancytopenia.

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Correlation of Finger Prints with Blood Groups as an Identity Tool

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Abstract

Finger print is the cheapest and user friendly tool of identification. It's correlation with blood group is medicolegally important to trace the victim and accused for detection of crime. In this study thumb prints of 100 medical students of GMC, Latur were taken and correlated with their blood groups. In the study blood group B (39%) was the commonest ABO group, Rh + ve (92%) was commonest Rh system. Amongst the finger print patterns- Loops were most common (64%), whorls were second commonest (31%), the study suggests an association between finger print patterns and blood groups. Blood group B showed more Loops (28%) and blood group A (9%) showed more whorls. Our aim is to help investigating agencies by providing a clue in crime detection by fixing probable culprit. We can find out probable blood group of accused if we find chanced finger print and vice-versa.

Keywords: Finger Print; Unique Identity; Blood Group; Clue for Fixing Probable Culprit.

Introduction

The scientific study of fingerprint is called dermatoglyphics [1]. This is the study of ridge patterns in the skin [2]. It is based on the principle that skin of the balls of the fingers and thumbs is covered with characteristic ridges, the arrangement and distribution of which remains constant and persists throughout life and the patterns of no two hands resemble each other [3]. This system was 1st used in India in 1858, by Sir William Herschel in the Bengal. Sir Francis Galton systematized this method in 1892. Fingerprint Bureau was 1st established in Kolkatta [2]. In Henry system of classification there are three basic fingerprints patterns, loops which constitutes about 60-65%, whorls about 30-35% and arches about 5% [1]. In case of criminals, impressions of all the digits of both the hands are taken and preserved by the police for future identification [3]. Recently in India Gowda and Rao, in their study on Gowda Saraswat Brahmin community of south Kannada district (Karnataka) reported high frequency of loops with moderate whorls and low arches in the individuals of A, B and O blood groups [4]. Hahne [5] and Herch [6] in their study also found correlation of blood groups and finger print patterns. So, purpose of our study is to correlate blood groups and finger print pattern, when we find a chance finger prints on crime scene than we can find out probable blood group of accused and we can help investigating agencies to solve the crime by fixing probable culprit.

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Material and Method

This study was carried out in department of forensic medicine at GMC, Latur. A batch of 100 students was selected for the study. They were asked to press their right and left thumb tips on the ink stamp pad and then to transfer impressions on plain paper sheet and rolled impression obtained by rolling both thumbs [3]. After that their details such as name, age, sex, birthdates, address and blood groups were noted. Their blood groups were confirmed from their college identity cards. Powerful magnifying hand lens were used to differentiate patterns of fingerprints as loops, whorls and arches. This different pattern than correlated with their blood groups

Observation

Table 1: Distribution of blood group among cases

Blood Group	Cases
A +	18(18%)
B +	39(39%)
AB +	09(9%)
O +	26(26%)
A -	01(1%)
B -	02(2%)
AB -	01(1%)
O -	04(4%)

Table 2: Distribution of finger prints pattern among cases

Pattern of finger prints	Total
Loops	64 (64%)
Whorl	31(31%)
Arch	05(5%)

Table 3: Distribution of blood groups according to sex

Sex	A +	B +	AB +	O +	A -	B -	AB -	O -	Total
Male	10(10%)	21(21%)	03(3%)	08(8%)	01(1%)	01(1%)	01(1%)	03(3%)	48
Female	08(8%)	18(18%)	06(6%)	18(18%)	00	01(1%)	00	01(1%)	52

Table 4: Distribution of finger prints pattern according to sex

Finger Prints pattern	Male	Female
Loops	28(28%)	35(35%)
Whorls	17(17%)	15(15%)
Arches	03(3%)	02(2%)

Table 5: Correlation of blood group and finger prints in male

Sex	A +	B+	AB +	O +	A -	B -	AB -	O -
Loops	04(4%)	14(14%)	03(3%)	07(7%)	00	01(1%)	00	01(1%)
Whorls	06(6%)	05(5%)	00	01(1%)	01(1%)	00	01(1%)	02(2%)
Arches	01(1%)	02(2%)	00	00	00	00	00	00

Table 6: Correlation of blood group and finger prints in female

Sex	A +	B+	AB +	O +	A -	B -	AB -	O -
Loops	05(5%)	14(14%)	04(4%)	01(1%)	00	01(1%)	00	00
Whorls	03(3%)	03(3%)	02(2%)	06(6%)	00	00	00	00
Arches	01(1%)	00	00	01(1%)	00	00	00	00

Table 7: Correlation of blood group and finger prints in general

Sex	A +	B+	AB +	O +	A -	B -	AB -	O -
Loops	09(9%)	28(28%)	07(7%)	08(8%)	00	02(2%)	00	01(1%)
Whorls	09(9%)	08(8%)	02(2%)	07(7%)	00	01(1%)	00	02(2%)
Arches	02(2%)	02(2%)	00	01(1%)	00	00	00	00

Type of Blood Groups (Table 1 and 3)

Majority of cases belongs to B +ve group (39%) followed by 0 +ve group (26%) and A +ve (18%). Blood group B +ve were most common among males followed by A +ve and 0 +ve. Blood group B +ve and 0 +ve were common among females followed by A +ve and AB +ve.

Finger prints patterns (Table 2 and 4).

Loops were commonest pattern of finger prints about (64%), followed by whorls (31%) and arch (5%) among both sex Correlation of blood groups and finger prints pattern (Table 5, 6 and 7).

Blood group B +ve shows highest frequency of

loops, blood group A +ve shows highest frequency of whorls. Blood group B +ve shows highest frequency of loops, followed by O +ve , followed by A +ve in males and blood group A +ve shows highest frequency of whorls followed by B +ve, followed by O –ve in males. Blood group B + ve show highest frequency of loops, followed by A +ve followed by AB +ve in females. Blood group 0 +ve shows highest frequency of whorls followed by A +ve and B +ve, followed by AB +ve in females.

Discussion

Finger prints are impressions of patterns formed by the papillary or epidermal ridges of the fingertips. The finger prints are distinctive and permanent in individuals. The fingerprint system is the only guide to identity, which is unfailing in practice [2]. Loops are most common about 60-70 %, followed by whorls about 25-35% and arches about 6-7% [1,2,3] in this study similar results were obtained i.e. loops were 64%, whorls 31% and arches 5%. The results of study by Ahmed Khurshid Pasha et el revealed that blood group B was predominant among the students in order of B>O>A>AB. Blood group B was also most common blood group in both the genders [9]. In this study similar results were obtained i.e. blood group B +ve were commonest amongst both genders, followed by O +ve and A +ve. There is specific correlation between finger prints and different parameters like gender and blood groups [8]. Bharadwaja et al study revealed that individuals with blood group A have more of loops, while that of blood group AB had more of whorls [7]. Dr. Prateek Rastogi et al found that blood group A had a higher frequency of loops but Blood group O was associated with a predominance of whorls [9]. In present study different results were obtained , blood group B +ve shows highest frequency of loops, blood group A +ve shows highest frequency of whorls. This shows that there was definite correlation between finger prints pattern and blood groups. So by identifying different finger prints we can find out probable blood group of individuals and vice versa, which may help the investigation and detection of crime.

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Correlation between Vitreous Electrolytes and Time since Death: An Autopsy Based Study

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Abstract

Context: Estimation of time since death has always remained an important requirement in medico legal as well as civil cases. In last few years researchers have studied various chemical tests to estimate the time since death. Body fluids which are available for such chemical examination are whole blood, serum, cerebrospinal fluid, aqueous humour and vitreous humour. Amongst all these available body fluids, the vitreous humour has been largely utilized and vitreous potassium concentration has become most widely used method to predict the time since death. *Aims:* To find the correlation between vitreous potassium, vitreous sodium and time since death. *Settings and Design:* The present study is prospective study done at B J Govt. Medical College during October 2012 to October 2014. *Material and Methods:* 207 cases brought for postmortem examination during study period were selected after applying inclusion and exclusion criteria. *Statistical Analysis:* Statistical analysis was done using SPSS software to find coefficient of correlation, regression equation and ANOVA test was applied to study the significance. *Observation and Results:* The statistical analysis showed that there is no any significant correlation between time since death and vitreous sodium. However analysis showed a highly significant positive linear correlation between time since death and vitreous potassium concentration with regression equation as, $y = 0.2115 (x) + 8.9122$ with coefficient of correlation of + 0.8024. The rise was found up to 46 hours after death. The present study also showed that 95% confidence limit of over ± 17.14 hours limits the usefulness of this method in estimating time since death. *Conclusion:* The vitreous potassium is a very useful indicator for determination of time since death. However one should keep check on sampling errors and method of analysis, as it can make difference in the final results.

Keyword: Vitreous Potassium; Sodium; Time Since Death; Correlation.

Introduction

In any postmortem examination determination of time since death i.e. the interval between death and time of examination of body is an important issue [1]. The estimation of time since death is undoubtedly one of the most significant research in forensic medicine and yet it is still considered as to be most controversial and inaccurate one [2].

It is known that many of chemical changes start in the body immediately or shortly after death. It has also been observed that these changes progress in an orderly fashion till the disintegration of body. Changes in chemical constituents have its own time factor or rate of change. These changes occur especially in body fluids like blood, spinal fluid and vitreous humour of eye. Thus it was hypothesized and later confirmed that determination of the chemical quantity could help forensic pathologists to ascertain time since death more precisely [3].

As compared to other body fluids, vitreous humour of eye is stable and less susceptible to rapid chemical changes and contamination. It is also easily accessible and its composition matches a lot to that of aqueous fluid, cerebrospinal fluid and serum. Hence it is suitable for many analyses to estimate

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time since death [4].

The accurate estimation of time since death carries great value in medico legal investigations of serious crimes. Hence several workers have studied and reported that the accurate prediction of time since death i.e. even within two hours, can be possibly made from vitreous humour potassium [5]. Hence the current study is to find the correlation between vitreous potassium and sodium concentration with time since death.

Material and Methods

The present study was conducted during October 2012 to October 2014 at department of Forensic Medicine, B J Govt. Medical College Pune. The cases brought for postmortem examination formed the material for collection of vitreous humour. Total 207 cases were studied. Cases where exact time of death was known and it correlated with postmortem changes like postmortem lividity, rigor mortis and putrefaction were selected for sample collection. Dead bodies which were kept in cold storage, cases where exact time of death was not known, cases with known ocular disease or trauma, cases whose time of death on enquiry from different sources was found to differ by more than $\pm$ 15 minutes, hospitalized cases where electrolytes or diuretics were given prior to death and cases with known electrolyte disturbances prior to death were excluded from the study.

The information regarding age, sex, cause of death, date and time of death was gathered from police records, hospital records and from eye witnesses, relatives, friends and attendants of the deceased. Examinations of dead bodies were conducted in sufficient light. External examination was carried out to note the appearance and situation of rigor mortis, appearance, site and colour of postmortem lividity, state of eyes with reference to cornea, any external injury to eyes and signs of decomposition. Sample was drawn from right eye of each individual.

After collecting the samples only the clear samples were processed further. Samples having any particulate matter, cloudy, discolored or hemorrhagic were discarded and were not included in the study.

Vitreous humour was collected from the posterior chamber of the eye, slowly and gradually avoiding tearing of loose fragments of tissues by needle aspiration through a puncture made 5-6 mm away from the limbus near outer canthus using 10 ml sterile syringe and 21 gauze needle, directed in such a position that the tip of needle is near retina. Vitreous humour was then slowly aspirated. As much of the vitreous humour as can be aspirated was removed because the vitreous humour next to the retina has a different concentration of solutes than in the central portion of the globe.

Once the sample was aspirated, the syringe was detached from needle. The needle was kept in situ to inject sterile water in the posterior chamber of eye to restore the eyes for cosmetic purposes. The aspirated vitreous humour sample was poured in a rubber stoppered glass vial for sodium and potassium estimation by Flame Photometry Method. Analysis was done immediately after collection of samples without any time delay.

Observations and Results

Total numbers of cases studied during study period were 207. Maximum time since death for which vitreous sample collected was 46.00 hours. In the study population there was a female preponderance with maximum number of cases from age group of 0 to 20 years (33) followed by age group of 21 to 40 years (32). While maximum number of males were from the age group of 0 to 20 years (30) followed by age group of 21 to 40 years (24) (Graph I). Distribution of cases with respect to Time Since Death (TSD) showed that out of 207 cases maximum i.e. 98 (47.4%) were with TSD less than 12 hours followed by 87 (42.1%) cases with TSD between 12 hours and 24 hours and 22 (10.5%) cases with TSD 24 hours and more than 24 hours (Table 1). For vitreous sodium the statistical analysis was not significant (Table 3). However for vitreous potassium the statistical analysis showed that there is highly significant change ($p < 0.001$) in vitreous potassium concentration with time since death (Table 2). To find the exact correlation between the vitreous potassium concentration and time since death we did the regression analysis and we charted a graph. The graphical representation (Diagram 1) showed that the coefficient of correlation (r) was + 0.8024. It means there is a positive linear correlation between TSD and vitreous potassium concentration. The regression equation for the Diagram 1 was, $y = 0.2115 (x) + 8.9122$ (where 'y' is vitreous potassium concentration i.e. independent variable and 'x' is time since death i.e. dependant variable, 'a= 0.2115' is the slope of regression line and 'b=8.9122' is the intercept of regression line). The analysis of Table 4 gave us, 95% confidence limit of x i.e. Mean ± 2 (standard deviation of x) = Mean ±17.14 and Regression coefficient i.e. Standard deviation of x /

standard deviation y = 3.27 hrs. This means that an increase of 1mEq/L in potassium concentration will indicate an increase of 3.27 hours in time since death and 95% confidence limit for all cases will be ±17.14 hours.

Table 1: Percentage distribution of cases depending upon time since death (TSD)

S. No.	TSD (IN hrs.)	No. of Cases	Percentage Distribution.
1.	00 hrs - 12 hrs.	98	47.4
2.	12 hrs – 24 hrs.	87	42.1
3.	≥ 24 hrs.	22	10.5
		207	100.00

Table 2: Levels of vitreous potassium depending upon the time since death (TSD)

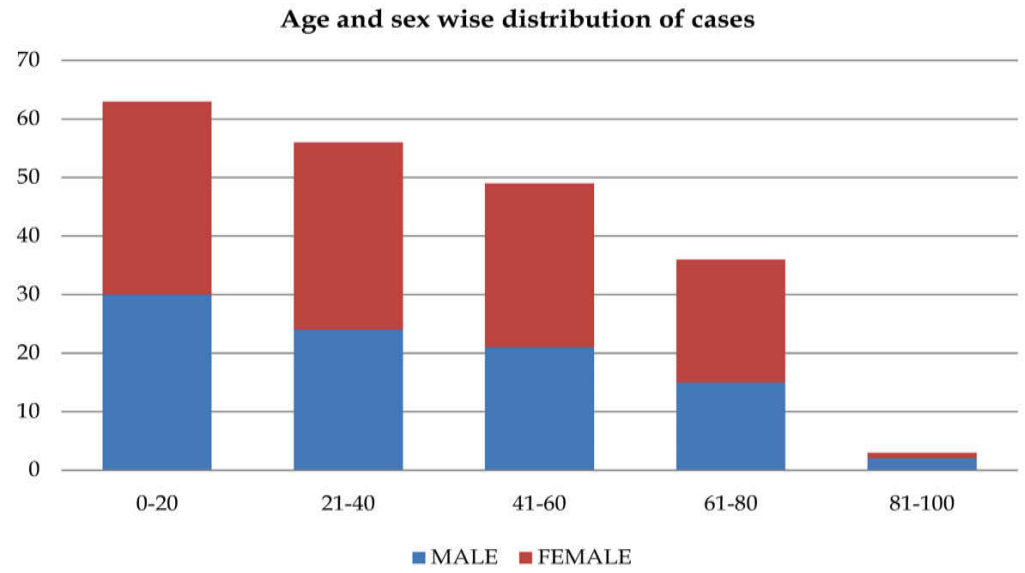
TSD (hrs)	No. of cases	Vitreous Potassium (mEq/L) Mean	SD	ANOVA F	P value
00 hrs - 12 hrs.	81	10.53	2.826		
12 hrs – 24 hrs.	72	13.51	0.953	52.85	<0.001 HS
≥ 24 hrs.	18	14.81	1.621		
Total	171	12.24	2.678		

Table 3: Levels of vitreous sodium depending upon the time since death (TSD)

TSD (hrs)	No. of cases	Vitreous Sodium (mEq/L) Mean	SD	ANOVA F	P value
00 hrs - 12 hrs.	81	176.23	90.905		
12 hrs – 24 hrs.	72	166.47	61.353	1.152	0.319 NS
≥ 24 hrs.	18	147.25	45.479		
Total	171	169.07	75.799		

Table 4: Correlation between time since death and vitreous potassium concentration

Time since death (hrs.) X variable	Sample size	207
	Mean	17.28
	Standard deviation	8.57
Vitreous Potassium y variable	Sample size	207
	Mean	12.69
	Standard deviation	2.10



Graph 1: Age and sex wise distribution of cases.
In above graph - On X axis – Age in years. On y axis – Number of cases studied.
Blue colour – Male sex. Red colour - Female sex

Table 5: Correlation between time since death and vitreous potassium concentration for different durations

Sr. No.	Investigator	Found rise in vitreous potassium up to ...hours
01	Sturner [8]	104
02	Hansson et al [17]	120
03	Lie [15]	100
04	Coe J I [21]	6 - 24
05	Adjutantis et al [5]	12
07	Agrawal R L et al [3]	24
08	Stephens et al[9]	35
09	Madea et al [10]	120
10	Knight B. [22]	100
12	Munoz et al [12]	41
13	Madea B et [13]	120
14	Garg V et al [2]	104
15	Deokar R et al [14]	40
16	Present study	46

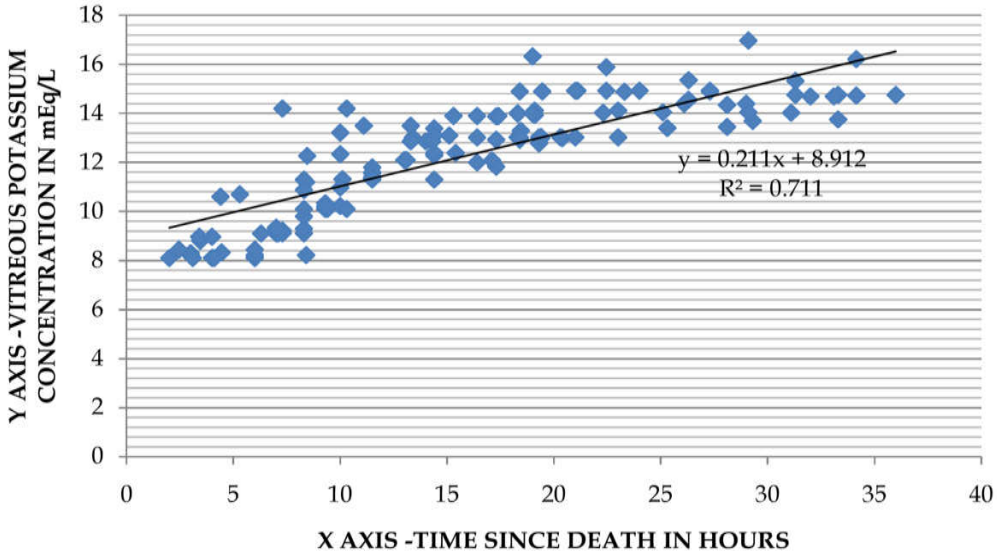


Diagram 1: Correlation between time since death and vitreous potassium concentration

Discussion

Estimation of time since death has always remained an important requirement in medico legal autopsies. Estimation of time since death can directly or indirectly help to find out the time of assault. Time passed between death and postmortem examination and time for which deceased survived after say, sustaining fatal injury considered together give the time of assault. But even after adapting all possible methods, in many cases only gross estimation is possible with the help of parameters like cooling of body, changes in eye, postmortem staining, rigor mortis, decomposition changes, contents of stomach and bowels, contents of urinary bladder and circumstantial evidence, but besides these changes many chemical changes also begin to take place in the body after death and progress in a fairly orderly fashion until the body disintegrates which may prove to solve this query [6].

Various chemical tests to estimate the time since death have been largely developed in last few years. Body fluids which are available for such chemical examination are whole blood, serum, cerebrospinal fluid, aqueous humour and vitreous humour. Amongst all these available body fluids, the vitreous humour has been largely utilized and vitreous potassium concentration has become most widely used method to predict the time since death [1]. Same is investigated in this study. Apart from potassium the postmortem changes of sodium has also been investigated.

Aqueous humour in the anterior and posterior chambers of the eyes and vitreous humour which is contained within the vitreous body constitutes the intraocular fluid. Because of largervolume, easy

availabilityand lesser or no contamination, vitreous humour was preferred in this study. Also vitreous humour is relatively inert and slightly influenced by sudden changes in the human blood chemistry [7]. The current study of potassium in the vitreous humour showed that with increasing time since death there was considerable rise in the levels of potassiumThus vitreous potassium and glucose can be used as indicators to estimate time since death. But the study of vitreous sodium concentration showed no considerable variation and hence was of no use to estimate time since death.

The study shows that with the increase of time since death the levels of potassium in the vitreous humour increased significantly.This observation is supported by workers [2, 3, 8-14].

During lifetime potassium is almost intracellular. Normal vitreous potassium concentration ranges from 2.6 – 4.2 mEql/L. High intracellular concentration of potassium is maintained by sodium potassium pump. After death this pump does not operate and therefore potassium is leaked out of cell, leading to high potassium levels. It is postulated that normal antemortem route of entry of potassium in vitreous humour isthrough ciliary body [7]. After death there is autolysis of the vascular choroids and retinal cells of the eye which release substantial amount of potassium into the vitreous humour causing rise in the potassium levels [15].

However the findings of workers like Hughes W B[16], Hansson L et al [17] and Devgun M S. et al [18]are not in line with present study findings. Hughes W B found that in case of vitreous humour, variance in the internal factors like enzyme supply, surviving oxygen supply etc. make postmortem changes to differ from theoretically predicted one [16]. Hansson et al suggested role of technical difficulties like pipetting and dilution of viscous fluid as the cause of wide spread dispersion of potassium values [17].

A straight line relationship was found between the vitreous potassium levels and the time since death.This is in confirmation with the observation made in most of the previous researches. This observation was verified by the least squares analysis. The resulting linear regression equation in the form of $y = ax + b$ (where 'y' is vitreous potassium concentration i.e. independent variable and 'x' is time since death i.e. dependant variable, 'a' is the slope of regression line and 'b' is the intercept of regression line) was, $y = 0.211 x + 8.9122$.

From this it was found that there appeared a linear relationship between vitreous potassium concentration and time since death and this was a simple straight line (Diagram 1) as observed by majority of the investigators [9, 14, 17, 19, 20].

But Adjutantis and Coutselinis [5], Hughe s[16] and Coe [21] found this line to be biphasic in which the slope of the first few hours after death is steeper than for more prolonged times after death, which is not in agreement with this study.

Regarding vitreous sodium, results of study showed that the levels of sodium in vitreous humour after death wereinsignificantly variable with the increasing time since death. This observation is in agreement with studies made by other workers [7, 15, 19, 21, 22].

In this study it was found that vitreous potassium levels increase up to 46 hours after death. Various researchers found this rise in vitreous potassium for varying hours after death (Table 5).

From above observations it is clear that majority of western workers reported a longer time period as compared to 46 hours in present study. According to some investigators this could be because tropical climate of India, where dead bodies decompose faster leading to faster biochemical changes leading to attainment of diffusion equilibrium of potassium across the cell membrane[7].

The present study showed that 95% confidence limit of over ± 17.14 hours limits the usefulness of this method in estimating time since death. From review of literature it is evident that the reliability of the test showed greater variation with different investigators. While Adelson [23] found the 95% confidence limit of ± 10 hrs, Adjutantis et al [5]felt that standard deviation was ± 1.7 hrs. On the other hand Sturner and Gantner [24] and Lie [15] in their study found a close correlation between vitreous potassium and the postmortem interval and the 95% confidence limit was ± 4.7 hrs. However the greater majority of investigators have found a much greater standard error to be present ranging as high as ± 34 hrs [10]. Further , it is also evident that there is marked variation in the slope of values of potassium derived from various investigators. But majority of the investigators found these slopes to be straight.

Through the researches of last few decades, certain factors have become apparent behind the marked variation in the confidence limits and slope of values of potassium derived from various investigators. These factors can be external such as sampling techniques, different sample size, analytical instruments and environmental temperature during death or internal factors such as age of the individual, the duration of terminal episode, manner of death

like burns, hanging, drowning and electrolyte imbalance especially concentration of blood urea nitrogen or presence of uremia at the time of death [3]. Sample manipulation prior to analysis can also be a reason behind the grater variability in vitreous potassium concentration [25].

Hence during sampling of vitreous humour two precautions must be taken as -

(1) If vitreous aspirate is less than 0.5 ml, it may give unrepresentative results; owing to the uneven distribution of potassium within vitreous body [3]. Hence it is necessary to remove whole of the fluid from the eye that can be aspirated because the vitreous humour next to the retina has a highest concentration of solutes than the central portion of the globe until putrefaction sets in [7].

(2) Secondly, the vitreous must be aspirated slowly to avoid tearing loose fragments of the tissue [12]. Such tissue fragments grossly distort the electrolytes in the vitreous, since it is from those cells from which most of the electrolytes are derived as mentioned by Lie [15] and later by Coe [21].

Recent studies in this field have shown that the values of vitreous potassium can vary with the use of different instruments which are used to measure potassium concentration. Coe and Appledemon-strated that potassium concentration obtained by flame photometry was lower than the values obtained by direct potentiometry with a potassium ion selective electrode [26].

However one should remember that this study cannot be employed if eyes are injured; absent or sample drawn is unclear. The procedure of vitreous humour aspiration requires adequate skill, lack of which leads to instrumentation and sampling error.Analysis of vitreous electrolytes is machine and technique dependent and hence mechanical and technical errors are possible.The study cannot be applied in cases where electrolyte imbalance is evident prior to death.

Conclusion

The vitreous potassium is a very useful indicator for determination of time since death. However one should keep check on sampling errors and method of analysis, as it can make difference in the final results.

Ethical Clearance

Obtained from institutional ethics committee.

Conflict of interest: Nil.

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Original Article

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Pattern of Skull Fractures in Fatal Craniocerebral Injury Cases

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Abstract

Background: In this modern era of scientific development and industrial progress, craniocerebral trauma is the leading cause of morbidity, mortality and achieved status as a 'global health epidemic'. Skull fracture is a important component of craniocerebral injury. Fracture pattern, type, extent, and position are important in assessing the sustained injury. The skull fractures, offer varying diagnostic and medico- legal problems to the medical jurists as well as to the clinicians. So in present study more emphasis was given on study of skull fractures. *Materials & Methods:* A prospective cross sectional study was carried out during period from 1st June 2011 to 15th October 2012 in the department of FMT of Rural Medical College, Loni. In present study 100 fatal cases of craniocerebral injury were studied. During medicolegal post-mortem examination, detailed external as well as internal examination was conducted in each case and injuries were examined in details. Skull fracture was noted in terms of type, location, number, extension & associated complications. In this way collected data was analysed & presented in this paper. *Results:* In the present study we found skull fractures in 71 cases out of 100 cases. Linear type of skull fracture was found in 40 cases. In 34 (47.88%) cases both the vault as well as base were involved. In case of vault fracture, occipital bone was commonest location (8 cases). It was noted that the commonest site of basal fractures was the combination of anterior, middle and posterior cranial fossa accounted for 15 cases. *Conclusions:* Majority of fatal cases of head injury shows skull fracture. Combined involvement of vault and base was seen in most of the cases. Linear fracture was the commonest type of fracture observed. In vault fracture, occipital region was commonly involved & fronto-parieto-temporal. In base fracture, combination of anterior, middle & posterior cranial fossa was the commonest combination observed.

Keywords: Craniocerebral Injury; Skull Fracture; Medicolegal Problem**.**

Introduction

In this modern era of scientific development and industrial progress, craniocerebral trauma is the leading cause of morbidity, mortality and achieved status as a 'global health epidemic'. Vehicular accidents, fall from height & assault are common modes of head Injuries. Other modes are occupational head injuries, industrial accidents, head injuries sustained in natural calamities like earthquakes and building collapses, sports and recreational activities. Out of these, head injuries due to vehicular accidents supervene [1].

There are three main components of head scalp, skull & brain. The term craniocerebral injuries can be used to describe the presence of skull & brain injury [2]. National Advisory Neurological Disease and Stroke Council has defined craniocerebral injury as "a morbid state resulting from gross or subtle structural changes in the scalp, skull and / or the contents of the skull, produced by mechanical forces" [3].

A skull fracture indicates that substantial force has been applied to the head and is likely to have damaged the cranial contents [4]. Fractures may be caused by direct or indirect violence. Direct injuries

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may be caused by: 1. Compression as by midwifery forceps or crushing of the head under the wheel of a vehicle. 2. An object in motion striking the head, e.g. bullets 3. Head in motion striking an object as in falls. Indirect injury of the skull occurs from a fall on the feet or buttocks. There is no relation between the damage to the brain & linear fractures of skull. Skull fractures can occur without any significant or detectable brain injury or any impairment of consciousness. Conversely fatal brain injury may occur without fracture of skull [5].

Skull fractures are useful in Forensic Pathology as they can often indicate the position & nature of the head injury [6]. The causative forces & fracture pattern, type, extent, and position are important in assessing the sustained injury [7]. The skull fractures, especially by blunt force offer varying diagnostic and medico- legal problems to the medical jurists as well as to the clinicians [8]. So in present study more emphasis was given on study of skull fractures in relation to its incidence, type, location, pattern of vault & base fractures.

Material & Method

In present study 100 fatal cases of craniocerebral injury were studied, which were sent to the mortuary of Rural Medical College, Loni for medico-legal post-mortem examination. Preliminary data related to name, age, sex, address, brought by whom, date and time of incidence, date and time of admission, treatment given, date and time of death were noted. A detailed external as well as internal examination was conducted in each case and injuries were examined in details. More stress was given on head dissection. Head was dissected layer by layer. Scalp & under scalp area was examined for any injury. Skull fracture was noted in terms of type, location, number, extension & associated complications. Meninges were examined for haemorrhage. Then Brain matter examined for injury. In the last details of fracture of base of skull was noted by stripping the dura matter. In this way collected data was analyzed & presented in this paper.

Observation & Result

Incidence of Skull Fracture

Out of 100 fatal cases of head injury, we found skull fractures in 71 cases & in remaining 29 cases we did not found any skull fractures.

Location of Skull Fractures

We found skull fractures in 71 cases. Out of these cases, in 34 (47.88%) cases both the vault as well as base were involved, whereas 33.80% cases showed fractures of vault only. In 18.30% cases fractures of

Table 1: Incidence of Skull Fracture

Type of Case	No. of Cases (%)
Cases with Fracture of Skull	71 (71)
Cases without Fracture of Skull	29 (29)
Total	**100 (100)**

Table 2: Distribution of Cases according to the location of Skull Fractures

Type of Case	No. of Cases (%)
Cases of Vault Fracture	24(33.80)
Cases of Base Fracture	13(18.30)
Case of Vault and Base Fracture	34(47.88)
Total	**71(100)**

Table 3: Distribution according to the Type of Fracture of Skull

Type of Fracture	No. of Fracture (%)
Linear	40 (56.33)
Comminuted	20(28.16)
Depressed	1(1.40)
Separation of Sutures	1(1.40)
Depressed-Comminuted	2(2.81)
Depressed-Linear	3(4.22)
Comminuted-Linear	2(2.81)
Linear-Suture separation	1(1.40)
Linear-Depressed-Suture separation	1(1.40)
Total	**71(100)**

only base of skull was observed.

Types of Skull Fracture

In present study we found linear type of skull fracture in 40 cases, comminuted fracture in 20 cases, depressed fracture in 1 case & suture separation in 1case. We also found various combinations of above mentioned types. Combination of depressed fracture and linear fracture was seen in 3 cases. Combination of linear fracture & sutural separation was seen in 1 case. Combination of comminuted fracture & linear fracture was noted in 2 cases. Combination of depressed fracture & comminuted fracture was noted in 2 cases. Unique combination of linear fracture, depressed fracture & sutural separation was seen in 1 case.

Vault Fractures

If vault of skull is considered, its fracture was noted in 58 cases. Out of which, 7 cases shows frontal bone involvement. Occipital bone involvement was noted in 8 cases. In 5 cases temporal bone was involved. 3 cases shows parietal bone involvement. In rest of the cases simultaneous involvement of vault bones were seen.

Table 4: Distribution of Cases according to the Site of Fractures of Skull Vault

Site of Fracture Bone	No. of Cases (%)
Frontal	7(12.06)
Parietal	3(5.17)
Temporal	5(8.62)
Occipital	8(13.79)
Fronto-Parietal	2(3.44)
Fronto-Temporal	3(5.17)
Parieto-Temporal	5(8.62)
Parieto-Occipital	3(5.17)
Temporo-Occipital	1(1.72)
Fronto-Parieto-Temporal	9(15.51)
Fronto-Parieto-Occipital	2(3.44)
Parieto-Temporo-Occipital	2(3.44)
Whole Vault	8(13.79)
Total	**58(100)**

Base Fracture

In present study, base of skull was fractured in 47 cases. The commonest site of basal fractures was the combination of anterior, middle and posterior cranial fossa accounted for 15 cases, followed by anterior cranial fossa fractures in 13 cases, combination of anterior and middle cranial fossa fractures in 7 cases, posterior cranial fossa fractures in 5 cases, middle cranial fossa fractures in 4 cases and combination of middle and posterior cranial fossa fractures in 3 cases.

Table 5: Distribution of Cases according to the Site of Fractures of Skull Base

Site of Fracture	No. of Cases (%)
Anterior Cranial Fossa	13(27.65)
Middle Cranial Fossa	4(8.51)
Posterior Cranial Fossa	5(10.63)
Anterior Cranial Fossa + Middle Cranial Fossa	7(14.89)
Middle Cranial Fossa + Posterior Cranial Fossa	3(6.38)
All Three Fossae Fracture	15(31.91)
Total	**47(100)**

Discussion

In this study71% fatal cases of craniocerebral injury showed fractures of skull in various forms; while 29% fatal craniocerebral injury cases did not reveal any fracture (Table 1). Fracture of skull indicates an impression of severe injury and the impact occurred with considerable force. Agarwal SS et al [9] showed that nearly 75% (72 cases) had had fractures of the skull. Chattopadhyay S and Tripathi C [10] found that multiple cranial bones were involved in 56 (76.7%) of cases. Similar findings were also noted by Tandle RM and Keoliya AN [11].

In the present study, 71% cases had skull fractures, of which 47.88% had fracture of vault and base, whereas 33.80% cases showed fractures of vault only and 18.30% cases showed fractures of base only (Table 2). In majority of fatal head injury cases, there

were combinations of fracture of vault and basal fracture, explained by the fact that, the fracture commences at the region of maximum impact, usually on the vault of the skull and radiate mainly in the direction of force, downwards the skull base. It was suggestive that injuries are caused due to heavy forceful impact and commonly seen in vehicular accidents. In a study done by Devadiga KV and Jain SP [12], 12 cases had fracture of vault as well as of the base of skull, 8 cases had fracture of vault and 6 cases had basal fracture of skull. The study of Davidson A and Wilky JS [13] showed maximum incidence of combination of fracture of vault and base. Findings of the present study are not consistent with the studies of Tirpude BH et al [14] & Kohli A and Banerjee KK [15].

In present study we found linear type of skull fracture in 40 cases, comminuted fracture in 20 cases, depressed fracture in 1 case & suture separation in 1case. We also found various combinations of above mentioned types (Table 3). Linear fractures are likely to be caused by a forcible contact with a broad resisting surface like the ground. Tandle RM and Keoliya AN [11] showed in their study that linear fracture was the commonest type. The study of Agarwal SS et al [9] revealed that nearly 75% (72 cases) had fractures of the skull, commonly being fissure fractures. Similar findings were also noted by Patel DJ and Agnihotram G [16] & Menon A et al [17].

If vault of skull is considered, its fracture was noted in 58 cases. Out of which, 8 cases shows occipital bone involvement followed by frontal bone (7 cases), temporal bone (5 cases), parietal bone (3 cases). In rest of the cases simultaneous involvement of vault bones were seen (Table 4). These findings are not consistent with the study of Akang EEU et al [18], in which commonest site of skull fracture was frontal bone (12.4%), followed by temporal bone (9.4%). Our study is also contradicts with the study of Behera C et al [19] (commonest involvement of parietal bone in 32.91% cases) & Khan MK et al [20] (temporal bone was the commonest site).

In the present study, commonest site of basal fractures was the combination of anterior, middle and posterior cranial fossa accounted for 31.91% cases, followed by anterior cranial fossa fractures in 27.65% cases, combination of anterior and middle cranial fossa fractures in 14.89% cases, posterior cranial fossa fractures in 10.63% cases, middle cranial fossa fractures in 8.51% cases and combination of middle and posterior cranial fossa fractures in 6.38% cases (Table 5). In most of the cases, fractures of the base of skull are the extension of fracture of vault. The study of Chattopadhyay S and Tripathi C [8] showed that middle cranial fossa was the most vulnerable to mechanical injury (38.35%, N=28). The study of Tirpude BH et al [14] indicates that among basal fractures, middle cranial fossa was found in 25.9% cases (commonest site). Other authors like Khan MK et al [20], Parmar P et al [21] & Manish K et al [22] also found that middle cranial fossa was commonly fractured.

Conclusion

- Majority of fatal cases of head injury shows skull fracture.
- Combined involvement of vault and base was seen in most of the cases.
- Linear fracture was the commonest type of fracture observed.
- In vault fracture, occipital region was commonly involved & fronto-parieto-temporal combination was the commonest combination observed.
- In base fracture, combination of anterior, middle & posterior cranial fossa was the commonest combination observed.

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A Retrospective Study of Histopathological Changes in Electrocution in Tertiary Hospital

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Abstract

Background: Injury and death from the passage of electric current through the body is common in both industrial and domestic circumstances. The study has been conducted to find out the incidence of electrocution deaths in tertiary center, common source of electrocution and the study of the pattern of injuries sustained by the victims. Histopathological study of skin lesions and other organs of the electrically injured victims are received for microscopic examination. *Methods and Material:* In the present study, 30 cases of electrocution have been considered. Case details including history are retrieved from records during the period of 2011 to 2016 and have been analyzed. The findings are recorded in proforma and evaluated histomorphologically. *Results*: 30 cases (6.6%) of electrocution deaths, all are males. The highest number of autopsy cases are observed in the age group of 21-30 years, followed by 31-40 years. Most of the victims are electrocuted at work places and very few victims electrocuted in their houses. The most common causative agent is high voltage electricity (93.3%) followed by the home appliances (6.7%). 90% of the cases died on the spot. All the electrocution deaths in the present series are accidental cases and no homicidal or suicidal cases observed. *Conclusions:* The risk of getting electrocuted from the haphazardly installed electric wires without proper maintenance in most parts of the place is indeed a matter of concern. The spread of awareness and adoption of safety measures are important factors required for prevention of fatal electrocution and the study is to look for the consistency in the frequency of these histopathological findings.

Keywords: Accidental; Electrocution; Entry Wound; Exit Wound; High Tension Wire; Skin Lesions; Myocardial Fibers.

Introduction

Electrocution is defined as death caused by the passage of electrical energy through the body [1]. Electrocution is the passage of a substantial electrical current through the tissue, which can cause skin lesions, organ damage, and death. Injury and death from the passage of electric current through the body are common in both industrial and domestic circumstances. The incidence of electrocution deaths in the developed country like the united states during the year of 2002-2008 is 432 (consumer product associated electrocution) [2] and in a developing country like India during 2013 and 2014 are 10218 and 9606 respectively, i.e., 2.1% of all accidental deaths (National Crime Reports Bureau) 2. Electrical injuries commonly involve multiple organ systems. The body injury due to electricity may include burns in the skin and deeper tissues, cardiac rhythm disturbances and other associated secondary injuries due to fall. The current pathway through the body will determine the type and extent of injury and flow through the heart are associated with worse injuries and outcome. Death may be due to ventricular fibrillation, respiratory paralysis, blunt trauma or drowning. These are collectively referred to as electrocution injuries. The electrocuted person may lose consciousness and die due to fall from height or drowned in a bath tub whichever may be the circumstance. Among these, ventricular fibrillation is the most common cause of death. Fatalities are

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almost always accidental.

Hence, the present study has been carried out to assess the incidence of electrocution deaths in tertiary center and to find out the common source of electrocution, and study the pattern of injuries sustained by the victims along with histopathological changes.

Materials and Methods

A retrospective study of 452 deaths during 2011 to 2016 were carried out in the Department of pathology, vydhei Institute of Medical Sciences and Research Centre Bangalore. Analysis of the autopsy cases of electrocution deaths brought to our Centre, have been carried out as regards the history of the cases and post-mortem examination findings are retrieved from case records. The material received are entry and exist wound of skin tissue bits, heart, kidney, lungs and brain for histopathological study. Microscopic details gave clue to the cause of death, findings are recorded in Proforma and analysis done.

Results

In the present study, 452 cases analyzed, 30 cases (6.6%) are of electrocution. The year 2015 had the highest number of electrocution deaths (Table 1), and male victims outnumbered females. The highest number of cases is observed in the age group of 21-30 years followed by 31-40 years as shown in (Table 2). Most of the victims are electrocuted in the work place (90%) and the remaining victims are electrocuted in their houses with common causative agent is high voltage electricity (93.3%) followed by the home appliances (6.7%). Entry and exit wounds caused by the electrical injuries are observed in 40% of the cases but no entry or exit wounds are observed in 6.7% of the cases (Table 3). As shown in (Table 4 a and b), the upper extremity is the most frequently involved site of entry wound (60%) followed by the chest, flank and abdomen 6.7%; while exit wounds are mostly observed in the lower extremities (30%). 90% of the cases died on the spot and the majority of these victims are electrocuted by high tension wire. All the electrocution deaths in the present series are accidental cases and no homicidal or suicidal cases are observed.

Table 1: Year wise distribution

Year wise	No. of cases	Percentage
2011	2	06.7
2012	3	10
2013	7	23.3
2014	7	23.3
2015	8	26.7
2016	3	10

Table 2: Age Wise Distribution of Electrocution Deaths

Age Group (Years)	Frequency	Percentage %
11- 20	4	13.3
21-30	15	50
31-40	5	20
41-50	6	16.4
Total	30	

Table 3: Distribution of entry and exit wounds

Characteristics	Number	Percentage%
Entry only	16	53.3
Entry and exist	12	40
No entry or exist	02	6.7
total	30	

Table 4: Distribution of lesions, site of entry and exist wound

Part of body	Number Entry wound(a)	Percentage %	Number Exist only(b)	Percentage %
Upper extremity	18	60	6	20
Lower extremity	7	23.3	9	30
Abdomen and flank	3	6.7	0	0
No exist	3	10	15	50
Total	30		30	

Table 5: Distribution of histopathological changes occur in different organs and skin

Organ/Tissue	Histological finding	Frequency&Percentage
Skin	Sub-epidermal separation& Epidermal coagulation	28(93%)
Number-30	necrosis Nuclear streaming	25(83%)
Heart	Separation of Myofibers	4(29%)
Number- 4	Alternating hyper contracted hyper distended myocytes	4(29%)
	Square Nucleus expression in myocytes	4(29%)
Kidney	Tubular Necrosis of renal cortex	5(45.45%)
Number -11	Parenchymal breach	3(27.3%)
	Foci of hemorrhage	3(27.3%)
Lung	Congestion of alveolar walls	8(57.1%)
Number- 8	Interstitial and intra alveolar edema	2(14.3%)
	Hemorrhage in to alveolar space	2(14.3%)
Spleen	Rupture	3(100%)
Number 3	Congestion and hemorrhage	
Brain	Edema and Congestion	6(85.7%).
Number-3		

Fig. 1: Microscopy of skin showing nuclear streaming in Electrocution

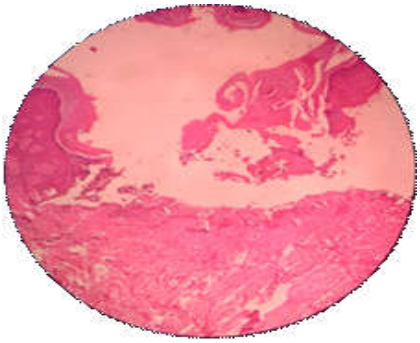

Fig. 2: Microscopy of skin showing epidermal coagulation necrosis

Fig. 3: Microscopy of heart showing bundles of elongation myofibrils

Fig. 4: Microscopy of heart showing square expression of Nucleus within myocytes

Discussion

The wide-spread commercial utilization of electrical power has been associated with a rapid increase in both fatal and non-fatal injuries. In the present study, death of male accounted for 100% of the cases, which is in concordance with the findings of other workers [3,4,5]. The male predominance is attributed to association of men with electrical work and repair of electrical appliances handling more than the women. The peak age group of deaths is between 21-30 years (50%), is very rare in both extremes of ages. This age group is the most active phase in life with higher chances of occupational exposure to risk. Ragui S [3] Bharath *et al*. [5], Gupta *et al*. [6] and Shah and Joe [7] observed similar findings in different parts of the country.

The high rate of indoor deaths (78.06%) is due to accidental electrocution is observed by Dokov [8] in Varna. Similar findings were observed by Byard *et al*. [9] in South Australia, Bharath *et al* [5]. in Andhra Pradesh, and Gupta *et al*. [6] in Gujarat, India. The

findings in the above mentioned groups are not in concordance with that of the present study where most of the cases occurred outdoors (93.3%). The low incidence of electrocution indoors (household) death in the present study could be attributed to the erratic power supply in that place.

In a study by Tirasci et al [10] 42.3% and 18.7% of the cases of electrocuted deaths are caused by electric wires and electric cables at work place. However, in the present study, 93.3% of the cases were electrocuted due to high voltage electricity. This is because of poor maintenance of the electric cables, using of bad quality wires, breakage, which may remain unattended on the road side may be the causes of outdoor accidental electrocution.

Study by Ragui S [3] observed 72 of the cases had only entry wounds while 20% had no entry or exit wounds, similar findings were observed by Tirasci [11]. This is in contrast to the findings of the present study where 53.3% had entry and corresponding exit wounds 40% [Table 3]. In the present study 6.7% of cases does not show any entry or exit wounds, can be due to wet body surfaces at the time of electrocution.

Ragui S. [3], observed 77.77% of entry wounds are observed in the upper limb and 43.75% of exit wounds in the lower limb. Similar findings are observed by Sheikhazadi *et al* [4], Bharath *et al* [5]. and Tirasci [10].

In the present study most of the entry wounds are on the upper extremities while exit wounds are located in the lower extremities as shown in Table 4 (a and b) which are correlated with the above studies.

Ragui S from Manipur India [3] (100%) and Dokov [8](78.06%), electrocution cases were accidental. whereas similar study done by Shah and Joe [7] (61.86%) in Tamil Nadu, Interestingly, in the present series, all the cases are accidental in nature which is correlated with above studies.

In all the cases of electrocution deaths, the histopathological findings of electrically injured wounds are attempted to identify the point of entry and exist.

Microscopy of the Skin

Stefan Jellinek (1871-1968) Austrian scientist [11] studied histopathology of skin changes in several cases on electrocution deaths in the earlier part of 20thcentury. In his work, proved microscopic changes due to electrical injury are consistent. The common microscopic features in the skin are the *streaming of the nuclei, the basal epithelial layers show nuclear elongation, pyknotic nuclei and are tightly packed*. The nuclear elongation is attributable to an electric polarization effect.

The similar changes is corroborated by another scientist Heinlein in 1962. However these nuclear changes are also seen in many other types of injuries such as in blunt dermal injuries, cauterization, blisters following barbiturate poisoning and freezing. Nuclear changes are therefore not specific evidence of electrocution by themselves. The nuclear changes with circumstantial evidence and other corroborative findings, gave a clue towards the conclusive evidence of electrical injury [12].

Bharath *et al*. [6] in his 2 studies and Viswakanth et al [12] observed microscopic findings of the skin due to electrical injury including nuclear streaming, sub-epidermal separation and epidermal coagulative necrosis were 100% and 67%.

Manish *et al*. [13] studied 86 cases of which 15(17.44%) deaths are due to electrical injury. Their microscopic findings of skin which are mentioned above, observed by same group includes 49% and 37% respectively.

In our study, majority of electrocution deaths, shows nuclear streaming (93%), sub-epidermal separation and epidermal coagulative necrosis constitute 83% (Figure 1&2, Table 5). This is in concordance with the above study.

Microscopy of the Heart

Electrical injury seen in the heart as dysrhythmias or coagulative necrosis of the myocardium [13]. The commonest cause of death in electrocution related injury is due to a disturbance in cardiac conduction system causing ventricular fibrillation. Though ventricular fibrillation is considered as the main cause of death following electric shock, electric injury sometimes can cause patchy necrosis of the myocardium [14].

A study was conducted by Vittorio Fineschi *et al*. [15] and by Viswakanth et al [12] observed instantaneous death due to electrocution characterize the morphologic changes. They observed the frequency of myocardial fiber breakup in cases of electrocution accounting for 90% and 100% respectively.

In the present study, a total of 14 heart specimens out of that 4 (29%)(Table 5) cases showing myocardial fiber breaks with squaring of nuclei, areas of thinning, elongation of myocardial fibers (Figure 3 & 4), along with foci of sub endocardial micro infarction. Majority of them are unaccompanied by

inflammatory reaction, which is suggestive of sudden death.

In our study microscopic features of 11 kidney specimens, show acute tubular necrosis with foci of hemorrhage. The organs sent along with skin are heart, lung, spleen which shows congestion, edema. Laceration of parenchyma of the above mentioned organs are due to electrocution or fall from height.

Conclusion

The final diagnosis of death due to electrical injury is based on electrical marks along with the light microscopic changes of the skin and other organs. Following observations, the present light microscopic of skin and other organs show epidermal nuclear streaming, epidermal separation, coagulative necrosis and myocardial fibers breakup in heart, acute tubular necrosis in kidney, congestion, edema, hemorrhage and necrosis present in the other organs gave a clue to death.

The risk of electrical injury due to haphazardly installed electric wires without proper maintenance in most parts of the places is indeed a matter of concern. In addition, the electric power supply system has to be improved with the installation of underground cables for the prevention of unnatural deaths. The important factors required for prevention of fatal electrocution are by upgrading the electrical transmission lines, adoption of safety measures and spread of awareness.

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Conflict of Interest: Nil

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Medicolegal Profile of Homicidal Deaths: A Two Years Retrospective Study

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Abstract

Homicide is one of the heinous crimes executed by human beings. It may be a consequence of argument between acquaintances, robbery, sexual assault, financial conflict, property disputes, infidelity and other causes and results in innumerable deaths reverberating across every levels of society. In this study we have analysed data of autopsied homicidal deaths between January 2015 to December 2016. We found that males were common victims (56.52% cases) and the age group of 21-30 years was most commonly affected. We have found an increasing trend of homicide in this area. Most cases homicides were executed by sharp weapons followed by blunt.

Keywords: Homicide; Rural; Method.

Introduction

Homicide is defined as killing of one human being by another human being [1]. It is one of the oldest crimes which dates back to the dawn of civilization. Culpable homicide may be amounting to murder or not amounting to murder (Sec 304 IPC). Murder is defined under Sec 300 IPC and its punishment is given under Sec 302 IPC [2].

Homicidal deaths may be a consequence of argument between acquaintances, robbery, sexual assault, financial conflict, property disputes, infidelity and other causes. The incidence of homicide is rising rapidly day by day due to increase in population, unemployment, depression, stress and strain, drug and substance abuse, terroristic activities and easy avaibility of weapon of offence. Homicides results in innumerable deaths reverberating across every levels of society. The global average of homicidal deaths is 6.9 per 100,000 population [3].

Various medicolegal information like time and place of assault, method used for homicide, motive, etc plays a critical role in reconstruction, analysis and adjudication of homicidal deaths, particularly in the absence of reliable witnesses [4]. This study has been undertaken to study the different medicolegal aspects associated with homicidal deaths in and around Loni, a rural region of Western Maharashtra, India.

Material and Methods

A retrospective research was conducted on the cases of homicide over a period of two years extending from January 2015 to December 2016. The material for the present study comprise 23 victims of homicide, out of a total of 628 autopsies conducted at the mortuary of Pravara Rural Hospital, affiliated to Rural Medical College of Pravara Institute of Medical Sciences (Deemed University), Loni. All files including complete post mortem report, police inquests, lab reports, etc were reviewed. The data so procured were compiled and analysed. Present study include only homicidal deaths as a result of mechanical injuries and asphyxia.

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Results

Out of 628 autopsied cases in our study period, homicidal deaths constitute 23 cases , (3.66%) [Table 1]. The male to female victim ratio was 1.3:1. Majority of the cases (39.12%) were amongst the age group of 21-30 years. Only one case (4.34%) of infanticide was noted [Table 2]. Sharp weapons were used for homicide in majority of cases (34.78%), followed by hard and blunt type of weapon (21.73%) and ligature strangulation (17.39%) [Table 3]. In our study we found that 14 cases (60.87%) were fresh and remaining 9 (39.13%) were decomposed [Table 4] . Most of the homicidal incidents took place at the victim's home (39.12%), 7 bodies (30.43%) were found in the street while 5 (21.75%) were discovered in a remote area [Table 5]. In our study majority of the cases were seen in summer season (47.82%) followed by monsoon (34.79%) and winter (17.39%). The motive behind most of the homicides were robbery (26.09%), followed by argument, revenge and property gain (13.04% each) [Table 6]. In our study majority of the cases were seen in summer season (47.82%) followed by monsoon (34.79%) and winter (17.39%) [Table 7]. Maximum number of the homicides took place in the evening (39.12%), followed by night (30.43%) and afternoon (26.09%) [Table 8].

Table 1: Incidence of homicidal deaths

Year	Total No of Autopsy	No of Homicides
2015	318	08
2016	310	15
Total	628	23 (3.66%)

Table 2: Distribution of cases based on age and sex of the victims

Sr. No	Age group	No of Male	No of Female	Total no (%)
1	0-10	1	1	2 (8.70%)
2	11-20	1	1	2 (8.70%)
3	21-30	6	3	9 (39.12%)
4	31-40	1	2	3 (13.04%)
5	41-50	2	1	3 (13.04%)
6	51-60	0	2	2 (8.70%)
7	60 & above	2	0	2 (8.70%)
	Total	13	10	23 (100.0%)

Table 3: Distribution of cases according to method of homicide

Sr. No	Pattern of Homicide	No (%)
1	Blunt weapon injury	05 (21.73%)
2	Sharp weapon injury	08 (34.78%)
3	Firearm	02 (8.70%)
4	Ligature strangulation	04 (17.39%)
5	Throttling	02 (8.70%)
6	Smothering	02 (8.70%)

Table 4: Distribution of cases according to condition of body

Sr. no	Condition of body	No (%)
1	Decomposed	09 (39.13%)
2	Fresh	14 (60.87%)

Table 5: Distribution of cases according to place of occurance of crime

Sr. No	Place of Crime	No (%) 5
1	Home	09 (39.12%)
2	Street	07 (30.43%)
3	Workplace	02 (8.70%)
4	Remote area	05 (21.75%)

Table 6: Distribution of cases according to motive of homicide

Sr. No	Motive	No (%)
1	Argument	03 (13.04%)
2	Revenge	02 (8.70%)
3	Financial conflict	03 (13.04%)
4	Property gain	03 (13.04%)
5	Infidelity	02 (8.70%)
6	Robbery	06 (26.09%)
7	Others	04 (17.39%)

Table 7: Distribution of cases according to season of occurance of crime

Sr. No	Season	No (%)
1	Summer	11 (47.82%)
2	Monsoon	08 (34.79%)
3	Winter	04 (17.39%)

Table 8: Distribution of cases according to time of commission of crime

Sr. No	Time	No (%)
1	Morning	01 (4.35%)
2	Afternoon	06 (26.09%)
3	Evening	09 (39.12%)
4	Night	07 (30.43%)

Discussion

During the study period, from January 2015 to December 2016, 628 medico-legal autopsies were conducted, of which homicidal deaths constituted 23 cases (3.66%.). Majority of the cases were seen in the age-group of 21-30 years, which is the most active phase of life. This may be due to various reasons like marital disputes and infidelity, unemployment, arguments, revenge and financial conflicts. This is in accordance with the study conducted by Gupta A [5] and Mohanty MK [4], but in contrast to the observation made by Kominato Y [6] and by Saint Martin P [7]. In our study the male to female ratio was 1.3:1 which is in accordance with the study conducted by Kominato Y [6]. But studies of other researchers have shown a relatively high male predominance [8,9].

Deaths due to sharp weapon injuries (34.78%) were the commonest method of homicide followed by blunt weapon injuries (21.73%) and ligature strangulation (17.39%), which suggest that in the vicinity of crime scene, easily available weapon was sharp followed by blunt. This is in accordance with the study conducted by Gupta A [5], Hugar BS [10], P. Wahlsten [11]. Maximum number of victim (39.12%) were murdered at their residence only, which highlights that the perpetrators were familiar to victim's whereabouts, while 07 bodies (30.43%) were found on the street. The motive behind most of the homicides were robbery, followed by argument, revenge and property gain (13.04% each). As this is a rural area and most of the people are farmers who reside in their farms. Also this particular region is occupied by various main highways of Maharashtra. This is in contrast with the study conducted by Mohanty MK [4], where revenge followed by argument were the most common reasons behind homicide.

In our study majority of the cases were seen in summer season (47.82%) followed by monsoon (34.79%) and winter (17.39%). In a rural region, usually the labor-class are unemployed as there is no any farming work available during this season. Maximum number of the homicides took place in the evening (39.12%) and night (30.43%) which highlights that most crimes are committed in darkness which reduces the chance of the assailant being recognized. Also, after a days work, the rural people consume alcohol and other substances of abuse which increase the chances of arguments or taking revenge.

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Maternal Autopsy Study: An Experience at Tertiary Care Centre at Nanded

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Abstract

Background: Maternal mortality rate is recognized as a social indicator and is dependent upon the general socioeconomic status, nutrition level and the level of maternal healthcare in the community. *Aims:* The present study was undertaken with a view to determine factors causing maternal deaths, to recognize cause of death and to discuss the utility of autopsy record as a useful and adjunct data source for ascertainment of maternal deaths and to study the cases that were subjected to pathological autopsy. *Material and Methods:* This was a retrospective study. The maternal autopsy data during the period 2009 to 2014 were analyzed. Clinical data was also obtained from the case record. The maternal death cases related only to pregnancy were included in the study. Paraffin sections were reviewed. Autopsy findings were correlated with clinical details and investigation in each case to establish an accurate cause of death. *Results:* 33 pregnancies related maternal death cases were studied. The age ranging from 15 -26 years. Cases belonged to lower socio-econmic status. Haemorrhages were the predominant cause of maternal mortality. 70% of maternal deaths were occurred within the first 24 hour of hospital admission. Multigravidity was seen in 60% cases of maternal deaths. *Conclusion:* Maternal death is the index of health care in community. Forensic pathologist plays a crucial role in identifying the cause of maternal death. Findings of such studies and the RCH guidelines will improve the maternal care and helps to reduce the maternal mortality rate.

Keywords: Maternal Mortality; Autopsy; Haemorrhages; Forensic Pathologist; Maternal Death.

Introduction

A maternal death is defined as death of a woman occurring while pregnant or within 42 days of termination of pregnancy, irrespective of the duration or its management but not from accidental or incidental causes [1]. Maternal mortality rate (MMR) is recognized as a social indicator and is dependent upon the general socioeconomic status, nutrition level and the level of maternal healthcare in the community [2].

There is a large gap between the MMR in developed countries and that in developing nations. The World Health Organization reports that the MMR in the South Asian region ranks second only to sub-Saharan Africa [3]. Over 600000 maternal deaths occur each year worldwide [4]. In India, many women dies due to pregnancy-related complications and those who survive suffer from severe maternal morbidity [5]. Maternal death rate in India was 1000 per 100000 live births in 1959 and it decreased to 301 per 100000 live births in 2003 [6].

To reduce the maternal mortality rate upto 109 by 2015 is one of the eight priorities of Millennium Development Goals set by Member States of the United Nations. A woman dies as a result of complication arising during pregnancy and childbirth every 90 seconds in the world, and every 7 minutes in India. The majority of these deaths are preventable. MMR for 2015 is 149. The current MMR of Maharashtra is 104 (Ranking 3rd in India) [7]. The causes of maternal deaths have been classified as direct (resulting from obstetric complications of pregnancy, labor or puerperium) or indirect (resulting from preexisting disease or disease aggravated by the physiological

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effects of pregnancy) depending upon their relationship with pregnancy [8].

The Forensic Pathologist plays a crucial role in identifying these cases and identifying the cause of death. Review of autopsy reports can prove to be one of the useful sources to identify pregnancy-related deaths and elucidating the emerging trends.

The present study was undertaken with a view to determine factors causing maternal deaths, to recognize cause of death and to discuss the utility of autopsy record as a useful and adjunct data source for ascertainment of maternal deaths and to study the cases that were subjected to pathological autopsy. The pathological autopsy study was done for the classification and confirmation of cause of death by correlating clinical findings. Pathological autopsy is important to know pathophysiological changes in various organs which is important to know the sequence of events leading to death.

Material and Method

This was a retrospective study carried out in the department of pathology at our institute. In a retrospective study, the maternal autopsy data during the period 2009 to 2014 (05 year) were analyzed. Clinical data was also obtained from the case record. The maternal death cases related only to pregnancy were included in the study.

The protocol followed during autopsy in a maternal mortality is similar to other pathological autopsies; other specific changes that were sought were frothy bubbles in the right atrium in search of air embolism, detection of acute fatty liver of pregnancy or evidence suggestive of pulmonary or amniotic fluid embolism. All cases underwent an external and *in situ* examination followed by dissection and preservation of the organs in 10% formalin. Blood culture and culture of other specimens was done when indicated. A gross examination of the organs and histopathological examination of at least one block each from the cerebrum, cerebellum, meninges, heart, liver, spleen, kidney, stomach, intestines, pituitary and adrenal glands was carried out. Multiple sections were studied from the lungs in an attempt to identify pulmonary emboli. Whenever indicated, more sections from these organs were studied. Paraffin sections were then stained and examined (Hematoxylin and Eosin). Autopsy findings were correlated with clinical details and investigation in each case to establish an accurate cause of death.

Results and Observations

A total 33 pregnancy related maternal death cases were studied. The age ranging from 15 to 26 years with a mean age 21 years. Nearly 70% women had education level below secondary level and remaining were illiterate. Cases belonged to lower socio-econmic status and few belonged to below poverty line (BPL) group. None were from high socio-econmic group.

The various causes of maternal mortality are listed in Table 1. Direct causes were responsible for 76% cases of maternal death. Among the various causes, haemorrhages (O072.0 and O072.1, ICD-10) act as the predominant cause leading to maternal mortality contributing for 45 % of cases. Haemorrhages occurs due to rupture of uterus in 02 cases, retained placenta in 03 cases, post partum haemorrhage due to atonic uterus in 03 cases and DIC in 05 cases. While in remaining 02 cases haemorrrhages occurs due to abortion in second trimester.

09% cases were due to hypertensive disorder of pregnancy which includes 02 cases of eclampsia (O15.0, ICD-10) followed by 01 case of severe pre-eclampsia (O14.1, ICD-10). Among the indirect causes, anaemia (O99.0) and lobar pneumonia (J18.1) act as major contributory cause of maternal death.

Regarding the antenatal care, 79% of the deceased women had received adequate antenatal checkup as per the RCH guidelines. Remaining 21% cases were not registered even in primary health centre. Even, they had not received any type of antenatal care including tetanus vaccination and supplementation of iron and folic acid.

70% of the deceased women had institutional deliveries and remaining 30% cases were from home delivery. Later, the home delivery cases were admitted in the hospital due to delivery complications.

Other associated factors related with maternal death are shown in Table 2.

Majority of maternal deaths were seen between the age group of 19 – 22 years. 70% of maternal deaths were occurred within the first 24 hour of hospital admission. Multigravidity was seen in 60% cases of maternal deaths. In our study, we didn't found the case of grand-multiparity. 60% cases of maternal death were seen in last trimester of pregnancy followed by first trimester.

The histopathological findings were also studied in each case of maternal mortality.

The histopathological findings are illustrated in Table 3.

Table 1: Underlying causes of maternal mortality (n=33)

Sl. No.	Cause	ICD -10 Code	No. of cases	Percentage
1.	**Direct causes (n = 25)**			
	Pre-eclampsia/eclampsia	O14.1 & O15.0	3	09.09%
	Haemorrhage	O072.0 & O072.1	15	45.45%
	Puerperal sepsis	O85	1	03.03%
	IUD	036.4	2	06.06%
	Ruptured Ectopic pregnancy	O00.1	2	06.06%
	Pulmonary thromboembolism	I26.0	1	03.03%
	Amniotic fluid embolism	O88	1	03.03%
2.	**Indirect causes (n = 8)**			
	Anemia	O99.0	3	09.09%
	Lobar pneumonia	J18.1	3	09.09%
	Acute hepatitis	B17.9	1	03.03%
	Acute fatty liver	K76.0	1	03.03%
	Total		33	100%

(IUD: Intra-Uterine Foetal Death)
(ICD: International Classification of Diseases)

Table 2: Associated factors of maternal mortality

Variables	No. of cases
Age (in year)	
15 – 18	06 (18.2%)
19 – 22	16 (48.5%)
23 – 26	11 (33.3%)
Ward stay	
< 24 hrs	23 (69.7%)
> 24 hrs	10 (30.3%)
Gravida	
Primigravida	13 (39.4%)
Multigravida	20 (60.6%)
Trimester of pregnancy	
First trimester	10 (30.3%)
Second trimester	03 (09.1%)
Third trimester	20 (60.6%)
Method of delivery	
Vaginal	15 (45.5%)
Abortion / MTP	02 (06.0%)
Undelivered	01 (03.0%)
Surgical (LSCS)	15 (45.5%)

(LSCS: Lower Segment Caesarean Section)

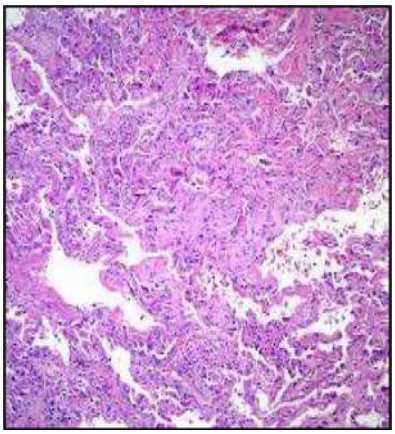

Fig. 1: Diffuse alveolar damage

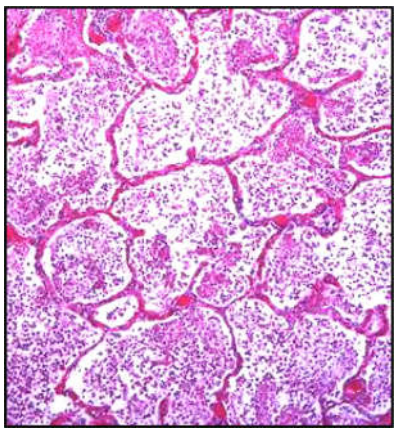

Fig. 2: Lobar Pneumonia

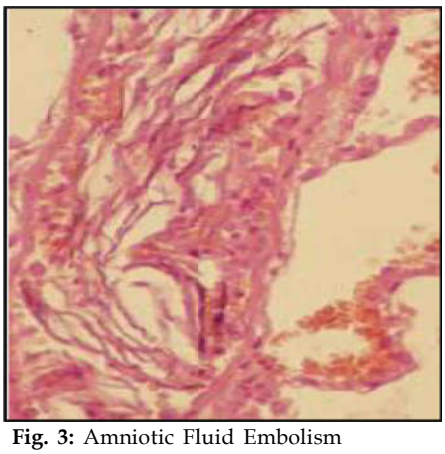

Fig. 3: Amniotic Fluid Embolism

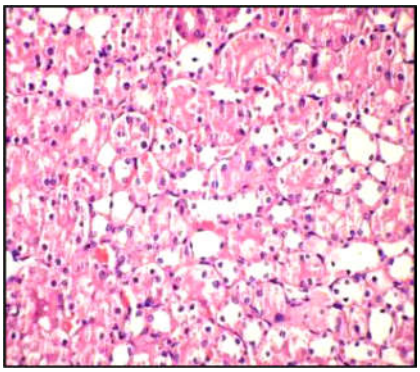

Fig. 4: Acute Tubular Injury

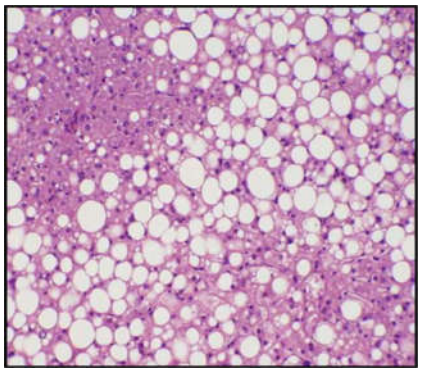

Fig. 5: Acute Fatty Liver

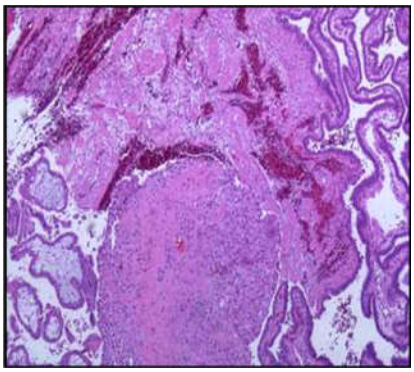

Fig. 6a: Tubal (Ectopic) Pregnancy

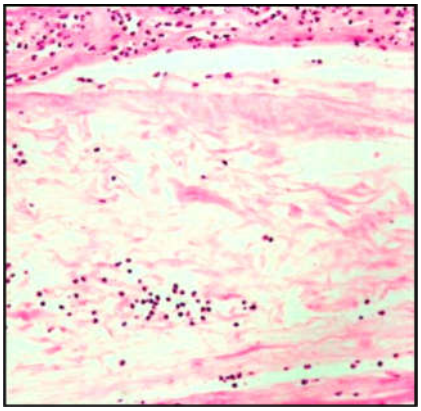

Fig. 6b: Acute Chrioamnionitis

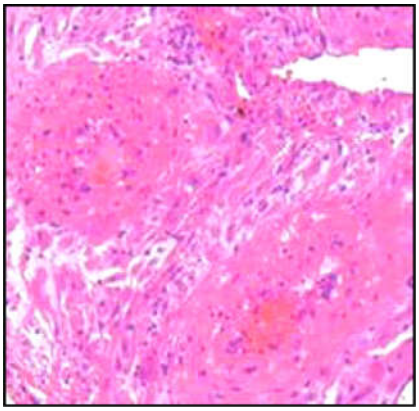

Fig. 7: Intervillous Thrombosis

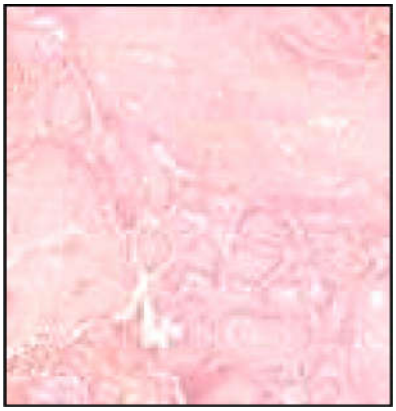

Fig. 8: Placental Infarct

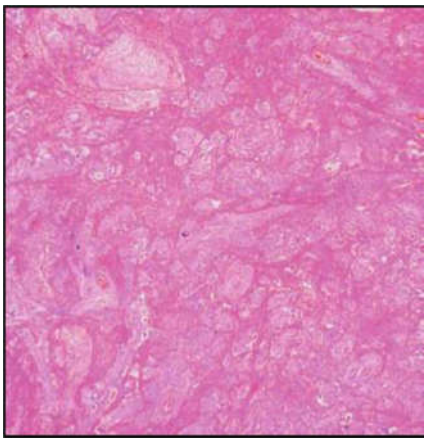

Fig. 9: Perivillous Fibrin Deposition

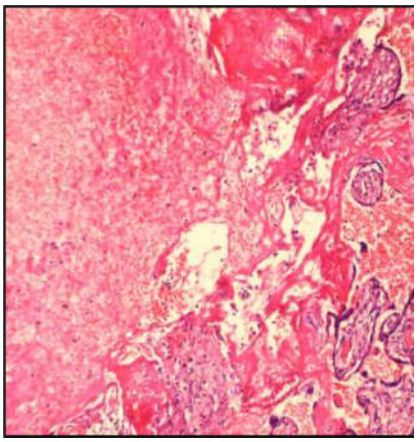

Fig. 10: Intervillous Haemorrrhages

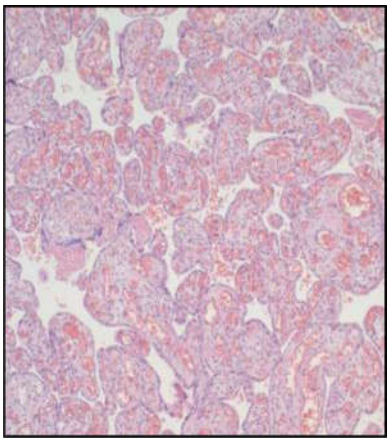

Fig. 11: Villous Capillary Hypervascularity

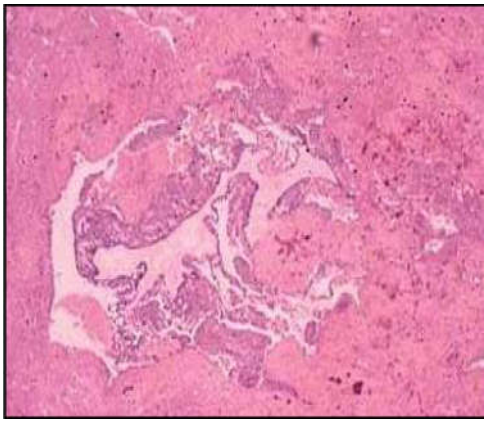

Fig. 12: Retained placental bits with massive Intramyometrial haemorrhage

Table 3: Histopathological findings according to underlying cause of maternal death

Sr. no.	Diagnosis	Histopathological findings
1	Pre-eclampsia and Eclampsia	Petechial haemorrhages were noted over the external surface and cut surface of internal organs of body. Also noted large blood clot (on gross and on microscopy) in posterior partial region in 01 case. DIC changes (microthrombi) were noted in the internal organs. Also, renal tubular necrosis and arteriosclerosis along with fibrinoid necrosis of uterus seen.
2	Haemorrhages	Areas of haemorrhages were noted within the myometrial tissue. In 3 cases, retained placental bits were seen. Also, changes of DIC were seen.
3	Puerperal Sepsis	**Heart:** Mononuclear cell infiltrate within the interstitium of heart. **Lung:** Diffuse alveolar damage with parenchymal infiltrate seen. **Liver:** Hyperplasia of kuffer cell and sinusoidal endothelial cells. Centriacinar necrosis was noted. Periportal neutrophilic infiltrate seen. **Kidney:** Acute Tubular Injury (ATI) was noted. Features of ATN are: Interstitial oedema, hydropic degeneration, Shedding of tubular epithelial cells in to the lumen. **Uterus:** Inflammatory infiltrate within the decidual tissue, myometrial and parametrial tissue.
4	Intra-uterine death of foetus	**Placenta:** Utero-placental vascular insufficiency noted. Perivillous acute inflammatory infiltrate. Perivillous fibrin deposition. Intervillous thrombi & haemorrhages. Villous capillary hypervascularity seen.
5	Ruptured Ectopic pregnancy	Entrapment of chorionic villi within the wall of the fallopian tube along with large ares of haemorrhages.
6	Amniotic fluid embolism	Epithelial squames, meconium material and fatty material seen within the pulmonary vasculature and parenchymal tissue.
7	Pulmonary thromboembolism	Microthrombi were seen within the pulmonary vasculature.
8	Lobar pneumonia	Pulmonary alveoli were studded with neutophillic infiltrate. Diffuse alveolar damage seen.
9	Acute fatty Liver	Microvesicular steatosis with focal hepatocellular necrosis.
10	Acute hepatitis	Hepatic parenchymal inflammation. Periportal inflammatory infiltrate. Focal hepatocellular necrosis seen.

(DIC: Disseminated Intravascular Coagulation)
(ATN: Acute Tubular Necrosis)

Table 4: Comparative studies of associated parameters

Studies	Factors					
	Age (year)		Gravida		Ward stay	
	15 - 25	> 25	Primi	Multi	< 24 hrs	> 24 hrs
Jashnani et al [9]	70%	30%	44%	56%	--	--
Panchbhai et al [2]	57%	43%	37%	63%	31%	69%
Varikar et al [10]	85%	15%	--	--	--	--
Varsha et al [11]	52%	48%	46%	54%	46%	54%
Bardale et al [12]	53%	47%	57%	43%	44%	56%
Present study	67%	33%	33%	67%	70%	30%

Discussion

Maternal mortality rate (MMR) is recognized as a social indicator and is dependent upon the general socioeconomic status, nutrition level and the level of maternal healthcare in the community. Most of the causes of maternal mortality can be preventable with the help of proper ante-natal care according to RCH guidelines.

The comparision between the various associated parameters of maternal mortality of different studies are shown in Table [4].

Majority of the maternal death were seen in the age group of 15 – 25 years. Multi-gravidity was most commonly associated with maternal mortality. Bardale et al [12] found that maternal mortality was most commonly seen in primigravida. During the present study, the 70% cases of maternal death were occurred within the first 24 hours of admission. This finding was not correlated with the findings of other studies.

Jashnani K D et al [9] found that acute viral hepatitis was emerged as the leading cause of

maternal death followed by PIH. Paul B [14] et al found that eclampsia was the predominant cause of death followed by PIH, Haemorrhages and then sepsis. Panchabhai T S [2] got the different results in their study. They found that high number of maternal death were attributed to infectious diseases and cardiovascular diseases. Similar findings were not seen in the previous Indian literature. Bardale et al [12] stated that haemorrhages was the predominant cause of maternal death. Varsha Patil et al [11] also noticed that haemorrhages was the most common cause of maternal death. In the present study, we also found that haemorrhages was the leading cause of death.

Amongst the indirect causes, anaemia was responsible for leading cause of maternal death which was comparable with the findings of Varsha et al [11] and Dileep Mavalankar et al. [15] In the present study, Multigravidity was most commonly associated with maternal death which was comparable with Jashnani et al [9] , Panchbhai et al [2] Varsha et al [11] Bardale et al [12].

Conclusion

Maternal death is the index of health care in community. With the help of advanced technology and advanced medical management, it is possible for us to reduce the incidence of maternal death in some extent. But, still India has higher MMR as compared to developed countries. Thus, forensic pathologist plays a crucial role in identifying the cause of maternal death using autopsy record and findings. Forensic pathologist also plays the role in elucidation of new emerging trends in maternal deaths. Thus, findings of such studies and the RCH guidelines will improve the maternal care and helps to reduce the maternal mortality rate.

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Original Article

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Study the Awareness of 'Consumer Protection Act 1986' Among the Interns in a Medical College in Jamnagar: A Questionnaire Study

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Abstract

Background: A breach in a duty in respect to reasonable care and skill which result in injury to patient is now count as a failure to provide service to patient. Such act can result in a lawsuit against the doctor (service provider), under the Consumer Protection Act (CPA). *Material and Methods:* A present cross-sectional questionnaires study was undertaken to study awareness of Consumer Protection Act amongst intern working at M. P. Shah Govt. Medical Collage, Jamnagar during October – December 2016. *Results:* Out of total 110, males were 62 (56.36%) and females were 48(43.63%) with mean awareness score about CPA were 9.85 ± 3.95 and 10.16 ± 4.01 respectively with p value was 0.357 (not significant). *Conclusion:* CPA awareness was found to be low among both male and female interns. Therefore, medical professionals need to update their knowledge and understanding on CPA and its amendments to be on a legally safer side.

Keywords: Consumer Protection Act; Medical Indemnity Insurance; Negligence.

Introduction

As medical profession is converting into a big health industry, the relation between doctor and patient is changing as a service provider and customer. So it was felt that medical treatment should also be made answerable and doctors were covered by various laws. A breach in a duty in respect to reasonable care and skill which result in injury to patient is now count as a failure to provide service to patient. Such act can result in a lawsuit against the doctor (service provider), under the Consumer Protection Act (CPA) [1].

Public awareness of medical and dental negligence in India is growing. Hospital managements are increasingly facing complaints regarding facilities, standards of professional competence and appropriateness of therapeutic and diagnostic methods. In addition, the expanding patient population is becoming more knowledgeable and aware of their rights, consequently taking action by contacting the consumer forum to lodge their complaints.

Before commencement of CPA all the disputes related to negligence of doctors or hospitals were filed under the relevant sections of Indian Penal Code to claim the damages or to get the negligent punished. These claims were time consuming and expensive. After the introduction of CPA drastic changes has occurred regarding referring claims to district, state, national forum [2]. As a result of all these, the knowledge of the CPA is must among all people who are related with health care sector.

Material and Methods

A present cross-sectional study was undertaken to study awareness of Consumer Protection Act amongst intern working at M. P. Shah Govt. Medical Collage, Jamnagar during October – December 2016. A self administered close questionnaires having 20 questions related to various aspects of CPA having two or four options were administered to all interns

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having basic medical graduate qualification i.e. M.B.B.S as a minimum criteria and those who were willing to voluntarily participate in the study. All interns were included who were posted in a M. P. Shah Govt. Medical College, Jamnagar during study period and interns who were not willing to participate in study were excluded from study. The questionnaire was design and printed. Ethical approval for the study was been taken from Ethical committee of M. P. Shah Government Medical College. Prior written consent was been taken from all participants before filling the questionnaire. The participants were received full explanation on how to fill questionnaire and answering of all questions are compulsory.

Information was collected regarding personal characteristics such as age in completed years, sex, and qualification and information on awareness about CPA including year of enactment, years of amendment, time limit for disposing off a complaint, amount of court fees charged & pecuniary jurisdictions, other powers to implement the provisions of the act, appellate authority etc.

The above information was collected by distributing questionnaires during above mentioned period and collected back immediately. The data was analyzed and tabulated as shown in tables. Score was allotted to each respondent depending upon marks obtained out of 20. Each question carried one mark. For each variable pertaining to respondents, the mean score was calculated and tabulated in front of each variable. After completing the data collection, data will be analyzed using SPSS software and evaluate for statistical significance of the study.

Results

The present study was carried out on 110 interns with minimum age of 21 years and maximum age of 24 years. It is evident from the table-1 that out of total 110, males were 62 (56.36%) and females were 48(43.63%) with mean awareness score about CPA were 9.85 ± 3.95 and 10.16 ± 4.01 respectively with p value was 0.357 (not significant).

Table 2 showed that out of 110, 54 interns (49.1%) had score between 35-50% among them 27 were male (24.55%) and 27 were female (24.55%). 15 (13.63%) male and 4 (3.64%) female interns were scored less than 35% and only 9 (8.18%) male and female interns scored more than 75%.

Table 3 shows that mean awareness score of introductory aspect of CPA, composition of Forum and power of consumer fora were more in male compare to female While mean awareness score of Procedural aspect of CPA, Negligence and its preventive aspect were more in female compare to male, but these differences were not statistically significant. All male interns had knowledge that CPA applicable to medical professions while only 2 female interns didn't know about that. Most of the interns, 38 male (34.55%) and 33 female (30.00%) didn't aware about the when CPA was passed from Parliament. Only 19 male (17.27%) and 16 female (14.55%) interns were aware about when Supreme Court of India included medical services under the ambit of CPA. Most of the interns, 32 male (29.09%) and 28 female (25.45%) didn't aware about the number of member of State commission, while 34 male (30.91%) and 26 (23.64%) female were aware regarding the where to appeal against lower commission decision. it is clear from study that, 36 (32.73%) male intern and 34 (30.91%) female intern were aware about the time limit to file a complaint from date on which case of action has arisen. 29 male (26.36%) and 25 female (22.73%) had awareness regarding the maximum time limit for giving justice. Only 27 male (24.55%) and 21 female (19.09%) interns had aware about the time limit for appeal at higher level and 28 male (25.45%) and 28 female (25.45%) had aware about who can file complain under CPA. we can learn that, 32 male (29.09%) and 25 female (22.73%) intern know about the power of consumer forum are like civil Court. 36 male (32.73%) and 23 female (20.91%) interns were aware regarding the compensation amount power of various consumer forum. Only 24 male (21.82%) and 22 female (20.00%) inter were aware regarding who can recover the amount from the opposite party. only 29 male (26.36%) and 27 female (24.55%) interns were aware about IPC for criminal Negligence. 28 male (25.45%) and 22 female (20.00%) intern were aware about essential ingredients to prove negligence. Only 26 male (23.64%) and 25 female (22.73%) intern were aware regarding where to file case of alleged professional negligence. we can learn that 29 male (26.36%) and 28 female (25.45%) interns were aware regarding the defenses available for a doctor against allegation of negligence. 27 male (24.55%) and 27 female (24.55%) interns were aware about various factors that reduce the risk of litigation against doctor. 33 male (30.00%) and 25 female (22.73%) were aware regarding product liability. Only 25 male (22.73%) and 26 female (23.64%) interns were aware regarding which type of consent is necessary for treatment.

It can be observed that out of 110 interns who participated in study, 59 interns (53.64%) 33 male and 26 female had awareness regarding medical indemnity insurance (Table 4).

Table 1: Sex wise distribution of awareness about CPA

Sex	Participated N (%)	Mean awareness	SD	p value
Male	62 (56.36%)	9.85	3.95	0.357
Female	48 (43.63%)	10.56	4.01	
Total	110 (100%)	10.16	3.97	

Table 2: Sex and grade wise distribution of awareness about CPA (as per marks secured)

Grade	Male	Female	Total
< 35%	15 (13.63%)	4 (3.64%)	19 (17.27%)
35-50%	27 (24.55%)	27 (24.55%)	54 (49.1%)
51-75%	11 (10.00%)	8 (7.27%)	19 (17.27%)
>75%	9 (8.18%)	9 (8.18%)	18 (16.36%)
Total	62 (56.36%)	48 (43.63%)	110 (100%)

Table 3: Awareness about CPA by various aspects (mean scores):

	Mean Score		p value	Mean score
	Male	Female		
Introductory aspect of CPA	1.69	1.60	0.515	1.65
Composition of Forum	1.03	0.96	0.623	1.00
Procedural aspect of CPA	1.94	2.25	0.152	2.07
Power of consumer forum	1.48	1.46	0.892	1.47
Negligence	0.87	0.98	0.480	0.92
Preventive aspect of negligence	1.84	2.21	0.104	2.00

Table 4: Awareness about medical indemnity insurance

Sex	Aware N (%)	Not aware N (%)
Male	33 (30.00%)	29 (26.37%)
Female	26 (23.64%)	22 (20.00%)
Total	59 (53.64%)	51 (46.36%)

Discussion and Conclusion

The association between the doctor and patient is based on faith and confidence. Fortunate are the doctors of the past who were treated like God and were respected by the people. Today, we observe a rapid pace of commercialization and globalization in all the spheres of life and the medical profession is no exemption to this actuality. The CPA was passed by the Indian Parliament in the year 1986 to safeguard and protect the interest of consumers. Prior to enforcement of this Act, cases against doctors were decided by civil courts and even under the Indian Contract Act. But the disadvantage of the latter was high cost and the fact that it was more time-consuming [3] Advantages of CPA:

- Court fee is less.
- Speedy justice.
- Procedural simplicity.
- A nonintimidating atmosphere and encouragement to settle the case without too many formalities and lengthy procedures.

The best defence is avoiding the grievance in the first place. Hence, medical persons need to update their understanding on CPA and its amendments to be legally circumspect. It is evident from this study that out of total 110 interns, males were 62 (56.36%) and females were 48(43.63%) with mean awareness score about CPA were 9.85 ± 3.95 and 10.16 ± 4.01 respectively with p value was 0.357 (not significant). 54 interns (49.1%) had score between 35-50% among them 27 were male (24.55%) and 27 were female (24.55%). 15 (13.63%) male and 4 (3.64%) female interns were scored less than 35% and only 9 (8.18%) male and female interns scored more than 75%. In Singh et al [4] study, the level of awareness about CPA was higher among males compared with females in both professions. It may be attributed to the fact that comparatively males devote more time to routine practice.

In the study of Kachare et al [5] observed that doctors belonging to para & non-clinical faculty had moderate to good knowledge compared to clinical faculty. Sikka et al [6] study revealed that only 14.3% of dentists in teaching institutions and 17.8% of dentists in private practice were actually having awareness of CPA greater than 75%. Gambhir et al[7] observed that more than 50% of the subjects had low

knowledge scores regarding CPA and in this more than 60% were graduate dentists and 47% were postgraduate dentists. Singh et al [4] found that the awareness on CPA among the private practitioners was higher in their study when compared to the academic or private clinicians. With the increasing knowledge, it was found that the PGs in Swapna et al[3] study were significantly more aware compared to the interns. This might be due to the reason that with increase in knowledge, awareness also increases.

Present study showed that interns had less knowledge and awareness regarding introductory and compositional aspect of CPA while they were well aware about procedural and power of consumer forums. These findings were similar to observed by Kachare et al [5] and Sikka et al [6]. Santhosh CS et al [8] observed that the awareness of ethics among academic professionals is less. Though most of the doctors knew what CPA is but they did not have an idea as to the limitation period for filing a complaint by the patient. Haripriya et al [9] study showed that detail knowledge regarding aims and objectives of consumer protection act and its application was limited.

While answering questions about medical negligence, various liabilities and judicial system related to medical malpractice only less than half the participants were able to answer. This indicates that the interns had only a limited understanding about negligence and law and more efforts should be made to sensitize the students about law and liabilities related to their practice. This finding was also observed by Rai et al [10].

The process of taking consent builds a good rapport with the patient as we communicate with the patient regarding the particulars of the treatment, thus allowing the patient to express his/her opinion and apprehension. In this study, Only 25 male (40.32%) and 26 female (54.17%) interns were aware regarding which type of consent is necessary for treatment. Swapna et al [3] observed that nearly 38.11% of the participants considered that a consent form was necessary for every treatment provided for their patient. Haripriya et al [9] study showed that almost every participant in study had knowledge of informed consent.

Present study showed that 59 interns (53.64%) 33 male and 26 female had awareness regarding medical indemnity insurance which is a good sign. Kachare et al[5] study showed that 82.43% doctors were aware about medical indemnity insurance.

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Review Article

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A Comparison between Organ Donation laws in Spain and India

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Abstract

Organ Transplantation is one of our greatest scientific achievements, a miracle we have come to take for granted due to tremendous advances in medicine. However, the act of harvesting the organs of a deceased individual, though scientifically established, also involves a race against time to prevent ischemia and the ever present possibility of malpractice. Thus the social and legal aspects of organ donation seem to be as, if not more, complicated than the surgical and immunological aspects of transplantation itself. Indian law has various provisions to facilitate organ transplantation; however, rate of deceased donor organ transplantation is just 0.5 per million populations (PMP). In contrast, Spain is a leader in Organ Donation, with rate of 34.4 deceased donations PMP. In this article we aim to study the laws in both countries, and the possibility of adopting some of the policies implemented by Spain, so as to increase the number of donations in India.

Keywords: Organ Donation Law; Spain; India; Comparison.

Introduction

The history of transplantation stretches back many centuries, with many documents claiming organs, limbs or skin were transplanted from one to the other. However, other than that which has occurred in the last seventy years, most accounts of transplantation are more legend and less fact. Successful modern organ transplantation as we know it, with the transplantation of solid organs such as the liver, kidneys, heart etc has occurred more recently after decades of research in immunology and graft rejection.

The first successful kidney transplant was conducted in 1954 by Joseph Murray[1]. A kidney was transplanted from one twin to another, thus using the shared genetic traits to bypass the problems of graft rejection. Further research on immuno-suppression and the development of various new drugs like Cyclosporine and Tacrolimus greatly reduced mortality due to graft rejection. Thus, successful transplants of the kidney, liver, pancreas, heart and lungs became the norm.

Along with developments in the scientific arena, there was much debate in society to declare irreversible loss of brain function, or Brain-Stem death as a form of death. Organs could retrieved from brain dead individuals, as cardiac function and perfusion were unaffected, therefore protecting the organs from ischemic damage. In 1968, "A Definition of Irreversible Coma" was published by the Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death [1]. It conclusively established irreversible loss of brain function as a form of death, paving the way for organ harvesting and transplantation.

In India the Transplantation of Human Organs Act, established in 1994 also establishes Brain-Stem Death as a form of death, thus allowing the harvesting of organs.

It is estimated that the prevalence of end stage renal disease requiring a transplant in India is between 151–232 PMP. Taking these figures it can be estimated that more than 200,000 people require a kidney transplant in India. 1675 deceased donor kidney transplantations took place in 2015, according to reports released by the MOHAN

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foundation[2]. (It should be kept in mind that this data refers only to renal transplantation, and due to a lack of a national registry, data on other organs is lacking.)

As mentioned before, India has an abysmal rate of organ donation, at 0.5 per million population (PMP) [2], in contrast to Spain with a rate of 34.4 PMP in the year 2009 [3].

Thus it can be seen that number of organs needed far exceeds their supply, and India urgently needs to implement new policies and public awareness programmes to tackle the problem.

Spain : A leader in Organ Donation

Spain occupies a privileged position among large countries for having one of the highest rates of deceased organ donation. This is result of the implementation of a set of measures, mainly of an organizational and legislative nature, internationally known as the *Spanish Model of Organ Donation and Transplantation*.

The Spanish National Transplant Organization (ONT for *Organizacion Nacional de Transplantes*) is the technical agency of the ministry of health charged with overseeing donation and transplantation activities in the country. Donation activities are coordinated at National (ONT), Regional (17 regional networks) and Hospital (approximately 170 hospitals involved in 2009) levels. Each procurement hospital has a Transplant Coordinator (TC), with the responsibility of identifying donors, and converting potential into actual donors.

In addition to this, systematic early identification and referral of potential donors was a key component of increasing the number of donations. Potential donors include patients outside the Critical Care Unit (CCU), who are referred to critical care physicians and the TC staff. An important aspect of the Spanish system is the acceptance of organ donation as an essential aspect of End-of-life care and as another service to be offered by the CCU. The importance of communicating this principle to patients and their families has likely played a role in the appointment of TCs, the majority of whom are critical care physicians.

The use of Expanded Criteria Donors and promoting Donation after Circulatory Death are other measures implemented to increase the rate of donation in Spain [4].

While some similarities exist between the structure of the organizations overseeing donation and transplantation between two countries, the coordination and implementation at all levels is superior in the Spanish system as compared to India. Moreover, India's criteria for donors is rather limited, in contrast to the more flexible approach adopted by Spain.

Organizational Structure

India has a National Organ Transplant Programme (NOTP) under the Directorate General of Health Services. The National Organ and Tissue Transplant Organization (NOTTO) has been established as the apex body overseeing organ donation and transplantation in the country. Its functions include networking with regional and state organizations, as well as laying down guidelines and creating awareness. There are 5 Regional Organ and Tissue Transplant Organizations (ROTTO) located in Mumbai, Chennai, Kolkatta, Chandigarh and Guwahati. State networks (SOTTO) have yet to be put in place [5].

Thus it can be seen that the ONT and the NOTP are very similar. The 17 regional coordinating centres in Spain are more likely analogous to the state level SOTTOs soon to be set up. Due to the vast size and population of the country, India requires regional ROTTOs in the network, as intermediaries between the national and state bodies.

However the state bodies have not yet been set up, and are still in the planning phase. In addition to this some states have already set up coordination mechanisms of their own. An example of this is the Zonal Transplant Coordination Centres (ZTCC) that are present in Maharashtra. These are government organizations present in Mumbai, Pune, Aurangabad and Nagpur. Each monitors cadaver transplants and maintains a transplant registry in the city it's located in, while coordinating a network of hospitals. For example, the Mumbai ZTCC includes 3 municipal medical colleges, 1 government medical college, a central government hospital and 11 private hospitals [6].

Similarly, Tamil Nadu and Andhra Pradesh have an Indian Network for Organ Sharing (INOS) in each state. Unlike the ZTCC these are not government bodies, but networks that have been pioneered by the MOHAN foundation, a prominent Non-Governmental Organization in the field of organ donation[7].

Thus what India lacks is a system with a cohesive structure. Rather, there is a haphazard collection of individual organizations in different cities, with no established modes of communication between them.

The use of Expanded Criteria Donors

Expanded Criteria Cadaveric Donors are defined as donors above 60 years of age, or donors above 50 years of age with at least two comorbidities from among cerebrovascular cause of death, hypertension or renal insufficiency [8]. The survival of recipients of marginal kidney donors is inferior as compared to ideal cadaveric donor recipients, however it is significantly better than those transplant candidates who remained on maintenance dialysis treatment [9]. Expanded Criteria Donors can also play a role in liver transplantation [10].

Spain follows an 'old for old' strategy, where aged kidneys (organs harvested from aged donors) are preferentially allocated to old recipients, irrespective of HLA mismatch [6]. The efficacy of 'old for old' transplants has been shown, with recipients of this group showing an eight year actual graft survival comparable to old recipients receiving transplants from young donors; conversely young recipients of old donors showed a significantly worse actual graft survival [11]. Thus the use of Expanded Criteria Donors, and the adoption of an 'old for old' matching strategy is an effective way of expanding the donor pool while maximizing graft survival.

Donation after Circulatory Death

Donation after Circulatory Death (DCD) is used to define the harvesting of organs from individuals declared dead using circulatory criteria, not neurological criteria used in Donation after Brain Death (DBD). The modified Maastricht classification is most commonly used to classify circulatory death [12].

DCD is currently being practiced in various countries. A study conducted by the *European Committee on Organ Transplantation within the Council of Europe* documents 10 countries in Europe which have incorporated DCD in their organ donation and transplant protocols. Prominent among these were Belgium, the United Kingdom, the Netherlands (mainly controlled) and France and Spain (mainly uncontrolled) [13].

The United States of America, Australia and Japan also have established systems to facilitate DCD.

DCD is an accepted aspect of deceased donation, and has been described under the Critical Pathway for organ donation. The Critical Pathway was developed by a working group convened with the support of the *The Transplantation Society,* The Spanish *Organizacion Nacionale de Transplantes (ONT)* and the *WHO* [14].

It should be kept in mind that before the advent of donation after brain death, DCD was the only possible source for organs. Indeed, the first heart transplanted by Cristiaan Barnard was a retrieved from a DCD donor. In the wake of a profound lack of available organs, it is prudent to consider Donation after Circulatory Death to expand the donor pool.

Presumed Consent

The system of Presumed Consent is also known as the opt-out system, where unless the deceased has specified that he does not want to donate organs in life, consent for donation will be assumed.

This system of Presumed Consent is not strictly implemented, and the wishes of the family of the deceased are always respected [6]. In fact, the statute for presumed consent was present in Spain ten years prior to the organizational changes, with no change

Table 1: Main elements of the Indian and Spanish models of transplantation

Country	INDIA	SPAIN
Organization	National Organ and Tissue Transplant Organization (NOTTO) Regional Organ Tissue and Transplant Organization (ROTTO) (5 regional centres) State Organ Tissue and Transplant Organization (SOTTO) yet to be established	ONT (*Organizacion Nacional de Transplantes*) National Level Regional level (17 regional coordinators) Hospital level
Transplant Coordinator	Present in registered hospitals, may be:- Doctors, Nurses, Non-Medical professionals such as social workers, Counsellors etc.	Present in the registered hospitals – Almost always doctors (Mostly Critical Care Physicians or Nephrologists) assisted by nurses in large centres
Expanded Criteria Donor	Accepted occasionally, No provision for an old-for-old system	Routinely utilized, old-for-old model followed
Donation after Circulatory Death	Not permissible under THOA	Permissible under law and carried out mainly in three cities with large populations
System of Presumed Consent	Absent	Present, but not implemented strictly

Table 2: Expanded Criteria Donors

Expanded Criteria Donors
All donors aged 60 years or older
Donors aged 50 – 59 years with at least two of the following comorbidities
Cerebrovascular cause of death
Hypertension
Renal Insufficiency (Serum Creatinine above 1.5 mg/dL)

Table 3: Modified Maastricht classification of DCD

Category	Description	Type
I	Dead on arrival	Uncontrolled
II	Unsuccessful resuscitation	Uncontrolled
III	Anticipated cardiac arrest	Controlled
IV	Cardiac arrest in a brain-dead donor	Controlled
V	Unexpected arrest in an Intensive Care Unit (ICU) patient	Uncontrolled

Table 4: Possible measures to increase organ donation in India

Elements that can be implemented in the Indian set-up
*Implementation of a **systematic organizational approach** with coordination at various levels ranging from National, Regional, State and Hospital levels*
*To establish a **single multi-party system** incorporated at the various levels of coordination mentioned above, and prevent the proliferation of individual organizations in different states and cities*
*Establishing mechanisms to facilitate **Donation after Circulatory Death***
*Establishing mechanisms to retrieve organs from **Expanded Criteria Donors** and implementing an 'old for old' system*

in Organ donation rates [15].

It should also be kept in mind that most Indians have yet to come to terms with the moral issues associated with organ donation, and many are distrustful of the procedure. The implementation of measures like presumed consent, where 'presumed' can be misinterpreted as 'forced', might alienate society further.

Conclusion

Although India has laws and various systems in place to facilitate organ donation, they seem to be falling short, as the low rate of deceased organ donation shows. After a study of the policies present in Spain, there is a possibility that their implementation can lead to an increase in the number of organs retrieved for transplantation, and make the mechanism for retrieval of organs more efficient.

A single multi-party system of coordination at all levels is the key to ensuring greater retrieval of organs and their efficient distribution. The current scenario is quite disorganized, with various individual organizations working independently in different regions. It is possible that with so many different entities, chances to harvest and allot organs may have slipped through the gaps in communication.

In addition to this, a change in donor criteria should be considered in response to the ever increasing need for more organs. This includes Expanded Criteria Donors and Donation after Circulatory Death. Amendments to the law, along with the formation of new guidelines and protocols can accomplish this.

As mentioned before, the system of Presumed Consent is not very effective, and not suited to the needs of the Indian system. Our current opt-in system should remain, and the focus should be on strengthening it.

Currently, Indian hospitals and medical teams are very capable of conducting transplants. There is no doubt that scientifically and surgically, we have the knowledge and skills for these procedures. However it is the organizational and legal aspects that require fine-tuning. Improvement in these spheres will benefit patients on the waiting list, and save many lives.

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Grievous Hurt Eighth Clause: Medico-Legal Considerations

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Abstract

Grievous hurt as defined in Section 320 Indian Penal Code (IPC) has 8 clauses. Out of these the eighth clause is one, interpretation of which confounds most individuals, doctors and judiciary. A doctor may be tasked with opining whether a hurt is grievous or not based on the eighth clause. A clear understanding of law with application of medical science helps the doctor to opine clearly thereby helping the law enforcers in administration of justice. The lack of proper documentation or clear opinion on the other hand hinders justice and can result in judgements where the medical evidence is not correctly inferred by the judiciary. This article highlights the eighth clause of grievous hurt, its interpretation by courts and the precautions that should be followed by the medical man in interpreting and opining grievous hurt as per eighth clause.

Keywords: Grievous Hurt; Endangering Life; Severe Bodily Pain; Ordinary Pursuits of Life.

Introduction

Grievous hurt as defined in Section 320 Indian Penal Code (IPC)[1] has 8 clauses. Out of these the eighth clause is one, interpretation of which confounds most individuals, doctors and judiciary. The judiciary has in various judgements tried to interpret the clause giving rise to plethora of inferences.

Many a times the doctor is asked opinion regarding a particular injury being grievous hurt or not which may not be covered in the first seven clauses. In such scenarios the doctor is required to have a clear understanding of law and opine objectively so that the opinion furnished by him stands the test of time and the questions of lawyers and courts.

Section 320 IPC. Grievous Hurt [1]

Grievous hurt.—The following kinds of hurt only are designated as "grievous":-

First-Emasculation.

Secondly-Permanent privation of the sight of either eye.

Thirdly-Permanent privation of the hearing of either ear.

Fourthly-Privation of any member or joint.

Fifthly-Destruction or permanent impairing of the powers of any member or joint.

Sixthly-Permanent disfiguration of the head or face.

Seventhly-Fracture or dislocation of a bone or tooth.

Eighthly-Any hurt which endangers life or which causes the sufferer to be during the space of twenty days in severe bodily pain, or unable to follow his ordinary pursuits.

The eighth clause of grievous hurt has 3 parts:

1. Any injury that endangers life
2. Causes the sufferer to be during the space of twenty days in severe bodily pain, or
3. Causes the sufferer to be during the space of twenty days, unable to follow his ordinary pursuits.

Though there are three parts to 8th clause much

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overlapping is seen in these sub-clauses as a particular injury may endanger life as well as cause severe bodily pain and unable to follow ordinary pursuits.

Discussion

- *Any Hurt That Endangers Life*

An injury which causes imminent threat to life would be an injury which endangers life. The term "endangers life" is much stronger than an expression dangerous to life. This expression appears to have been designedly used by the Legislature to exclude cases of hurt which however dangerous to life, do not put life in a given case to danger [2].

The court has accepted that throwing of lit matchstick on clothes causing burns is an injury that endangers life or causes the sufferer to be in severe bodily pain for 20 days [3]. In a case where there was left temporo-parietal extradural hemetoma with pericisternal contusion in CT scan of head, and the patient was treated with emergency craniotomy, EDH evacuation done under general anesthesia, it was decided that the medical evidence unequivocally proved that the hurt caused to patient by the accused was one which endangers his life and which causes severe bodily pain and it could be reasonably presumed that he was unable to follow his ordinary pursuits during the period when he was hospitalised [4]. Squeezing of testicles in male is grievous hurt because it endangers life [5].

However in some conditions the court has not accepted certain injuries as endangering life:

a. Injury which penetrates into the abdominal cavity exposing the omentum is not grievous because it does not endanger life [6,7].
b. Stab wound, measuring 4 cm X 2 cm X cavity deep over left lower chest was not considered as dangerous to life because the X-ray did not reveal any fracture [8].
c. Stab wound over left arm 10 cm below shoulder measuring 3 cm x 1 cm bone deep with underlying deltoid muscle partially severed is not grievous hurt [9].
d. Stab wound on the stomach is not grievous hurt when there is no hospital stay of 20 days [10].
e. If the patient presented in casualty five hours after the incident with minor bleeding it could not be said that the injury was endangering life.

This sub-clause is used synonymously with dangerous injury. There should be enough evidence to show that the injury inflicted on the victim can cause threat to life or death. For an injury to be Grievous under this sub-clause, it is necessary that there should be some evidence that the injury has changed the basal body state in such a way that it could have caused death. This evidence should be clearly documented by the examining and treating doctors. The doctors should measure the vitals, record their findings correctly, do investigations where required and opine their opinion. A combined study of all the factors would lead a doctor to opine that the injury is a grievous injury as it endangers life.

- *Causes the Sufferer to be During the Space of Twenty Days in Severe Bodily Pain, or Unable to follow his Ordinary Pursuits.*

1. Role and Implication of Comma in the Clause

This clause has been interpreted by the lawyers in such a way where it is said that there is a comma between severe bodily pain or unable to follow ordinary pursuits, which shows that both these clauses are separate clauses with no relation to each other. Hence the duration of twenty days is applicable only for severe bodily pain and not for ordinary pursuits of life thereby meaning that impairment of ordinary pursuits of life even for one day would be grievous hurt. However this proposition has been constantly denied by the Indian judiciary by convention. When the comma is ignored then it follows that in order to make any hurt fall within the ambit of Clause 8, the injured person should be unable to follow his ordinary pursuits during space of 20 days [11].

Severe bodily pain means such a pain lasting for 20 days which prevent a person from doing ordinary pursuits of life.

2. Time of 20 days – Absolute Requirement of the Section

According to law, a penal statute must be construed strictly. The mere fact that he remained in the hospital would not be enough to conclude that he was unable to follow his ordinary pursuits during that period. Hence both the ingredients that the victim was in severe bodily pain and unable to follow his ordinary pursuits and that the stay was of 20 days has to be proved for a hurt to be grievous hurt [12].

Even if the individual does not get admitted to hospital, if it can be shown that the injuries were such that they cause severe bodily pain and the person is unable to follow ordinary pursuits then that would be grievous hurt. The law does not say

that the patient must get himself admitted in the hospital [13].

Any hospital admission for a period of less than 20 days would mean that the injured was not in severe bodily pain because the requirement of this clause specifically states a period of 20 days. In a case decided by the Madras high court Stab wound on stomach was found to be not grievous because the hospital stay was less than 20 days [10].

When a victim has been discharged on the last day i.e. 20th day then it cannot be said to be grievous hurt because 20 days means clear 20 days including the 20th day [14].

3. Hospital Stay more than 20 Days without Documentation of Severe Bodily Pain – not Grievous Hurt

Mere admission to the hospital for any number of days (more than 20 days) will not amount to Grievous hurt. It has been held in Queen vs empress that although the patient may have recovered for following ordinary pursuits yet for the sake of permanent recovery or greater ease or comfort be willing to remain as a convalescent in a hospital, especially if he is fed at the public expenses. It was pointed out that mere fact that the sufferer did not attend his duty for the statutory period or that he remained in hospital for that period is no indication of his ability to do so [15].

In a case where the victim accompanied the police to aid in investigation it was decided that he could not be in severe bodily pain [16].

- *Unable to Follow Ordinary Pursuits*

Ordinary pursuits of life are those works that are done by an individual routinely in his day. These pursuits do not include an individual's occupation or profession.

The doctor has to state in his opinion that during hospital stay the patient was not able to follow his ordinary pursuits; only then the injury would be Grievous as per this clause [17].

In Thana and ors though the hospital stay was more than 20 days, after ten to twelve or fifteen days the victim was able to take his meals by himself but needed assistance to go to the lavatory. The necessity for this assistance according to the Doctor was because of his feeling giddiness and vertigo due to severe bodily pains which was due to injuries sustained by the victim. Here it was decided that the victim was unable to follow his ordinary pursuits and the hurt was grievous hurt [18].

- *Importance of Exhibiting Medico-Legal Reports in Court*

It is well settled law that if the doctor is not deposing in the court to exhibit his report then that report will not be acceptable as evidence. There are only certain reports which are exempted from oral evidence as given in sections 292 and 293 CrPC [19].

In Mahesh Chander v/s State, it was decided that since the doctor who made the MLC of the accused was not examined by the court and his signature was not verified his evidence is not admissible as evidence [20].

It is not necessary for the doctor who prepared the report to be examined. For the report to be admissible it only has to be exhibited in the court. A document can be proved by the author of document or anyone else who can identify his signature. It has been held that MLC is an authentic record of injuries and can be safely relied upon by the Courts, even when the doctor is not examined in the Court and the record is proved by any other doctor or record keeper. Any person who alleges that the MLC i.e. the record of injuries produced in the Court was not authentic and there has been tampering with the record, has to show to the Court how tampering has been done. It is not a legal requirement that the doctor who examined the plaintiff alone can answer questions [21].

In case the nature of injury shown in the MLC of the victim is grievous but the doctor concerned who has given the report is not examined in the court then this injury should be taken as simple and not grievous [22,23,24].

- *Opinion of Doctors – Court Considerations*

In a case where a doctor issued a certificate that the injury was grievous hurt but did not support it with hospital documents it was said that the hurt is not grievous. Moreover no X-ray or CT scan was done in the case to show that the laceration on skull led to a fracture and was grievous hurt [25]

It is the duty and responsibility of the doctor to give opinion regarding the nature of injury sustained by the victim in the criminal case and the court cannot substitute its own opinion by usurping the function of medical expert [14,26,27].

In a case where the MLC mentioned that there was a contused lacerated wound 3 cm on the forehead of the victim, but did not mention the nature of weapon not did it mention on record that the complainant faced 20 days of pain, the injury was not considered as grievous [28]

In Gurbax singh, due to assault, the victim suffered from perforation in the ear with loss of hearing as opined by the specialist doctor. However since he did not record that there was a permanent privation of an ear or a member of a joint or that the victim faced 20 days of pain it was decided that the injury was not grievous [29].

An incised wound over parietal region 3" x 1" bone deep held to be not grievous in nature, because the statement or records of doctor did not prove that the said injury would fall in the ambit of the expression 'grievous hurt' as defined in section 320 I.P.C [30].

In another case a victim was examined by four doctors separately and following injuries were found on the body of the victim: Cut injury of right lower eyelid and Cut injury of right cornea with expulsion of iris and vitreous through the wound. The court held that two doctors have stated that the injury sustained by the victim on his right eye is serious and grievous. The evidence of rest two doctors was not specific about the nature injury. There is no evidence from the doctors that the victim has sustained permanent privation of his sight in his right eye [31].

In a case where the clear medical documents, unequivocal testimony of medical officer and the post mortem version, proved that the injured was caused Grievous hurt, The High court of Gujarat convicted the accused under relevant sections of law [32].

Opinion Writing – Doctors Responsibility and considerations

Based on the above judgements and views taken by various courts the doctors should keep the following things in mind while opining Grievous injury in a Medico-Legal case:

- Be objective. The opinion should not be based on the physical appearance of the patient but on the actual injuries sustained.
- The general appearance and vital signs should be recorded in all cases of injuries.
- The injuries should be documented properly and completely including the site, size, colour, duration and nature of injury.
- Any relevant investigation if required should be done and the results documented. For example if a fracture is suspected then X-ray should be done and the result documented. If for any reason an investigation is not done that should also be documented.
- If an opinion cannot be furnished on first examination (e.g. Laceration of face) then the doctor may reserve his opinion and may re-examine the patient after a particular duration.
- An investigating officer can request the physician to comment whether a person was able to follow his ordinary pursuits or not and whether he was in severe bodily pain during the space of 20 days or not. The doctor can opine to the same if he is sure of the nature of injury.
- A doctor should always mention whether the hurt was simple or grievous in a Medico-legal report. It is also advisable that the doctor mentions the reason why he believes that injury to be Grievous.
- The hospital records in Medicolegal cases are to be preserved for 10 yrs or till the case is pending in the court.

Conclusion

Eighth clause is a very difficult clause to understand and interpret. The clause has been interpreted in a variety of methods by different courts of India. These judgements on one hand, act to simplify the understanding of the said clause and on the other hand make the clause equally difficult to understand. Nature of every injury will vary and there is no clear guidelines whether a particular injury can be labelled as grievous hurt or not under eighth clause. In every case the doctor and the court have to test their knowledge. The doctors are an important bridge between crime and justice. The role of doctors in such cases cannot be undermined. It has been noted that in many cases the justice is not served because of incomplete documentation or examination of injuries. However, the courts should also understand that medical science has its limitations and the doctors being medical man cannot to be expected to be legally correct in all situations. The courts have in many cases opined that they should not usurp the function of medical experts. Similarly the doctors cannot also usurp the function of legal personnel.

However, the doctors should always remember that though their prime responsibility is to treat the patients, they have an equally important legal responsibility. They are authority of medicine and should work diligently to help the law enforcers in administration of justice.

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Case Report

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Hemorrhage in Sternocleidomastoid and Other Strap Muscles in a Case of Hanging: An Unusual Autopsy Finding

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Abstract

The deaths due to of fatal pressure over neck in hanging are distinguished by a very thin line from ligature strangulations and may lead to complexity and controversy during the further course of investigation if the findings are not interpreted properly at the autopsy stage. We report a case of an individual who was allegedly found hanging with no suicide note being recovered but during autopsy significant hemorrhage was seen in the Sternocleidomastoid and other Strap muscles, an uncommon autopsy finding in a case of hanging. After examining the ligature mark and other autopsy findings the case concluded to be of hanging only. The authors intend to highlight that an autopsy surgeon should not rush to the conclusion just because of one aberrant finding which is not usually seen in a particular manner. The case should be examined in totality considering the other findings and only then the cause and manner of death should be opined.

Keywords: Sternocleidomastoid Hemorrhage; Strap Muscles Hemorrhage; Hanging; Strangulation.

Introduction

There has been continuous research going on for better understanding of Asphyxial deaths by Ligature [1-5]. Determining the manner of death as suicidal, accidental or homicidal in the cases of Fatal Ligature compression of Neck has always been a challenge faced by Autopsy Surgeons particularly in those cases where circumstances are not clear like suicide note being not found in case of hanging, partial hangings etc. The peculiar diagnostic features of the external and internal neck findings help a lot in arriving at a proper cause and manner of death [6-11]. In many cases such findings may be encountered in postmortem period which creates a doubt about the manner of death in the mind of autopsy surgeon who has to lead the investigators from the medicolegal angle. We report a case of an individual who was allegedly found hanging but during autopsy significant hemorrhage was seen in the Sternocleidomastoid and other Strap muscles, an uncommon autopsy finding in a case of hanging.

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Case Findings

The deceased was a 46 years old male and was found hanging in his house after which he was taken to a hospital where he was declared brought dead. No suicide note was recovered by the police. The body was then brought for postmortem examination to Department of Forensic Medicine, All India Institute of Medical Sciences for postmortem examination. The body of the deceased was of average built and 5 feet 10 inches long. Rigor mortis was present all over the body. Postmortem lividity was present over back and dependent parts of the body. Face was congested. Bluish discoloration of lips and nails was present.

There was a reddish brown parchmentised ligature mark present in the middle one third of neck. The ligature mark was present 6 cm below mentum and 8 cm above suprasternal notch and its width was 1 cm. The ligature mark was present 8 cm below the right mastoid process and 4 cm below left mastoid process over lateral aspect of neck respectively. The

ligature mark was directed upwards, backwards and obliquely merging with the posterior hairline at the nape of neck **(**Image 1). The total neck circumference was 44 cm. In internal examination of neck the hemorrhage was found in the anterior and lateral aspect of neck along the right Sternocleidomastoid and other strap muscles (Image 2,3). No other external or internal injury was present over the body. The thyrohyoid complex was intact and tracheal mucosa was congested. The internal organs were congested. Rest of the findings were non-specific.

Image 1: Ligature mark over right side of neck

Image 2: Hemorrhage in Neck Muscles

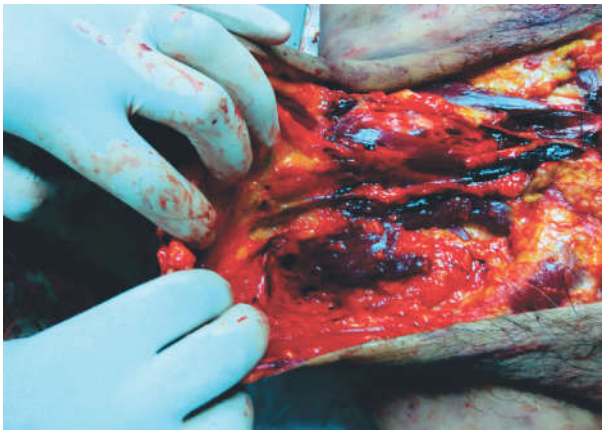

Image 3: Hemorrhage in Neck Muscles

Discussion

The deaths due to fatal pressure over neck in hanging are distinguished by a very thin line from ligature strangulations and may lead to complexity and controversy during the further course of investigation if the findings are not interpreted properly at the autopsy stage. In the present case, hemorrhage was found in the anterior and lateral aspect of neck along the right sternocleidomastoid and other strap muscles which is an unusual postmortem finding. Bruising and strap muscle hemorrhage are found more commonly in strangulation cases than hanging [7-11]. This created a doubt about the alleged history and manner of death as no suicide note was recovered by the police. The ligature mark in a case of hanging is abraded, brownish, hard, parchment type, oblique, does not completely encircle the neck, is placed high up in the neck between the chin and the larynx and has a gap in the skin at the point of suspension. The same findings of the ligature mark were observed in our case [6-11]. Cyanosis of lips and nail was indicative of asphyxia. There was no fracture of thyrohyoid complex. No other external injury other than the ligature mark was in the present case. All the finding in the case together with ligature mark point towards the death being due to hanging. Nikolic [12] has reported injury to sternocleiodomasoid to be present in about 33% of the total hanging cases. This case highlights that an autopsy surgeon should not rush to the conclusion just because of one aberrant finding which is not usually seen in a particular manner. The case should be examined in totality considering the other findings and only then the cause and manner of death should be opined.

Compliance with Ethical Standards

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Conflict of Interest

There is no conflict of interests of any of the author.

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Amniotic Fluid Embolism with Aspiration of Gastric Contents: Report of an Unusual Association

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Abstract

Amniotic fluid embolism (AFE), an exceptional, disastrous, complication of pregnancy may occur in association with aspiration of gastric contents, one of its clinical mimics. Histologic confirmation of particulate components of amniotic fluid such as fetal squamous cells, lanugo hair, mucin and debris in pulmonary microvasculature is the foundation of diagnosis and presence of partially digested vegetative material with acute inflammatory changes in terminal bronchioles is a telltale sign of aspiration of particulate gastric content. We report a case of amniotic fluid embolism with aspiration of gastric contents in a 32 year pre-eclamptic, anemic patient that occurred after induction and augmentation of labor with a vaginal administration of misoprostol and artificial rupture of fetal membranes respectively. These episodes culminated in death of mother and female fetus during labor.

Keywords: Amniotic Fluid Embolism; Maternal Mortality; Aspiration; Gastric Contents.

Introduction

Maternal deaths are routinely and medico legally investigated all over the world to find out the causes and categorize them. This exercise is done as maternal mortality is pointer of competence of health care system in a country and helps in formulating the national health care policy. The legal aspect of investigation is to find out if there was any negligence or malpractice by health care professionals' leading to death of mother [1]. Maternal mortality is also directly related to fetal mortality as the risk of fetal death increases with mother's death. It not only affects relatives and communities but also at times demoralizes the sincere health care professionals [2]. At national level, it brings substantial economic losses so as to act as stumbling block to community development.

There are direct and indirect causes of maternal demise. The former are most important and include hemorrhage, obstructed labor, eclampsia/pre-eclampsia, amniotic fluid embolism, thrombo-embolism/thrombosis, sepsis, ectopic pregnancy, anesthesia complications and unsafe abortion. The indirect causes include cardiac disease, neurological conditions, psychiatric causes, indirect malignancies and infections such as hepatitis, malaria, AIDS, and anemia [3-5]. Delayed and/or incorrect treatment and a shortage of supplies increase the maternal deaths [4-5].

Amniotic fluid embolism, one of the complications associated with pregnancy, clinically masquerades with acute myocardial infarction, anaphylaxis, air embolism, pulmonary thromboembolism, placental abruption, pre-eclampsia/eclampsia, uterine rupture, transfusion reactions, septic shock, hemorrhage, local anesthetic toxicity and aspiration of gastric contents [9-10]. Any of these entities may occur concurrently with AFE [11]. However simultaneous occurrence of aspiration with AFE has been documented as rarest of rare case reports [13-14].

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Case Report

A 32 year old, G2P1L1 female was referred from primary health center (PHC) to our hospital in the latent phase of labor at 38 weeks of gestation with probable clinical diagnosis of ANC with labor pains and pre-eclampsia. On admission the patient was conscious and oriented. Past obstetrics history revealed full term normal delivery of female baby 12 years ago. On examination, her general condition was fair, afebrile, pulse was 90 beats per minute and blood pressure 130/80 mm of Hg. Per abdominal examination revealed full term uterus, fetal heart sound 140 beats per minute and regular. Per vaginal examination revealed 1 cm dilated cervix. Per speculum examination exhibited patulous and posterior cervix. The labor was induced with per vaginal administration of tablet misoprostol 25µg. Her hemoglobin was 10 gm/dl, serum creatinine 0.6 mg/dl, blood urea 18 mg/dl, and blood group B Rh Positive (+ve). Urine examination- albumin 1+ by dipstick. Labor gradually progressed. Three hours after admission per vaginal examination revealed cervix 3 cm dilatation, 30% effacement, station -1, BOM+ (Bag of Membrane). Artificial rupture of membrane was done. Liquor was clear and it took six hours for dilatation of cervix. Fetus showed vertex presentation with station 0 to +1. Her blood pressure was 120/70 mm of Hg. Five hours after artificial rupture of membranes; she suddenly became breathless and unconscious while bearing down. Her blood pressure and pulse were not recordable. She failed to respond to all measures of cardio-pulmonary resuscitation. Both mother and fetus were declared dead 15 minutes after onset of clinical symptoms. Police was informed about the death of mother and fetus as it was a case of maternal death.

A post mortem was performed. Post mortem examination revealed edematous right and left lungs weighing 500gms and 450gms respectively. The tracheobronchial tree was patent and congested, edematous. The heart was normal in size and weighed 300gms. Brain, liver, spleen, kidneys, gastrointestinal tract exhibited congestion. Uterus measured 31cmx 28cm x2cm weighed 1250gms and did not reveal laceration. Female fetus weighed 3kg, crown to heel length was 55 cm and there were no external abnormalities. Placenta weighed 500gms. The placental membranes showed rupture. The cause of maternal death could not be ascertained on autopsy findings. We received bits of heart, lungs, kidneys, brain, intestine and spleen for histopathologic examination in a sealed container.

Microscopic Examination

Microscopic examination of H & E stained sections of lungs revealed fetal squamous cells, lanugo hairs and amniotic debris consisting of mucin, in the pulmonary microvasculature; and pulmonary edema (Figure 1-2). Bronchioles exhibited vegetative material and eosinophilic debris within their lumina (Figure 5 & 6). The histologic diagnosis of amniotic fluid embolism with aspiration of gastric content was made.

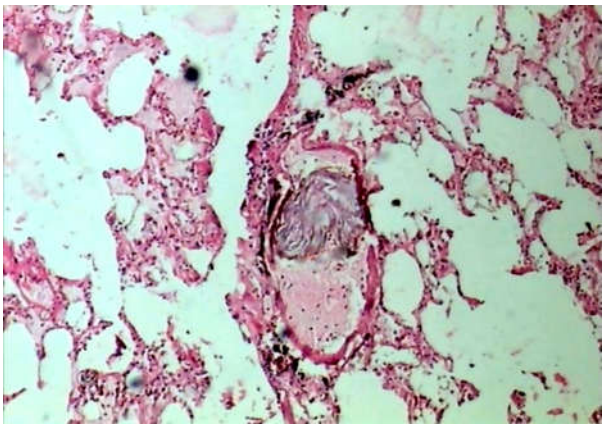

Fig. 1: Photomicrograph showing pulmonary arteriole filled with massive fetal squamous cells. (H-E; original magnification, x40).

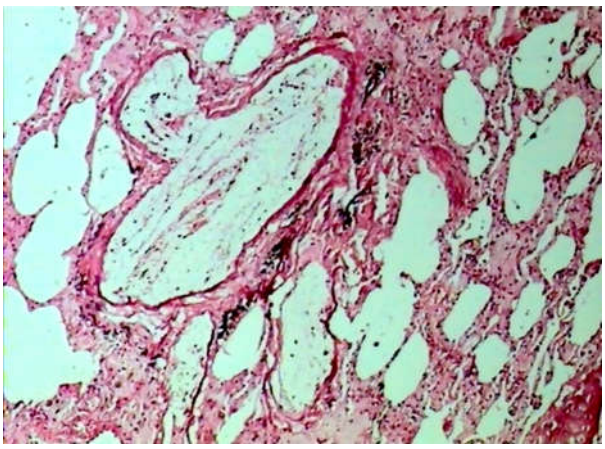

Fig. 2: Photomicrograph showing pulmonary arteriole completely filled with mucin. (H-E; original magnification, x40)

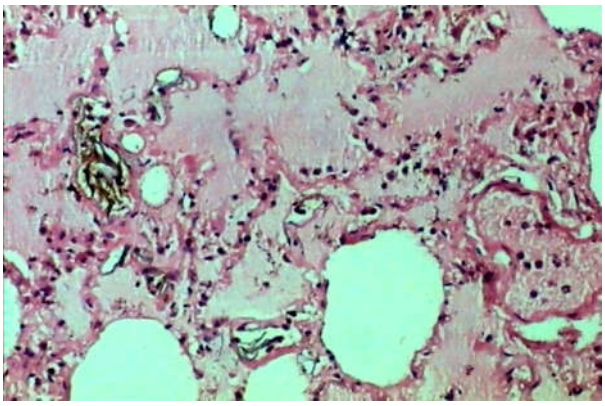

Fig. 3: Photomicrograph showing pulmonary edema and inter alveolar capillaries filled with fetal squamous cells. (H-E; original magnification, x40)

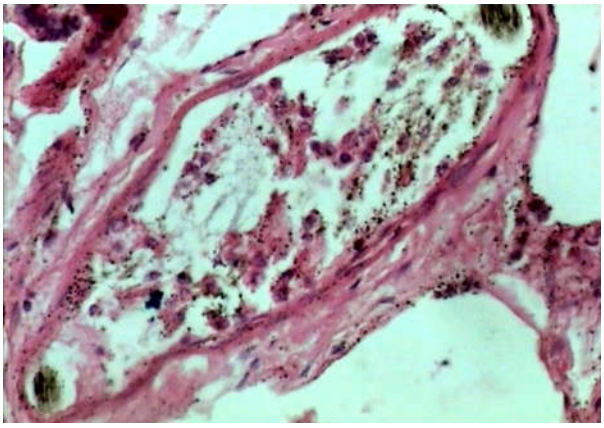

Fig. 4: Photomicrograph showing lanugo hair and amniotic fluid debris. (H-E; original magnification, x40)

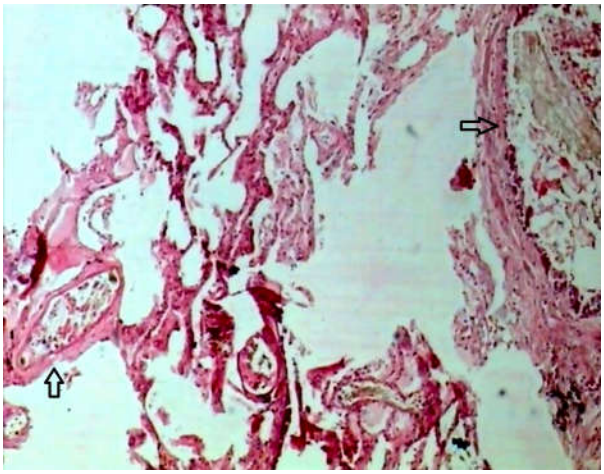

Fig. 4: Photomicrograph showing lanugo hair and amniotic fluid debris. (H-E; original magnification, x40)

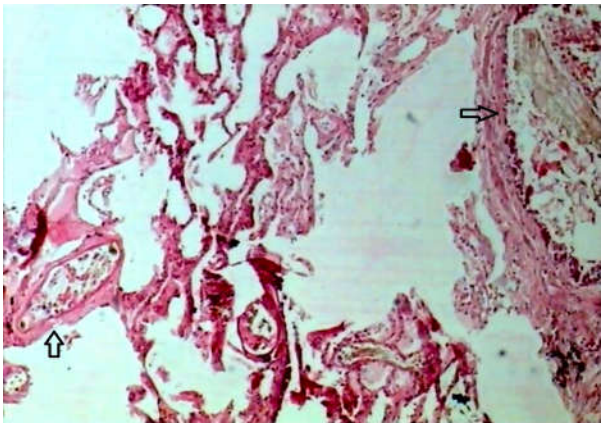

Fig. 5: Photomicrograph showing vegetative material in terminal bronchiole (Horizontal arrow) and mucin with lanugo hair (vertical arrow) in a pulmonary microvasculature. (H-E; original magnification, x40)

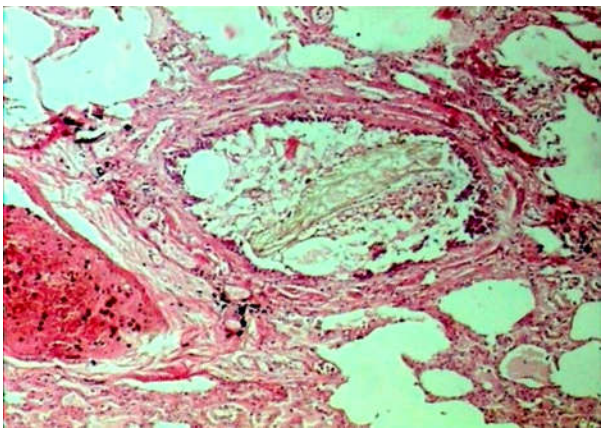

Fig. 6: Photomicrograph showing vegetative material in terminal bronchiole. (H-E; original magnification, x40)

Discussion

United Kingdom Obstetrics Surveillance System (UKOSS) program has been studying AFE and aspiration of gastric contents occurring as separate entities during pregnancy and labor [15]. However as in our case, both of these conditions may occur simultaneously. Aspiration of solid, semi-solid gastric contents in a tracheobronchial tree is easy to visualize and pose no diagnostic problem. However aspiration of aparticulate gastric acid juice in the respiratory system is very difficult to diagnose as it is liquid in nature and disappears rapidly [16]. In case of AFE aspiration of aparticulate acid gastric juice may not be noticed on histological examination as acid gastric juice gets miscible with pulmonary edema fluid caused by both AFE as well as aspiration. A tell-tale sign of aspiration is presence of a particulate material (vegetative material as in our case) in terminal bronchioles and alveoli. Recognition of aspiration with AFE is important as simultaneous occurrence of AFE and aspiration of gastric contents will speed up the development of hypoxia which may culminate in instantaneous death of mother.

Pulmonary aspiration is defined as the inhalation of foreign material into the lower respiratory tract beyond vocal cord [15]. It can cause severe maternal morbidity including acute respiratory distress syndrome (ARDS)/ acute lung injury (ALI), associated organ failure and maternal death. Emergency general anesthesia and pregnancy are the risk factors for gastric content aspiration. Pregnancy increases the risk of aspiration of gastric content due to delayed gastric emptying which may be attributed to effects of progesterone on lower esophageal sphincter and gastric smooth muscle. It also causes airway edema with congestion resulting in difficult prolonged intubation thus prompting for aspiration. The patient may aspirate stomach contents during labor. The labor itself and lithotomy position are responsible for this. The consequences depend on the period of survival after the aspiration. If patient subsists often develop aspiration

pneumonia and abscess [42]. However there are no epidemiological data on maternal pulmonary aspiration in pregnancy and its effects on the affected women. Also the data on the management of aspiration in pregnancy, as well as the subsequent maternal, fetal and neonatal morbidity and mortality, is sparse [15,43].

Pulmonary aspiration may be clinically asymptomatic (silent aspiration/unwitnessed) or clinically manifested by any combination of bronchospasm, hypoxia, cough, breathlessness and hypotension [43-55]. Witnessed aspiration event is characterized by presence of food particles in tracheobronchial tree [54]. Unwitnessed gastric aspiration is very difficult to diagnose and therefore it is difficult to estimate true incidence of aspiration induced lung injury [42].

The lung injury caused by aspiration of gastric contents ranges from mild subclinical pneumonitis to severe respiratory failure. The extent and progression of lung injury is determined by composition of aspirate [42]. Aspiration events lead to either aspiration pneumonitis or aspiration pneumonia. The aspiration pneumonitis evolves into two phases, phase-1occurs immediately after aspiration and is characterized by intense coughing and bronchospasm. The Phase-2 is characterized by onset of acute inflammation in the pulmonary parenchyma over next 4-6 hours [56].

In cases of sudden death, gastric contents are commonly found in upper respiratory tract at autopsy. It may be either agonal or early postmortem spill or antemoretem (true vital aspiration). It is not possible to distinguish between these entities unless clinical or witnessed evidence and/or histological findings of acute lung injury is available as there is no gold standard for diagnosis of aspiration induced lung injury [42-57]. Aspiration should be differentiated from regurgitation, The latter is characterized by reflux of gastric contents into oropharynx or esophagus without entry into lungs [42]. Agonal regurgitation of gastric contents occurs during pumping of chest and abdomen, commonly practiced resuscitation attempts. Thus finding of gastric contents in upper respiratory tract is medico legally less significant and could not be ascribed as a sole cause of death [57]. A death due to aspiration can only be attributed if the air passage beyond the level of vocal cord is completely occluded by food and most commonly seen in patient who have compromised central nervous system [58]. On other hand, presence of aspirated particulate gastric contents in smaller bronchi and terminal bronchioles with minimal inflammation substantiates the aspiration to be antemoretem in cases of sudden death [59-60].

Conclusion

Aspiration of gastric content may occur simultaneously with AFE particularly in an unconscious state leading to acute cardio-respiratory collapse and death thereby reducing the interval between the onset of symptoms of AFE and death.

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