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Contents

Editorial Citation and author metrics – A measure of author impact <i>Tanuj Kanchan</i>	221-222
Original Articles Radiological assessment of age of fusion at distal end of tibia in adolescent boys <i>Swapnil Patond, Varsha Pande</i>	223-225
Stature estimation from length of fingers in South Indian population – A cross sectional study <i>Pournima, J James Rajesh, K M Roop Kumar, B Siva Reddy, Jothi Marie Feula A</i>	226-228
Correlation between stature and arm span in students of a Medical College at Kakinada, Andhra Pradesh Phani Kiran Peethala, Pothula Umamaheswara Rao, Kristam Anudeep Kumar	229-231
Trend of researches in Forensic Medicine and Toxicology: An Indian scenario <i>Sunil M. Doshi</i>	232-236
An autopsy study of deaths due to hanging with emphasis on ligature material and periligature injuries <i>Harshwardhan Khushalrao Khartade, Vikas Premlal Meshram, Harish M Pathak, Abhijeet H Hosmani</i>	237-240
Asphyxial deaths: A study from Delhi, India BL Chaudhary, Raghvendra Kumar Vidua	241-242
Analysis of suicidal asphyxial deaths in Kota, the coaching city of India Pramod Tiwari, Deepak Sharma, Sachin Kumar Meena, Harshvardhan Tiwari	243-244
Estimation of age based on dental developmental stages – Exploring the population specific models Arun Kumar Patnana, Tanuj Kanchan, Narasimha Rao V Vanga, Ankita Chugh, Vinay Kumar Chugh, Kewal Krishan	245-248
Knowledge, Attitude and Practices of self-medication among medical students of Government Medical College, Baroda, Gujarat <i>Akhilesh K Pathak</i>	249-252
Profile of perpetrators of alleged sexual assault Basappa S Hugar, Jayanth SH, S Praveen, Girish Chandra YP, S Harish	253-257
Liver pathology: An autopsy based study from Southern Odisha Suryakanta Pati, Kiran Kumar Patnaik, Krusnasis Dash	258-261

Autopsy analysis of custodial deaths in RNT Medical College, Udaipur Manish Kumar Sharma, Akhilesh Sharma, Punit Jain	262-264
Age estimation from radiological examination of epiphyseal union of upper end of humerus in girls from Ahmedabad region Kalpesh Patani, Tikendra Dewangan, Saumil Merchant, Kalpesh A Shah, Dipak H Vora, NK Chaudhari	265-267
Review Articles Application of facial soft tissue thickness for facial reconstruction using Cone-Beam Computed Tomography: A Review <i>Kumuda Rao, Mahabalesh Shetty K, US Krishna Nayak, G Subhas Babu, D. Prashanth Shetty</i>	268-271
Case Series Gang rape: An analysis of a series of nine cases <i>Kh. Pradipkumar Singh, Soibam Neha, Th. Meera Devi</i>	272-273
Case Reports Fatal pulmonary embolism due to asymptomatic right atrial myxoma: A case report <i>Santosh H Bhosle, Ganesh D Niturkar, Vikas M Rathod, Kailash U Zine</i>	274-275
A rare injury pattern on heart in a lightning death – A case report Manas Ranjan Sahu, Sasank Shekhar Maharik, Sarthak Aeron	276-277
Foreign body ingestion and precautions during imaging (Button battery case) Krishna Kumar Singh, Shinto Devassy, Sanjeev Lalwani, Kangana Sengar, Arulselvi Subramanian	278-281
Opinion Consumer Protection Act, 2019 and its implications for the medical profession and health care services in India <i>MZM Nomani, Faizanur Rahman, Alaa KK Alhalboosi</i>	282-285

Acknowledging the reviewers of 2019

286

EDITORIAL

Citation and author metrics – A measure of author impact

Tanuj Kanchan

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In the times of 'publish or perish', the researchers continuously thrive to publish their work in high impact journals so that their work is disseminated to larger audiences, and is wellrecognised by others. To publish in the best journal, the impact or rank of journals is usually compared to make the right choices. Thus, knowledge about the rank and impact of journals is important. Considering its importance for the members of our subject speciality, the details of rank and impact of forensic journals were published in our previous editorial.¹Likewise, the scientific world, especially the recruiters, collaborators and funding agencies are interested to know about the scientific research output/ impact of the researchers and authors, and the quality of their work. To assess the impact of authors and their work, certain metrics called as the author level metrics are commonly utilized. The scientific analysis of measurements or metrics is called metrology. To develop an understanding about impact in research, the knowledge about three related terms in metrologyviz. bibliometrics, scientometrics, and informetrics is necessary.

Despite of the differences in their subject attributes; the three terms are often used synonymously. In fact, scientometrics is sometimes referred as a sub-group of bibliometrics. While bibliometrics is for library and document science, scientometrics is for science of science, and informetrics for information science.² Bibliometrics is defined as the 'quantitative study of physically published units, or of bibliographic units, or of alternatives of either'.³ Bibliometrics thus, refers to the quantitative (metric or mathematical) evaluation of books, journals, articles and other publications. Scientometrics on the other hand, is the quantitative analysis of scientific research activities. Quantitative study of any form of information is called Informetrics. We will focus predominantly on scientometrics in this editorial. Citation analysis is one of the commonly used scientometric tool or quantitative method to evaluate scientific research activities.⁴

A citation is a reference to published or unpublished scholarly sources and materials. These include books, journal articles, dissertations, abstracts, etc. For e.g.; a scholar working on a particular subject, cites the published and unpublished work related to the topic, or in other words a scholarly work is cited by researchers working on similar topics. The scholarly work may be cited as an introduction to the topic to show the present status of the work, in support of one's research observations, and even to show disagreement to the observation of others, etc. It is quite understandable that researchers would prefer to cite articles with reliable findings, and that are published in widely read and reputed journals with stringent peer-review policies. Every citation an article receives, indirectly speaks of the interest it has generated for the researcher who has cited it. Thus, the number of citations received by an article are considered to be directly proportional to the quality of the work, and the interest it generated. More the number of citations for an article, better is the work. And obviously the credibility/ impact of the author of the article, institution where the work was carried out, and the journal that published the article also increases.

Many metrics have been developed to measure the impact of these citations. The metrics which compare the work of authors are called as author level metrics. It is defined as the citation metrics that measures the bibliometric impact or scientific output of individual researchers, authors, academics and scholars. The simplest author level metrics is to count the 'total publications', 'total citations' or 'average citations count per article'. While total publications are a show of productivity of a researcher, total citations show the interest of other authors and scientific community at large who have cited the papers published by that particular researcher. Other metric tools have been developed to quantify a researcher's activities such as the *h*-index, *i*10 index and *g*-index, etc. These are considered superior to the simple citation or publication counts.

Amongst all the indices, *h*-index (Hirsch's index) remains the most commonly used tool for research evaluation.⁵ It considers the articles authored by a researcher, and the number of citations received by these articles. The *h*-index of an author thus, is a reflection of his/her productivity as well as the impact of his research in terms of the interest his/ her articles generate. The *h*-index was introduced by J.E. Hirsch as *'the number of papers with citation number >h'*.⁶ *h*-index of an author refers to the maximum value of *h* in a way that his/ her *h* number of papers have each been cited at least for *h* times. For e.g.; if the *h*-index of an author is 5 then he/ she has at least 5 publications which have at least 5 citations each.

h-index for researchers and authors is available on their profile on resources like Google Scholar, Scopus or Web of Science. Each of these resources however, while calculating the h-index considers only those articles and citations that are published or cited in journals included/ abstracted / indexed in their data base. Google Scholar in addition, has a simpler *i*10-index, which indicates the number of scientific publications of an author that have been cited by at least ten sources. Thus, the *i*10 index of an author denotes the number of articles which have at least 10 citations. The g-index was devised as an alternative for the older *h*-index, which does not average the numbers of citations. Instead, *g*-index is defined as the biggest number such that the top g articles received (altogether) at least g^2 citations. For e.g.; if the *g*-index of an author is 10 then the top 10 articles must have received at least 100 citations in total.

In the recent times, scholarly networking platforms, such as the Research Gate also provide information on author level impact. It not only takes into consideration the total publication and citation count, but also the number of reads, interests and recommendations, etc. With the world focusing on various indices to measure the impact of an author, it is recommended that researchers publish their work in reputed journals with high impact and readership, which will increase the chances of their article being read by larger group of researchers, with increased chances of culminating into higher number of citations and author impact.

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Radiological assessment of age of fusion at distal end of tibia in adolescent boys

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Abstract

Determination of age of an individual by using various methods is required for medico legal purposes in both civil and criminal matters. Ossification of bones is diagnostic tool for estimation of age until the process is complete for particular bones. Extent of ossification and union of epiphysis of bones can be determined in living subject by using skiagraphy. In the present study epiphyseal fusion of the distal end of tibia in 82 individuals was analysed on radiological basis to assess the range of variation of epiphyseal fusion at each age. X ray films of the participants were divided into three groups on the basis of degree of fusion. Firstly, those which were showing No Epiphyseal Fusion (NF), secondly those showing Partial fusion (PF), and thirdly those showing complete Fusion (CF). Observations made were compared with the previous radiological studies. In the present study epiphysis of distal end of tibia fused in majority of cases at 17-20 years. Earliest fusion occurred at 17 years. The observation of present study corresponds to data given by Davies and Parson in the population of England, Hepworth in the population of Punjab, Bokariya in the population of Rajasthan and Narain, Bajaj in the population Uttar Pradesh.

Keywords

Epiphyseal Fusion; Distal end of tibia; X-ray; Age estimation

Introduction

Determination of age of an individual using various methods is required for medico legal purposes in both civil and criminal matters. Estimation of age of person can be categorized as microscopic and macroscopic methods. Microscopic method includes Osteon counting base on remoulding of long bones. A macroscopic structure includes dental development, height weight, puberty changes, secondary sexual characters and ossification of bones. Ossification of bones is diagnostic tool for estimation of age until the process is complete for particular bones. Extent of ossification and union of epiphysis of bones can be determined in living subject by using Skiagraphy.

Epiphysis of the bones unites during age periods which are remarkably constant for a particular epiphysis and this is helpful in age determination.¹ In law the crime and punishment is entirely based on criminal responsibility and this in turn depend on the age of a person.² Age is helpful in identification of an individual which in turn is helpful in both civil and criminal cases according to Sangma et al.³ It has been also stated that the study of epiphyseal union of bones is considered a reasonably scientific and accepted method for age determination by the law courts all over the world.⁴

The present study is an attempt to determine the age from epiphyseal union from tibia. The aim and objectives of the study has been confined to estimate age from epiphyseal fusion of distal end of tibia in all participants, assess the age specific difference in epiphyseal fusion in participants and evaluate the

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Article History

Received: 9th June, 2018; Revision received on: 17th July, 2019 Accepted: 25th September, 2019 difference in the epiphyseal fusion in central part of the India with other part of India on the basis of previous studies.

Materials and Methods

The present study was carried out in Department of Forensic Medicine MGIMS Sewagram Wardha. A total of 82 participants comprising of students of schools, and college from district were included in this study. The participants were from 13-20 years of age group. Approval was taken from institutional ethical committee MGIMS, Wardha and informed consent was taken from all participants prior to each investigation. It was ensured that the study participants were born to parents living in central India and have lived since birth, and were free from any disease/deformity pertaining to bones or chronic disease affecting the general health.

The X-ray films were taken and films were developed with the help of experienced technicians. The part taken for X-ray was ankle for distal end of tibia. The X-ray plates were numbered denoting the serial case number allotted of right side with lead numbers. Minimum shots were taken to expose the joints involved in study and minimum and appropriate voltage settings of X-Ray machine were applied so as to avoid unnecessary radiation exposure of the subjects to get the desired qualities of X-Rays. For the study the X-ray films were divided into three groups for each epiphysis, and skeletal maturity was evaluated according to the Jit and Kulkarnis⁵ classification which was divided into three stages, Non Fusion (NF), Partial Fusion (PF), Complete Fusion (CF).

Results

A total of 82 male individuals were included in this study for radiological examination of distal end of tibia. Age distribution of the study participants are shown in Table 1.

Age (years)	Ν	%
13	8	9.76
14	12	14.63
15	10	12.20
16	16	19.51
17	14	17.07
18	10	12.20
19	12	14.63
Total	82	100.00

Table 1: Age distribution of participants

Table 2 shows distribution of participants divided into Non fusion (NF), partial fusion (PF) and complete fusion (CF) of ossification centres at distal end of tibia in adolescent age group.

Table 2: Incidence and extent of fusion of lower end of tibia in different age groups

Age in years	NF	PF	CF	Total
13	8(9.76%)	0(0.00%)	0(0.00%)	8(9.76%)
14	1(1.22%)	11(13.41%)	0(0.00%)	12(14.63%)
15	1(1.22%)	8(9.76%)	1(1.22%)	10(12.20%)
16		6(7.32%)	10(12.20%)	16(19.51%)
17			14(17.07%)	14(17.07%)
18			10(12.20%)	10(12.20%)
19			12(14.63%)	12(14.63%)
Total	10(12.20%)	25(35.37%)	47(57.32%)	82(100%)
2-value	120.4 (P< 0.001)			

Out of total 82 participants, 8 (9.76%) participant's shows nonunion in 13-14 years of age group. Partial union seen in 11 (13.41%), 8 (9.76%), 6 (7.32%) participants of 14-15 years, 15-16 years, 16-17 years of age groups respectively. Similarly, it shows complete fusion in 1 (1.22%) and 10 (12.20%) participants of 15-16 years and 16-17 years of age group respectively. It was observed that all 36 (43.90%) a participant between 17-20 years shows complete fusion.

Discussion

India is a vast country with diversity in social customs, multiple religions, dietary habits and variations in climatic conditions. Subrahmanyam quoted that owing to variation in climatic, dietetic, hereditary and other factors affecting the people of the different states of India, it cannot be reasonably expected to formulate a uniform standard for the determination of the age of the union of epiphyses for the whole of India.⁶ Human growth is continuous process which goes through, first a developmental stage and second, the maintenance of status. In the developmental stage, changes in skeletal and dental morphology occur in an age–age predictive sequence.⁷ Reddy stated that the bones of human skeleton develop from a number of ossification centers. At 11 to 12 weeks of intrauterine life, there are 806 centers of ossification, at birth there are about 450. The adult human skeleton carries only 206 bones.⁸ Mehta observed that it has been approved

by research in our country that the epiphysio-diaphysial union in Indian occurs about a year or two in advance of the age at which that occurs in Europeans.⁹ Jit and Singh revealed that precocity of epiphyseal union has been attributed to racial and climatic factors. Works in different regions of India-North (Punjab, Delhi and UP), East (Bengal) and South (Chennai) have given different ages of fusion of the epiphysis. Further, workers in the same region have also given different ages of fusion of the epiphysis of the same bone and in the same sex. This difference could possibly be due to inadequate material or recording of incorrect ages of the participants.¹⁰

82 males from age group of 13-20 years were studied radiologically for epiphyseal fusion of distal end of tibia in this study. Males in the age group of 13-14 years, shows non-fusion in 8(9.76%) cases. In 14-15 years of age group, non-fusion was seen in one (1.22%) case and partial fusion in 11(13.41%) cases. In 15-16 years of age group it shows non-fusion in one (1.22%) case, partial fusion 8 (9.76%) cases and complete fusion in one (1.22%) case. Similarly, 16-17 years of age group shows partial fusion in six (7.32%) cases and complete fusion in 10(12.20%)cases. The distal end of tibia shows complete fusion in all of cases 36 (79.9%) cases between 17-20 years of age group. The observation of present study corresponds to data given by Davies and Parson in the population of England, Hepworth in the population of Punjab, Bokariya in the population of Rajasthan and Flecker in the Australian population. The present study also matches with Christian in population of Mexico. Studies by Pillai in the population Madrasis and Galstaun in the population of Bengal show an earlier fusion by 1-3years in distal end of tibia when compared to the present study in population of central India (Table 3).

Study	Region	Age of fusion
Davies and Parson (1927) ¹¹	England	18
Hepworth (1929) ¹²	Punjabi (India)	17-18
Flecker (1932) ¹³	Australians	17
Bokariya P (2009) ¹⁴	Rajasthan	17-18
Christian C, (2005) ¹⁵	Mexican Americans	19
Pillai (1936) ¹⁶	Madrasis	14-17
Galstaun (1937) ¹⁷	Bengalis	14-16
Narain and Bajaj (1957) ¹⁸	Uttar Pradesh	17-19
Present Study	Central India	17-18

Table 3: Age of fusion in distal epiphyseal end of tibia as reported in various studies

By comparing the available literature, the age of skeletal maturity in this region are nearly similar to those in population of Uttar Pradesh and Rajasthan. As this study was done in Central India region the application of standards of this study may be considered ideal for application in the region of Central India. The ossification at distal end of tibia males is completed in all instances (100%) at the age of 17-20 year. By comparing the available literature about ossification, fusion was delayed one to three years in this study with population of Central India than those parts of south India and population of Bengal.

Conclusions

In the present study, the epiphysis of distal end of tibia fuses in the majority of the cases at 17-20 years. As the sample size is limited further studies are necessary. Moreover, the population in Central India is mixed type comprising of various religions and castes, so the findings of this study are not applicable to specific caste or religion for estimation of age. Region wise studies should be conducted for better correlation and comparison. Due to changing life style pattern, dietary, climatic, behavioural factors, age of ossification is changing as mentioned in the available literature. So as to evaluate these changes, studies are recommended in every region of India at regular time period for academic and judicial interest.

Ethical clearance: A prior approval was obtained from the Institutional ethics committee

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Stature estimation from length of fingers in South Indian population – A cross sectional study

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Abstract

For years, anthropologists and medico legal experts are using stature as a main feature of personal identification and till now stature has got a great significance. This paper is a study conducted in the department of Forensic Medicine and Toxicology in Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry, among the Under Graduate students. A stadiometer was used to measure height on standing erect in anatomical position with bare foot against a wall. The head was kept in the eye-ear-eye plane and then the height was measured to the nearest 0.1 cm. A sliding calliper was used to measure the finger length. All the measurements were taken at a specific time to avoid the diurnal variation. The results were analysed and a regression equation was derived for each of the finger. Out of ten fingers, eight proved to be statistically significant. The study results will augment the existing data and will be a tool of relevance to anthropologists and medico legal experts.

Keywords

Anthropologist; Height Estimation; Finger length.

Introduction

For years, anthropologists and medico legal experts were using stature as a main feature of personal identification and till now stature has got a great significance. It all can be traced since the last decade of 19^{th} century, where estimation of stature based on the measurements of body parts, especially long bones of the limbs were done. Pertaining to the correlation between stature and various long and short bones of the body, many researches have been conducted. Hand and foot length correlation with the stature is one of the commonest among all.¹ As of biological variability is concerned, the population of the world shows a very high variability. Population of India is no exception to it. It is also worth mentioning that much variability in biological characters is observed among the Indian population because of its various ethnic and racial groups.²Thus for stature estimation among a specific group of population, derived formula for one group of population cannot be used for another group as it will affect its accuracy.^{3,4}

Severely dismembered bodies are a common finding in mass disasters, terrorist attacks, plane crash, suicide bomb explosions etc. On such occasions just a finger or a foot or a hand or forearm or fragments of body parts will be presented to Forensic experts to comment and help in establishing the identity of them.⁵⁻ ¹³Studies on stature estimation from length of fingers and phalanges are few in national and international levels, ¹⁴⁻¹⁸ in particular, very less number of Indian studies are there involving all the fingers.¹⁹Thus this study is justified, as because of less number of Indian studies, in correlating the stature and

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Received: 10th March, 2019; Revision received on: 7th November, 2019 Accepted: 13th December, 2019 length of the fingers in South Indian population. This will augment the existing data and will be a tool of relevance to anthropologists and medico legal experts.

Materials and Methods

This study was carried out in the Department of Forensic Medicine and Toxicology, among the Under Graduate students of Sri Venkateshwaraa medical college hospital and Research Centre, Ariyur, Puducherry after obtaining institutional scientific and institutional ethics committee clearance. The Sample size was calculated as 400. Study subjects were healthy male and female students of 17-25 years belonging to the South Indian states. Subjects with physical deformity like kyphosis, scoliosis, amputations, etc. was not included in the study.

A stadiometer was used to measure height. Height was measured from crown to heel on standing erect in anatomical position with bare foot against a wall. The foot was kept parallel to each other with heels, buttocks and back touching the wall. The head was kept in the eye-ear-eye plane and then the height was measured to the nearest 0.1 cm. A sliding calliper was used to measure the finger length. The subject was asked to place the hand on a flat table, with palms facing upwards. The proximal crease was identified in all fingers and then sliding calliper was used to measure the distance between the proximal crease and the distal most point of the finger Figure 1. Same procedure was repeated for all the digits respectively. The measurements were taken in cms, and at a specific time to avoid effect of diurnal variations.

Statistical Analyses: The results of the study were analysed using SPSS (version 20). Normality of the data is tested using Kolmogrov Smirnov test. Continuous variables were expressed as Mean \pm SD for Normally distributed parameters and Median (Interquartile Range) for non-normally distributed parameters. Categorical variables were expressed as frequency. Correlation of length of the fingers with height of the individual was done using Spearman correlation test, since height was non-normally distributed. Linear regression analysis was done using finger length as independent variable and height as dependent variable. P value less than 0.05 was considered statistically significant.



Figure 1: Finger length measurement using digital callipers

Results

A total of 401 subjects (249 females and 152 males) participated in the study. The median age of our study population was 19 years with interquartile range of 18 - 20 years. Among the continuous variables lengths of right ring finger (RR), right little finger (RL), left thumb (LT), left index finger (LI), left ring finger (LR) and left little finger (LL) were normally distributed and were expressed as mean \pm SD in Table 1. Height, lengths of right thumb (RT), right index finger (RI), right middle finger (RM), and left middle finger (LM) were non-normally distributed and expressed as median with interquartile range (IQR) in Table 2.

Table 1:	Descriptive	statistics	for variables	showing	normal	distribution
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Variable	Mean	SD
RR	7.00	0.59
RL	5.70	0.53
LT	4.93	0.56
LI	6.92	0.63
LR	7.02	0.60
LL	5.74	0.58

RR - right ring, RL - right little, LT - left thumb, LI - left index, LR - left ring, LL - left little finger.

Table 2: Descriptive statistics for variables with non-normal distribution

Parameters	Median (IQR)
Age in years	19 (18-20)
Height in cms	162 (156-170)
RT	4.9 (4.6-5.4)
RI	6.95 (6.6-7.3)
RM	7.6 (7.2-8.0)
LM	7.6 (7.2-8.0)

 $\rm RT-$ right thumb, $\rm RI-$ right index, $\rm RM$ - right middle, $\rm LM-$ left middle finger, IQR - interquartile range

On correlation of height of the individual with the length of individual fingers, there was a significant positive correlation (p<0.01) between the two variables in all the fingers as shown in Table 3. Linear regression analysis was done using finger length as independent variable and height of the individual as dependent variable. Regression equation for height was derived for each of the ten fingers and it was significant for all five fingers of the left hand (LT - R²=0.39, p= <0.001; LI - R²= 0.46, p= <0.001; LM - R²=0.01, p= <0.001; LR - R²=0.57, p= <0.001; LL - R²=0.44, p= <0.001) and it was significant for index, ring and little fingers on the right side (RI - R²=0.513, p= <0.001; RR - R²= 0.551, p= <0.001; RL - R²=0.49, p= <0.001) as shown in Table 4.

Table 3: Cor	relation of	height	with le	ength o	of the fing	gers
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Variable	R	P value
RT	0.629	< 0.001*
RI	0.714	< 0.001*
RM	0.713	< 0.001**
RR	0.736	< 0.001*
RL	0.710	< 0.001*
LT	0.669	< 0.001*
LI	0.747	< 0.001*
LM	0.738	< 0.001*
LR	0.760	< 0.001*
LL	0.697	< 0.001*

RT – right thumb, RI – right index, RM - right middle finger, RR – right ring, RL – right little, LT – left thumb, LI – left little, LI – left index, LR – left ring, LM – left middle. *P value < 0.05 is considered statistically significant

Table 4: Linear regression analysis for estimation of	height from finger length
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Variable	Regression equation	R ²	P value
RT	163.3 + (0.01*RT)	0.001	0.582
RI	80.7 + (11.8*RI)	0.513	< 0.001
RM	163 + (0.009*RM)	0.001	0.56
RR	79 + (11.9 *RR)	0.551	< 0.001
RL	91.8+ (12.5*RL)	0.49	< 0.001
LT	110.8 + (10.6*LT)	0.39	< 0.001
LI	92.6 + (10.2*LI)	0.46	< 0.001
LM	160.4 + (0.3*LM)	0.01	0.01
LR	79.2 + (11.9 * LR)	0.57	< 0.001
LL	100.6 + (10.9*LL)	0.44	< 0.001

RT – right thumb, RI – right index, RM - right middle finger, RR – right ring, RL – right little, LT – left thumb, LI – left little, LI – left index, LR – left ring, LM – left middle

Discussion

Trotter and Glesser's regression equation for estimation of height was derived using length of long bones as independent variable. Though this equation is used worldwide, this is not found to be reliable for Asian population.⁸ There are also studies conducted in the North Indian population providing regression equation for estimation of height of the individual from the length of the fingers. Since the length of the fingers vary significantly between different population groups, in our current study we have aimed at deriving different regression equations to estimate the height of the individual from length of all ten fingers in South Indian population.

On correlation of height of the individual with the length of individual fingers, there was a significant positive correlation (p value <0.001). This shows that the height of individual is directly related to the length of the fingers. On linear regression analysis, the regression equation was significant for index finger, ring finger and little finger of the right hand and all the five fingers of the left hand.

A study in Karnataka showed estimation of height with middle finger length is most significant. Another study conducted in the same population group stated left thumb as the most significant independent variable in derivation of regression equation for estimation of height of the individual.⁸ This proves the fact that different regression equations for each of the ten fingers is needed in different population groups to arrive at the most accurate height of the individual. Our study provides regression models foe estimation of height of an individual from the length of fingers in South Indian population.

Conclusions

It is obvious from the study that there is a significant correlation between the length of the fingers and height of an individual. The formula derived from the regression analysis can be applied to estimate the height of an individual from any finger length. These formula will be effective in the identification process among the South Indian population and in solving many medicolegal issues.

Ethical clearance: A prior approval was obtained from the Institutional ethics committee

Conflict of interest: None to declare

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Correlation between stature and arm span in students of a Medical College at Kakinada, Andhra Pradesh

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Abstract

Stature is an important variable in fixing identity of a person. Measurement of stature is a straight away procedure provided if the entire skeletal system is intact and healthy. Armspan has been proven to be one of the most reliable predictors since both are strongly correlated. Armspan is the physical measurement of the lengthfrom one end of an individual's armsto the other when raised parallel to the ground at shoulder stature at a 90° angle. Such correlation is useful to predict stature in subjects in whom it cannot be reliably measured due to debility or structural defects. Determination of an individual's stature based on armspan will only ever be an estimation, as it is not always possible to replace an entity. Like most other anthropometric measurements, stature and armspan relationship is likely to differ in various ethnic groups. It is therefore important to study this relationship in native populations. The present study is designed to evaluate the relationship between armspan and stature. This study done on II MBBS students, Rangaraya Medical College, Kakinada who represent south indian population. Stature was measured with stadiometer and arm span was measure using acalbtrated steel tape. Stature was found to correlate positively with the arm span and the correlation was statistically significant. In cases of mass disaters and crimes involving mutilation of the bodies at the level of chest or abdomen, when identification of the unknown body stump involves estimation of stature, arm span can be considered to estimate the stature.

Keywords

Anthropometric Measurement; Arm Span; Correlation; Ethinicity; South Indian Population; Stature.

Introduction

Stature is the maximum distance measured from the point where the heel touches the floor to the highest point of the head while the person is in the erect position.¹ However, in some situations it is not possible to measure the stature of a person because of deformities of the limbs, in person who have undergone amputations or in unknown cadavers where lower limbs or trunk is mutated. In such cases, stature has to be estimated using other body parameters like hand and foot lengths sitting height and knee height, length of the sternum, vertebral column length, length of scapula, arm span as well as cranial sutures. Among all body parameters, correlation between stature and the arm span was found to be the most reliable. Arm span is the maximum distance between the tip of the longest fingers of both hands while the person extends both arms at the level of the shoulders.¹ The associations of arm span and body height vary in different ethnic and racial groups. The measurements of height and arm span and relationship between them have applied significance in Forensic Medicine, Plastic and Cosmetic Surgery and other allied clinical sciences.

Materials and Methods

After obtaining an institutional ethical clearance from the

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Received: 1stApril, 2019; Revision received on: 10th December, 2019 Accepted: 29th December, 2019 institute, and taking consent from the students a total number of 193 students (72 males and 121 females) were included for this study. Family history was taken and students beinging to South Indian states were only included in the study. Physically challenged students were excluded. The 193 students were divided into six batches. Five batches of 32 students and one batch of 33 students. The study was done one batch per day. Everyday the measurements were taken from 06:30 AM to 09:00 AM in the department of Forensic Medicine & Toxicology, Rangaraya Medical College, Kakinada. Observer bias has been ruled out by assigning a single observer.

For the measurement of the stature, the subjects were asked to stand erect with their heel together and backs straight as possible so that the heels, buttocks, shoulders and the head touched the rod of stadiometer a depicted in Figure 1. Head was placed in Frankfort horizontal plane. The arms were hung freely by the sides. Reading was taken from the stadiometer scale at the vertex point (highest point on their head). Arm span was measured using a calibrated steel tape to the nearest 0.1 centimeters in bare feet on a level concrete floor with the upper backs, buttocks and heels against the wall providing support as depicted in Figure 1.



Figure 1: Measuring the stature and the arm span

The participant's head was also in the Frankfort horizontal plane and the arms are outstretched at right angles to the body with palms facing forwards. The measurement was taken from one middle fingertip to the other middle fingertip, with the measuring tape passing. The measurements were taken twice, and an average of the two readings was calculated.

Data analysis was carried out using the statistical program SPSS (23.0) and Excel sheet for Windows. Mean, mode, median and standard deviation (SD) was calculated for all the variables studied. Height to arm span ratios (HAR), as well as regression equations, were derived to aid prediction of height from arm span. Statistical and graphical analysis was applied to determine their correlation.

Results

In our study 87.04% of the participants had an arm span more than height. Out of this, 40.47% were males and 59.52% were females. 82.6% of females showed less arm span in comparison to stature when compared to males as depicted in Table 1. Mean height to arm span ratio obtained were 0.963 in males and 0.986 in females. The mean measured stature and arm span for males were 171.536.26 and 178.028.208 whereas for females they were 157.775.66 and 1606.68 respectively as depicted in Table 2. Mean arm span and stature in male were more than female and it was statistically significant (P < 0.001). So, the same regression equation can not be used in both sexes to estimate stature.

Table 1: Correlative statistics for height [cm] and arm span [cm]

Group	Male (%)	Female (%)	Total (%)
Arm span = Height	0 (0%)	2 (1.65%)	2 (1.03%)
Arm span > Height	68 (94.44%)	100 (82.64%)	168 (87.04%)
Arm span < Height	4 (5.56%)	19 (15.70%)	23 (11.9%)

Table 2.	Descriptive statisti	cs for height	[cm] and arn	n snan [cm]
Table 2.	Descriptive statisti	co for norght	joini and ann	1 span [em]

Group	Ν	Arm span (Mean±SD)	Stature (Mean±SD)	HAR
Male	72	178.02 ± 8.208	171.53 ± 6.26	0.963
Female	121	160 ± 6.68	157.77± 5.66	0.986
Total	193	167.252 ±11.05	162.91± 8.89	0.974

We determined Pearson correlation coefficient to find the correlation between stature and arm span depending upon the sex. For males the regression equation was y = 0.6578x + 54.434, as depicted in Figure 2 and for females the regression equation was y = 0.7296x + 40.421 as depicted in Figure 3. Where, 'y' is the stature in cm, while,'x' is the arm span in cm. Stature was found to correlate positively with the arm span (r=0.862 for male, r=0.861 for female and r= 0.939 for all participants) and the correlation was statistically significant (p<0.05).





Figure 3: Scatter diagram for regression model among males (N=121)

Discussion

The earliest documented observation that man can be drawn in a square (and in a circle) was made by the Roman architect Vitruvius, thereby indicating that arm span was equal to height in the perfect human being. Until the 19th century, the equality of arm span and height in Vitruvian man was largely an artistic and philosophical concept. When measurement replaced impression, this equality was found to be uncommon, with arm span more often being greater than height. The English sculptor Bonomi first designed an instrument to measure height and breadth in man. His measurements in 84 subjects revealed arm span to be greater than height in 54, less than height in 24, and equal to height in only 6. Extensive measurements of arm span and height have only been done in this century.²⁴ When the accurate measurement for stature is unobtainable, it is computed using other surrogates. Arm span is the most widely used one. Arm span measurement can serve as one of the most reliable body parameter to determine stature of an individual. Several studies demonstrated that arm span measurements exceeded height measurements in all the ethnic groups and in both sexes.⁵ Datta⁶ in his study found that males were taller and had longer arms spans than females. The height-arm span ratio was 0.98–0.99, indicating height to be slightly less than an arm span in both sexes.⁶ In the present study height-arm span ratio of study subjects was 0.974. According to Mahanty et al the coefficient of determination for regression equation models obtained from arm span was 66.6% for height in the case of south Indian women,⁷ where as in present study it is of 74.1% as study is done on Andhra Pradesh girls.

Conclusion

In medico-legal cases, stature becomes a prime factor in identification of a deceased subject when only parts of the body are available. Arm span is considered a useful alternative to height, since arm span does not vary significantly with age. It is useful in determining age related loss in stature and in identifying individuals with disproportionate growth abnormalities.

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Conflict of interest: None to declare

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Trend of researches in Forensic Medicine and Toxicology: An Indian scenario

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Abstract

Research in medical field is a momentous pillar on which the entire health system lies on. If one compares the researches in forensic medicine and toxicology with other clinical specialties, the difference lies with the need and nature of researches. Aim of this study was to analyse the trend of researches in the field of forensic medicine and toxicology in India. Objectives of the study were to quantify the researches in terms of specialty areas as well as to explore the scope for further studies. Materials for the present study comprised of 1192 research articles published in the Indian journals from 2013 to 2017. Each article was analysed through its title and abstract available online. Each article was classified according to the area and topics covered. Identification of an individual was the most researched area of forensic medicine in India. The least researched area was the teaching learning aspects of the subject itself. As far as most repetitive researched studies are concerned, trends of poisoning followed by pattern of injuries due to road traffic accidents have their places at the top. More emphasis should be given to researches based on current medico legal issues of the community instead of giving attention to what is already there in literature. Repetition of researches should be aimed at creating novelty on particular aspect. Meta-analysis should be incorporated to coalesce the findings of researches and to develop methodological standards that can be suitably applied to local populations

Keywords

Research trend; Forensic Medicine; Toxicology; India

Introduction

According to Cambridge dictionary, research is a detailed study of a subject, especially in order to discover new information or reach a new understanding.¹Research remains the most integral part of mankind irrespective of the field it involve. Research in medical field is a momentous pillar on which the entire health system lies on. It is not hyperbole if it is said that every other day something new emerges out of the efforts made by medical fraternity. However, India, though possesses a large number of medical institutes and biodiversity of the population, is short of quality research publications.² It was observed that the problems with researches depends on working conditions of researchers, budgetary restraints and the conception of research it self.³

The subject, forensic medicine and toxicology, deals with the application of knowledge of medicine to aid in the administration of justice. Research in this field serves the legal system directly or indirectly. If one compares the researches in this subject with that of the researches in other clinical specialty, the difference is lying with the need and nature of the research itself. Etio-pathologic research in this field has limited value and instead it comprised of research regarding ante or post mortem findings, the methods of deriving scientific opinion, the reconstruction of event in question as well as researches that deals with the current medico legal issues. It was observed that

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Received: 28th May, 2019; Revision received on: 2nd November, 2019 Accepted: 10th November, 2019 the research output of forensic medicine has sometimes been regarded as insufficient and as of poor quality and it may not be because of lack of scientific competence but is a result of the questions asked, the available methods and specific aims.⁴

Aim of the present study was to analyse the trend of researches in the field of forensic medicine and toxicology in India. Objectives of the study were to quantify the researches in terms of areas covered as well as to assess the scope for further studies.

Material and Methods

The present study is Internet based 5-years retrospective study. Materials for the present study were comprised of the research articles published in the Indian journals within the time frame of 2013 to 2017.

Inclusion criteria for the articles: (1) Articles published in the Indian Journals that are indexed in Scopus and/or PubMed (Medline) (2) Coverage years for the journal within the indexing agencies must include the study period (2013 to 2017). (3) Scope for the journal should prioritize to publish researches in relation to forensic medicine and toxicology. (4) Journals listed in the UGC (University Grant commission, India) approved list of journals.

Exclusion criteria for the articles: (1) Articles published in the journals that did not fulfil the aforementioned criteria. (2) All review articles, case reports, case series, editorials, letter to editors etc. The Journals included in this study are Journal of Indian Academy of Forensic Medicine, Journal of South India Medicolegal Association, Journal of Punjab Academy of Forensic Medicine & Toxicology, Indian Journal of Forensic Medicine & Toxicology, Medico legal update and Anil Aggrawal's Internet Journal of Forensic Medicine and Toxicology. These journals fulfilled the aforementioned criteria for inclusion in the study at the time of data collection. Access for the articles were obtained online either through the website of the journal itself or through the external links provided by the journal websites. Microsoft excel was used to prepare data collection sheet. Each excel sheet was dedicated to major divisions of the subject forensic medicine and toxicology. Further, within each excel sheet columns were dedicated to areas covered under the divisions and subsequently topics of researches and their total number were noted at the end of each column. Each article was analysed through its title and abstract. Each article was classified according to the division, area and the topics covered. Total 1192 articles were included in the study. Data is presented in the form of numbers and percentage oftotal.

Table 1:	:	Frequency	of	articles	published
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Division	Numbers of articles	Percentage
Forensic Medicine	1047	87.83
Toxicology	145	12.16
Total	1192	100.00

Table 2: Classification of researches according to different areas of the subject

Area of research	Total Number	Percentage
Medical ethics and Law	55	04.61%
Forensic Identification	354	29.70%
Medico legal autopsy	62	05.20%
Thanatology	237	19.88%
Injuries	180	15.10%
Mechanical Asphyxia	80	06.71%
Sexual jurisprudence	43	03.60%
Forensic Science	20	01.67%
Toxicology	145	12.16%
Medical education	16	01.34%

Results

Table1 shows total number of researches according to the two major divisions of the subject.

Table 2 shows the classification of researches based on different areas of the subject. General aspects of forensic medicine i.e. ethics in medical practise, legal procedures, identification and medico legal autopsy are covered by 471 research studies. Thanatology is constituted by 237 studies with inclusion of death in its various aspects i.e. modes, manners and causes as well as changes after death. Mechanical and thermal Injuries cover 180 research articles. Rest of the areas i.e. mechanical asphyxia, gynaecological aspects, sexual offences, Infanticide, trace and impression evidences as well as Undergraduate

teaching of the subject contribute 159 research studies. Toxicology is covered by 145 research articles.







Fig. 2: Topic wise numbers of research studies (contd..)



Fig. 3: Topic wise numbers of research studies (contd..)

Topic wise distribution of research studies are portrayed in Figure 1, Figure 2 and Figure 3. The subsequent text is a further elaboration of the figures with inclusion of exact numbers of studies in parentheses after mentioning various research aspects. Knowledge, Attitude and practise (KAP) studies comprised of

studies on consent in medical practise (5), consumer protection act (CPA) (5), forensic odontology (3), medico-legal awareness (2) and video conferencing for giving evidence. Pattern of cases includes pattern of medico legal cases (22), negligence cases (6), profile of cases of "The Protection of Children from Sexual Offences Act, assault cases, consumer protection act and examination of bones. Miscellaneous studies include Right to Information act and ethics, Study of Medical Professional Liabilities, Quality of Medico-legal Reports, Role and utility of Clinical Forensic Medicine Unit, prescription writing, medical records and study on juvenile criminals.

Age estimation studies comprised of estimating age from teeth (31), pelvis (10), wrist joint (8), elbow joint (7), sternum (6), fourth rib (4), clavicle (4), femur (4), knee joint (3), skull sutures (2), hyoid bone (2), shoulder joint (2), carpal bones (2), ankle joint, tibia, mandible, hair and changes in the ovaries. Sex determination studies include sex estimation from skull dimension (9), correlation with fingerprints (8), sternum (8), teeth (8), foramen magnum (7), sacrum (5), fingers (5), skull sutures (5), foot (4), femur (4), mandible (4), orbits (3), mastoid process (3), palate (3), hyoid bone (3), pelvis (2), humerus (2), rib (2), thyroid cartilage, nail growth, quadriceps angle, clavicle, radius-ulna, hand dimension and maxillary sinus. Stature estimation covers studies to determine stature of an individual by foot dimension (19), hand dimension (13), cephalo-facial measurements (9), finger length (8), ulna (8), tibia (8), Arm span (4), inter-acromial Length (3), sternum (3), radius (3), anterior superior iliac spine (2), upper limb (2), foramen magnum, ovary, mandible, spleen length, humerus, femur, long bone x ray, thumb and femur-intertrochantor relation. Moreover, few studies are based on estimating total length of bone from its fragments by regression analysis i.e. femur (6) humerus (2) and tibia. Dactylography is studied in relation to identification (8), blood groups (6), diabetes (2), schizophrenia, cephalometry, epilepsy, anorectal malformation, overall health, dental caries, hypertension, tuberculosis, thalasemia, vitiligo, leukoplakia, oral submucous fibrosis and oral squamous cell carcinoma, sex wise ridge density and lip print. Cheiloscopy or lip print studies are based on finding uniqueness and its utility in investigation. Miscellaneous studies include palatal rugae (4), palm prints (4), cephalic index (2), lower facial-upper facial height, tattoo mark, tongue, External ear, handwriting, wormian (sutural) bones, suprascapular notch and foramen, body weight-foot print association, Foot anthropometry and stapes morphometry.

As far as medico legal autopsies are concerned, studies are found based on knowledge, attitude and practise in relation to conducting autopsies (12). Autopsy findings include studies on Atherosclerosis in coronaries (8), cardiac markers (4), general hisotopathology (3), organ weight (3), vitreous humour biochemistry (2), seroprevelence HIV-HCV-HBC (2), clinical and autopsy findings comparison (2), liver-gall bladder (2), renal, lung hisopathology, gall bladder histology, aorta atherosclerosis, pulmonary candidiasis, exhumation, hypertensive cardiac diseases and artefacts. Pattern of cases include studies based on socio demographic profiles of autopsied cases (6), Medical Certification of Causes of Death forms (2) and brought dead cases. Miscellaneous studies include body donation (2), death due to acute pancreatitis, perioperative Deaths, skull opening dissection methods, application of plastination and autopsy audit.

Homicides, suicides and accidental deaths are studied in the form of epidemiology, profile and pattern of the cases. Sudden death is studied in terms of its patterns (8), cardiac causes (6), respiratory causes (2), epilepsy and histo-pathological findings. Research studies under the heading of post-mortem changes are based upon estimating time since death from rigor mortis, algor mortis, adipocere formation, entomology and vitreous potassium (6) and vitreous ascorbic acid. Blood components include WBC and RBC morphology as well as blood levels of enzymes, MDA (Malondialdehyde) and Total Thiol in relation to time since death. Miscellaneous studies include time since death from degenerative Changes in Lungs, Muscle degeneration, cytoplasm changes of bone marrow cells, oral mucosa histology, histology of liver, CSF changes, nuclear organizer region and nail growth.

Mechanical injuries are studied according to injuries over various regions of the body, types of wounds, patterns of cases and manner of production of injuries etc. Miscellaneous studies include transportation injuries, colour of contusion, specific autopsy findings (3), documentation of injuries, study of weapons, carotid arteries injuries in accidents (2), stampede, weapons, ocular injuries etc. Thermal Injuries are studied in terms of medico legal and epidemiological aspects. Miscellaneous studies under thermal injuries include microbiology in burns, CarboxyHb levels in burns, histopathological findings (2) and immunochemistry in burns cases. Injuries due to physical agents are studied in terms of profile of cases and pattern of injuries.

General asphyxia deaths are studied in terms of profiles, pattern of injuries and autopsy findings. Hanging is studied in regards to profiles of cases (16), autopsy findings (13), pattern of ligature marks (7), Injuries to hyoid bone and thyroid cartilage (7). Strangulation is studied in relation to fracture of various cartilages (4) and histopathological findings. Drowning is studied in terms of autopsy findings (7), diatoms (6) and histopathological aspects (2). Sexual offences studies include patterns of cases, accused and victims profiles, sexual violence (2), samples examinations (3) and child sexual abuse. Under forensic science, marks were studied in regards to boot marks (5), bite marks (4) and footmarks (2). Undergraduate Teaching involves studies on undergraduate students in regards to Teaching learning aspects of the subject.

Within general toxicology, apart from trends of poisoning, studies include gastric lavage, histopathological findings, hepatic injuries (2), causes in suicidal poisoning (3) and domestic poisoning. Miscellaneous studies in specific poisoning include dextropropoxyphene, paraquet, endosulfan, substance abuse, pyrimethamine, arteether and corrosives.

Discussion

A large number of research articles are found to be based on knowledge attitude and practise, popularly known as "KAP" studies. They involve different types of population i.e. general population, medical students, clinicians etc. Moreover, trends, patterns, profiles, epidemiology also constitute the major chunk of articles among the total. As far as most repetitive researched studies are concerned, trends of poisoning (65) followed by pattern of injuries by road traffic accidents (64) have their places at the top. Overall majority of the studies are observational and very few are interventional. Clinical types of research such as randomised controlled trials, prospective cross-sectional, cohort or case–control studies can only rarely be applied in forensic medicine and instead the studies comprised of comparison and validation of methods as well as sensitivity studies.⁴

Identification of an individual is the most researched area of forensic medicine in India followed by death in terms of modes, manners and causes. As far as age estimation is concerned majority of the studies include dental parameters followed by bones. However, efforts must be made to ensure standardisation, calibration and evaluation procedures in terms of the methods used.⁵ The assumption of noticeable uniqueness that resides at the core of the fields of forensic identification is weakened by evidence of errors in proficiency testing and in actual cases.⁶ Moreover, much of the literature claiming to have proven distinctiveness in the forensic identification sciences is methodologically weak, and suffers flaws that go against the conclusion being claimed and sometimes the claim is made despite contrary data being presented.⁷

It is to be noted here that post-mortem changes are one of the least interested areas of research in comparison to its utilities in day to day autopsy work. The methods used to estimate time since death i.e. algormortis, rigor mortis, changes in the eye, putrefaction, etc are relatively crude and only an approximate time can be estimated. The biochemical methods are based on systematic pathophysiological changes without being affected by external conditions and are found to be more accurate.⁸ However, very few studies are found based on chemical changes in relation to estimating time since death. This is also supported by the fact that field studies on the reliability and precision of death time estimation by chemical means are still scarce in the literature.⁹

Female feticides, medico legal issues with pregnancy and abortions, sexual offences etc. are current affairs of attention in terms of criminality in India. However, study found very vague attention has been given to the researches incorporating all these aspects. The least researched area is the researches depicting teaching learning aspects of the subject itself. More emphasis can be given to upgrade teaching learning standards of medical education which can not only help an Indian medical graduate to be sounder towards dealing with medico legal issues but also creates interest towards the subject. To give future to legal medicine as an academic discipline, research must be given priority over routine casework.¹⁰

The meta-analytic approach is one of the most informative methods to organize and coalesce the findings of different studies.¹¹ Future scope must include forming various metaanalysis based on different areas of research studies that are published numerous times and in multiple ways. The major benefit which can be foreseen is generating standards that are more appropriately applicable to the legal aspects of forensic medicine in dealing with local problems.

Limitations of the study

Only Indian journals with the scope of publishing research articles of forensic medicine and toxicology are included in the study. All those articles which are published other than these journals do not constitute as the study material. The task of including all the Indian journals was next to impossible as there are plenty of them. Moreover, flood of predatory and substandard journals made the identification of the standard journals difficult.¹² Hence, chances are there about some valued researches of the subject that are published in the journals other than the journals included in the study may remain excluded.

Conclusion

More emphasis should be given to researches based on current medico legal issues of the community. Focus in regards to researches in this field should be altered in a way to minimise repetition of similar types of researches, rather repetition should be aimed at creating novelty on particular aspect instead of giving attention to what is already there in literature. Metaanalysis should be incorporated to coalesce the findings of researches. Furthermore, standards should be developed by means of researches which can be suitably applied on local population to minimise chances of influence created by affecting factors such as environment, ethnicity etc.

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An autopsy study of deaths due to hanging with emphasis on ligature material and periligature injuries

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Abstract

Hanging is that form of asphyxia, which is caused by the suspension of the body by a ligature, which encircles the neck, the constricting force being the weight of the body. Noose marks on the neck do not necessarily mean that an individual was alive when he was hanged. Hence, it becomes necessary for a forensic pathologist to differentiate between actual suicidal hanging and simulated hanging. Dried salivary stains due to dribbling of saliva from the angle of mouth and periligature injuries are two sure signs of antemortem hanging. Many researchers have conducted studies on ligature marks in hanging; however, very few studies have been undertaken on ligature material, periligature injuries, and the co-relation between them. Hence, this research work was carried to emphasize the importance of studying ligature material and periligature injuries, which are of vital importance in determining the antemortem nature of hanging. In the present prospective study, a total of 116 cases of deaths due to alleged hanging were studied. We observed that in most of the cases, the ligature mark was incomplete, above the level of the thyroid cartilage, and obliquely placed. Men most commonly used nylon rope to hang themselves, whereas women most commonly used odhani to commit suicide by hanging. Dried salivary stains indicating dribbling of saliva from the angle of mouth were observed in 11.2% cases. Periligature injuries were found in 10.34% in the form of abrasions with hemorrhages in 75% of cases and blisters in 25% cases. They were most commonly seen when hard ligature material was used.

Keywords

Antemortem hanging; Periligature injuries; Ligature material

Introduction

Hanging is that form of asphyxia, which is caused by the suspension of the body by a ligature which encircles the neck, the constricting force being the weight of the body.¹Virtually, all hangings are suicidal. Accidental hangings are uncommon, and homicidal hangings very rare.² However, in many cases of hanging, there are doubts expressed by the relatives or investigating authorities about the manner of death in hanging and as to whether the hanging is actual or simulated one. Ligature mark over the neck is the most critical and specific sign of death from hanging, which depends upon the composition of ligature. However, Casper JL concluded that the noose marks seen on the neck in hanging during life could be produced by a ligature applied to the neck within 2 hours after death.³ Thus, noose marks on the neck do not necessarily mean that an individual was alive when he was hanged. Hence, it becomes necessary for a forensic pathologist to differentiate between true suicidal hanging and simulated hanging. Blisters containing serum and abrasions with hemorrhages at ligature mark are strongly suggestive of suspension taking place during life.¹ These injuries are called as periligature injuries. Dried salivary stains due to dribbling of saliva from the angle of mouth and

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Received: 29th May, 2019; Revision received on: 21st November, 2019 Accepted: 7th December, 2019 periligature injuries are two reliable signs of antemortem hanging. However, wiping out of the salivary stains by relatives or doctors in the attempt of resuscitation causes loss of this important sign of antemortem hanging. Many researchers have conducted studies on ligature mark in hanging; however, very few studies have been undertaken on ligature material, periligature injuries, and the co-relation between them. Hence, this research work was carried to emphasize the importance of studying ligature material and periligature injuries, which are vital evidence of antemortem hanging.

Materials and Methods

The present prospective study was carried out at the Department of Forensic Medicine and Toxicology, from September 2015 to March 2017. A total of 116 cases of deaths due to alleged hanging were studied out of 1974 autopsies conducted during the study period.

The details about the victims regarding the age, sex, circumstances of death, type of ligature material, manner and supposed cause of death were obtained from inquest papers and police documents; history given by the relatives, crime scene investigation reports and crime scene photographs. The crime scene was also examined in a few cases. The ligature mark was meticulously examined. The bodies were dissected by Robert Virchow's Technique. Neck was opened in the last by giving "V" shaped incision from the mastoid process and carrying it along the lateral aspect of the neck up to the manubrium and then reflecting the flap of the neck skin. Internal findings of the neck were described by layer by layer dissection of the neck. Meticulous examination of ligature material, whenever available, was done.

Results

Total 1974 autopsies were performed from September 2015 to March 2017, out of which 116 cases (5.74%) of hanging were studied in detail during the present study. The most common age group involved in deaths due to hanging in both males and females is 21-30 years (Table 1). We observed that most of the cases 111 (95.68%) were of complete hanging, whereas only 5 cases were of partial hanging. Most of the males (89.47%) and all the females hanged themselves inside the home. Three males hanged themselves at their workplace, 3 hanged themselves at the hospital as they were suffering from long-term illnesses, and 2 hanged themselves in the farm (Table 2).

 Table 1: Distribution of cases according to age and sex

Age (years)	Male	Female	Total
<20	09	10	19 (16.37%)
21-30	25	21	46 (39.65%)
31-40	20	05	25 (21.55%)
41-50	08	03	11 (9.48%)
51-60	09	00	09 (7.75%)
61-70	03	01	04 (3.44%)
71-80	02	00	02(1.72%)
Total	76	40	116 (100%)

Table 2: Distribution of cases according to place of hanging

Place of hanging	Males	%	Females	%	Total	%
Inside home	68	89.47	40	100	108	93.1
At workplace	03	3.94			03	2.58
At hospital	03	3.94			03	2.58
In farm	02	2.63			02	1.72
Total	76	100	40	100	116	100

Ligature mark was incomplete (85.34%), above the level of thyroid cartilage (87.06%), and obliquely placed (93.10%) in most of the cases. However, in some instances, it was complete (14.65%), below the level of thyroid cartilage (1.72%) and horizontal (6.89%) (Table3). The nature of ligature material used for committing suicide by hanging was revealed in 105 cases, whereas in 11 cases, the nature of ligature material could not be determined. It is evident from Table 4 that odhani was the most common ligature material used (29.52%) followed closely by nylon rope (27.61%). Men most commonly used nylon rope (33.33%) closely followed by coir (27.53%) to hang themselves, whereas women most commonly used odhani (55.55%) to commit suicide by hanging. We also found a case where hospital bandage was used as ligature material for hanging; the person hanged himself because of long-term illness.

 Table 3: Distribution of cases according to particulars of ligature mark

Particulars of Ligature mark	N	%
Туре		
Complete	17	14.65
Incomplete	99	85.34
Level		
Above the level of thyroid cartilage	101	87.06
At the level of thyroid cartilage	13	11.20
Below the level of thyroid cartilage	02	1.72
Direction		
Oblique	108	93.10
Horizontal	08	6.89
Depth		
Deep	57	73.27
Shallow	59	50.86

Table 4: Distribution of cases according to ligature materials used

Ligature material	Male	%	Female	%	Total	%
Hard material						
Nylon rope	23	33.33	06	16.66	29	27.61
Coir	19	27.53	02	5.55	21	20
Electric wire	04	5.79	01	2.77	05	4.76
Soft material						
Saree	05	7.24	05	13.88	10	9.52
Scarf	01	1.44	00	00	01	0.95
Bedsheet & curtains/ turban cloth	05	7.24	02	5.55	07	6.66
Hospital Bandage	01	1.44	00	00	01	0.95
Odhani	11	15.94	20	55.55	31	29.52
Total	69		36		105	

Table 5: Findings on external examination other than ligature mark

External Findings	Ν	%
Marks of dribbling of saliva	13	11.20
Bleeding from mouth and nostrils	06	5.17
Facial congestion	03	2.58
Discharge of urine and faeces	05	4.31
Seminal purging	15	12.93

Dribbling of saliva from the angle of mouth was observed in 13 cases, whereas bleeding from mouth and nostrils was noted in 6 cases (Table 5). Periligature injuries were found in 12 cases in the form of abrasions with hemorrhages (Fig. 1A) in 9 cases and blisters in 3 cases (Fig. 1B). Out of these 12 cases, in 9 instances, hard ligature material like nylon or coir was used, and soft ligature material like odhani was used in only 3 cases. It suggests that periligature injuries are more common when hard ligature material is used (Table 6). Even after meticulous neck dissection, we did not find injury to the sternocleidomastoid muscle, fracture of the thyroid cartilage, and fracture of the hyoid bone in any case.

Table 6: Distribution of cases according to periligature injuries (n=12)

Periligature injuries	Ν	%
Abrasions with haemorrhages	09	75
Blisters	03	25
Total	12	100



Fig. 1: Periligature injuries (indicated by arrows) A- Abrasion with haemorrhages; B- Blisters

Discussion

Total 1974 autopsies were performed from September 2015 to March 2017, out of which 116 cases (5.74%) of hanging were studied in detail during the present study. Ambade et al. (4.1%),⁴ Patel et al. (4.65%),⁵ Rao (3.31%),⁶ and Saiyed et al. (3.29%)⁷ reported slightly lesser percentage of deaths due to hanging than the present study.

The most common age group involved is 21-30 years (39.65%), followed by 31-40 years (21.55%). Similar to the present study, Ambadeet al.,⁴ Patel et al.,⁵ Najanet al.,⁸ and Saiyed et al.⁷ reported 21-30 years as the most common age group committing suicide by hanging. In contrast, Rao⁶ observed that most of the persons committing suicide by hanging belonged to 31-40 years. Male preponderance peaking up in 21-30 years was observed by Ambade et al.⁴ and Patel et al.⁵, which is consistent with the present study, while Rao⁶ observed male preponderance peaking up in 31-40 years. Most of the victims in the present study were from the urban area, as this study was carried out in a metropolitan city.

We observed that complete hanging (95.68%) predominated partial hanging (4.31%). This finding is consistent with

observations of Ambade et al.,⁴ Patel et al. ⁵ and Rao ⁶ who reported 67.7%, 98.75%, and 88% of complete hanging cases, respectively. However, contrary to the observation of the present study, Dean et al.⁹ reported partial suspensions in most (83.41%) of the cases of hanging.

In the present study, home was the most common place (89.47%) of hanging for males followed by workplace (3.94%), hospital (3.94%) and farm (2.63%). All females committed suicide by hanging themselves at home. Thus, the home was the most common place preferred by victims to commit suicide by hanging. This is probably due to the secluded environment and easy availability of different ligature material available at home for ligation. Similarly, Ambade et al.,⁴Ahmad et al.,¹⁰Uzunet al.¹¹ and Vijayakumari¹² reported that 63.8%,97%,83.31% and 92.3% victims committed suicide inside home, respectively and it was the most common place for committing suicide.

It was observed that the ligature mark was incomplete (85.34%), above the level of thyroid cartilage (87.06%), and obliquely placed (93.10%) in most of the cases. Findings of the present study are consistent with that of Rao D⁶, who reported that in most of the cases ligature mark was incomplete (80.68%), obliquely placed (87.88%), and above the level of thyroid cartilage (82.58%).

In the present study, odhani was the most common ligature material used (29.52%) followed closely by nylon rope (27.61%). Men most commonly used nylon rope (33.33%) closely followed by coir (27.53%) to hang themselves, whereas women most commonly used odhani (55.55%) to commit suicide by hanging. Ambade et al.¹³ observed that nylon rope was the most common ligature material used (63%), followed by odhani(10.2%). According to them, nylon rope was the most common ligature material (67.3%) used by males, and odhani (45%) was most commonly used for ligation by females. Tumram et al.¹⁴ also observed that nylon rope was the most commonly used ligature material (32.5%), followed by odhani (22.5%). Thus, the finding of the present study that nylon rope and odhani are the most commonly used ligature materials in India is consistent with that of Ambade et al.¹³ and Tumram et al.¹⁴ This may be due to easy availability of these materials in the household.

Dried salivary stains caused by the dribbling of saliva from the angle of the mouth, which is an essential sign of antemortem hanging, was observed in 11.2% cases. It was observed by Ambade et al.⁴ and Saiyed et al.⁷ in 11.8% and 29.73% cases, respectively. Reasons for low reporting of this important sign of antemortem hanging may either be wiping out of the stains by relatives or doctors in an attempt of resuscitation or examining the body after it has been kept in cold storage overnight.

Another important signs of antemortem hanging are periligature injuries. Constriction of the neck by noose sometimes causes pinching of the skin and vertical folds, which rub against the noose and become abraded. Blisters containing serum may result from friction of the tight noose.¹⁵Ecchymoses alone has no significance as to whether hanging was caused during life or not, but abrasions with hemorrhages are strongly suggestive of antemortem hanging.¹ We observed periligature injuries in 10.34% of cases (n=12). These were in the form of abrasions with hemorrhages in 75% of cases and blisters in 25% cases. Tumram et al.¹⁴ observed periligature injuries in 17.5% cases out of which blisters constituted 28.5%, ecchymoses 50%, and abrasions 57.1%. When periligature injuries are correlated with ligature material used, it was found that they were most commonly seen when hard ligature materials like nylon rope and coir were used (n=9) and less commonly when soft ligature materials like odhani were used. Findings of the present study are consistent with that of Tumram et al.¹⁴, who observed that abrasion is the most common periligature injury, and periligature injuries are most common when rough and tough ligature material is used.

Conclusion

Meticulous examination of ligature material, ligature mark over neck and internal structures of neck along with circumstantial evidence immensely helped the authors to confirm the cause of death in cases of suspected hanging. Periligature injuries produced by hard ligature material further assisted the authors in determining antemortem nature of hanging and excluding the possibility of foul play.

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Asphyxial deaths: A study from Delhi, India

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Abstract

Violent asphyxia is a commonly reported mode of death. However, it is not a single entity and the objective of this study is to figure out the commonest form amongst them and to study the factors favouring that means. For this, the details about all the violent asphyxial deaths autopsied between 2006 and 2010, was collected from the department of Forensic Medicine and Toxicology, Lady Hardinge Medical College, New Delhi. During the study period167 (6.02%) deaths were reported due to violent asphyxia (5.77/100000 per year) out of a total of 2773 medico-legal autopsies conducted. The most common method amongst them was hanging (77.24%), followed by drowning (9.58%) and strangulation (5.98%). Violent asphyxia contributed in 6.02% of total medico-legal autopsy cases. The hanging was found as the most favourite means amongst them.

Keywords

Violent Asphyxia; Hanging; Medicolegal autopsy

Introduction

The accidents, suicides and homicides are common manner of unnatural death. In many of these cases some mechanical force is involved interfering with the process of respiration making it as a violent form of asphyxia and responsible for large number of deaths among them. Adelson defined asphyxia as "the physiological and chemical state in a living organism in which acute lack of oxygen available for cell metabolism is associated with inability to eliminate excess of carbon dioxide.¹There may be many forms of violent asphyxia such as Hanging, Drowning, Strangulation, Suffocation and Traumatic asphyxia etc.²

Materials and Methods

In this five years (from 1st January 2006 to 31st December 2010) retrospective study, the data related to a total of 167 (6.02%) cases with deaths due to any form of violent asphyxia autopsied in the Department of Forensic Medicine & Toxicology, Lady Hardinge Medical College, New Delhi, has been collected and analysed to find out the most common form amongst them along with various associated factors responsible for it.

Results

During the study period, a total of 2773 autopsies were conducted in the department and some form of violent asphyxia was found as cause of death in 167 (6.02%) cases. The maximum 66 (39.52%) cases were in age group of 21-30 years followed by 31 cases (18.56%) in age group of 31-40 years and

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Received: 18th July, 2019; Revision received on: 20th December, 2019 Accepted: 30th December, 2019 10 (5.98%) cases each in two extreme age group i.e. 0-10 and more than 50 years.

The males outnumbered the females and contributed 124 (74.25%) cases. The gender ratio was 2.88:1. The distribution of different forms of violent asphyxial deaths is shown in Table 1. Hanging amounted to the maximum number of violent asphyxial deaths (129 cases, 77.24%) followed by drowning (16 cases, 9.58%). In deaths due to hanging, male cases 96 (74.41%) outnumbered the female 33 cases (25.58%) (Table1). The gender ratio in hanging was 2.9:1 and was slightly higher than all other forms of asphyxia cases.

Cause	Males (%)	Females (%)	Total (%)
Hanging	96 (74.42%)	33 (25.58%)	129 (100%)
Strangulation	4 (40%)	6 (60%)	10 (110%)
Traumatic asphyxia	7 (77.78%)	2 (22.22%)	9 (100%)
Suffocation	3 (100%)	0 (0%)	3 (100%)
Drowning	14 (87.5%)	2 (12.5%)	16 (100%)
Total	124 (74.25%)	43 (25.74%)	167 (100%)

Table 1: Distribution of different form of violent asphyxia cases

Most of the cases (45.71%) were reported between June to September and 28.68% (Fig.1) and during morning hours between 10 am to 2 pm(29.46%) followed by 6 am to 10 am (28.68%) while the lowest incidence of hanging cases have been reported between March to May and 2 am to 6 am (3.88%) followed by 10 pm to 2 am (8.53%) (Fig. 2).

In hanging, eyes remained open in 67 (51.93%) cases, protrusion of tongue was seen in 56 (43.41%) cases, dribbling of saliva at angle of mouth (33 cases, 25.58%), discharge of semen at glans in 7.75% and fracture of hyoid was observed in 4.65% cases.



Figure 2: Distribution of hanging cases as per the reported time of incidence

Discussion

In the present study, the prevalence of violent asphyxia was 6.02% of all the cases while it was reported as 5.26% by Amandeep et al³, 3.9% by Gargi et al.⁴ and 23.69% by Ambade et al.⁵ The most common form of asphyxial death was hanging (129 cases, 77.24%), followed by drowning (16 cases, 9.58%) in contrast to Amandeep et al.³ where drowning was reported as the commonest (59.4%) form followed by hanging in 24.3% cases, whereas Gargi et al.⁴ found the prevalence of hanging as 20.7% amongst the cases studied. Prajapati et al.⁶ found a proportion of males to be 73% in all such type of deaths and the majority of the victims in the age group of 21 to 40 years. 68.4% of the persons committed suicide using hanging as a preferred option.

The maximum 66 cases (39.52%) of asphyxial deaths were in age group 21-30 years followed by (31 cases, 18.56%) in 31-40 years' age, quite similar to other studies ^{34,7} and the persons (59.24%) between 15-25 years of age group preferred hanging as a means for ending their lives. The males contributed for a total of 124 (74.25%) cases. Hanging and drowning were reported as first and second common form of methods used for committing suicide while in females as poisoning and fire¹ were more common means. The male to female ratio in drowning is 3.12:1 and in hanging this ratio was 1.45:1 in study by Amandeep et al.³

Azmak et al.8, reported 15.7% cases of deaths due to violent

asphyxia in contrast to 6% cases in the present study and also found 20.8% cases in the age group of 30-39 years, while it was 39.52% in the age group of 21-30 years, similar to a study by Ambade et al.⁵. The most common form of violent asphyxia was hanging (77.24%), followed by drowning (9.58%), in accordance with a study by Azmak et al.⁸ where hanging (41.8%) and drowning (30.5%) were found as first and second most common means of violent asphyxia. Ambade et al.⁵ also reported the similar trends.

In the present study fracture of hyoid bone was seen in 61% of hanging cases whereas Prajapati et al.⁶ found it only in 0.93% cases while it was reported in 40% cases of strangulation in contrast to Di Maio et al.⁹ in 12.5% cases and Verma et al.¹⁰ in 80% cases and 26% cases in the study by Luke et al.¹¹

The different reasons behind the high prevalence of hanging may be that it is a simple method to execute, need no special tools except a rope or its alternative which is easily available and a suspension point within the limit/ reach. Other reasons may be that it is less painful and bring about a rapid death and does not deform the body after death. Also no specific planning or technical knowledge is required for its execution. Further research and psychiatric evaluation is required to find out the factors responsible for its favouring nature in younger population (21-30 years), during certain months and that too between 6 AM-2 PM.

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Analysis of suicidal asphyxial deaths in Kota, the coaching city of India

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Abstract

Analysis of suicidal deaths in an area reflects the socioeconomic and mental health status of the population, which inherits medicolegal implications. Suicidal asphyxiation is one of the common methods of committing suicide. The study included 372 (11.5%) cases of suicidal asphyxiation in Kota city. Hanging and drowning were reported as common methods to commit suicides. The most commonly affected age group was 21 years to 30 years, which contributed to about 35.4% of total suicidal asphyxial deaths. Males were more commonly involved (79%). Educational stress was the main reason to commit suicide, and included 107 cases contributing to 29% of the total asphyxial suicidal deaths.

Keywords

Hanging; Drowning; Suicide; Death

Introduction

According to Durham, the French scientist, suicide is death resulting directly or indirectly from a positive or negative act of the person himself, which he or she knows will produce this result.¹ Suicide has become a severe public health problem globally, contributing around 9 lakh deaths every year, including about 1.7 lakhs in India.² Methods of suicide in a region depend upon many factors which are mainly categorized in physical and chemical methods. Hanging and drowning are the physical methods of suicide; self-poisoning is the most common method to commit suicide by chemical means.³ Among suicidal asphyxiation, hanging and drowning remain the most common method to commit suicide. The purpose of the present study was to analyze the suicidal deaths due to asphyxia and to draw the attention of the policymakers to devise measures for prevention of such casualties.

Materials and Methods

The present study was conducted on the deceased brought for postmortem examination at the mortuary of MBS Hospital and Govt. Medical College Kota during the period of January 2015 to December 2017 with the alleged history of suicides as a result of hanging and drowning. Data regarding the manner of death was collected from relatives, police, and law authorities. Only confirmed cases of suicides from hanging and drowning were included in the study.

Results

A total of 3217 medico-legal autopsies were conducted during the study period, out of which 372 (11.5%) deaths were suicidal

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Received: 23rd July, 2019; Revision received on: 2nd December, 2019 Accepted: 31st December, 2019 deaths as a result of asphyxia. Maximum number of suicidal asphyxial deaths were seen during 2015 (12.5%), followed by the year 2017 (11.3%) and 10.8% in 2016 as shown in Table 1.

Table 1: Year wise distribution of suicidal asphyxial deaths

Year	Total autopsies	Suicidal asphyxial deaths
2015	1075	135 (12.5%)
2016	1172	127 (10.8%)
2017	970	110 (11.3%)
Total	3217	372 (11.5%)

Males comprised of 292 cases (79%), and females comprised of 80 cases (21%). This study included 298 deaths as a result of hanging and 74 deaths as a result of drowning (Table 2).

Table 2: Distribution	of suicidal a	asphyxial deaths
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Cause of Death	Male	Female	Total
Hanging	228	70	298
Drowning	64	10	74
Total	292	80	372

Table 3: Age wise distribution of deaths due to hang	ging
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	0		00		
Age	2015	2016	2017	Total	
0-10	00	00	00	00	
11-20	26	23	20	69	
21-30	38	41	23	102	
31-40	20	21	36	77	
41-50	09	15	09	33	
51-60	04	02	02	08	
61-70	01	04	04	09	
Total	98	106	94	298	

Most of the victims of suicidal asphyxiation were in the age group of 21- 30 years (n=132) which was followed by the age 31- 40 years (n=92) as shown in Table 3 and 4.

Hanging (n=298) was the most common method of suicidal asphyxiation in the study population followed by drowning (74), 171 out of 298 hanging deaths, and 43 out of 74 drowning deaths occurred in the age group 11-30 years. The present study shows that educational stress was the main reason to commit suicide in 107 cases out of 372 cases accounting for 29% of the suicidal asphyxia deaths, followed by financial and family problems (Table 5).

Age	2015	2016	2017	Total
0-10	00	00	00	00
11-20	05	04	04	13
21-30	17	08	05	30
31-40	08	04	03	15
41-50	03	02	02	07
51-60	03	01	01	05
61-70	01	02	01	04
Total	37	21	16	74

Table 4: Age wise distribution of deaths due to drowning

 Table 5: Reasons reported for suicidal asphyxial deaths (N=372)

Reason	Ν	Reason	N
1-Educational stress	107	6-Marital disputes	16
2-Financial problems	75	7-Psychological problem	12
3-Family problems	70	8-Dowry	10
4-Unemployment	48	9-Grief	04
5-Love affairs	24	10-Unknown	06

Discussion

Unnatural death is one of the indicator levels of social and mental health in a country.4 Total 3217 autopsies were conducted out of which 298 deaths were hanging, constituting of 9.2% of the total autopsies. This observation is inconsistent with other studies from India. As per Rathod et al.,⁴ and Sharma et al.⁵ reported 5.4 % and 3.8 % of total deaths due to hanging respectively. Our study shows that most of the suicide victims were males and belonged to 3rd and 4th decade of life, which is similar to findings reported in earlier studies.^{4, 6-9} This is quite explainable by the pattern of Indian societies where the males of age group 21 to 40 years are active members and have maximum life stress of study, job, social pressure, and love affairs. Hanging and drowning were the most commonly employed methods of suicidal asphyxiation, probably because of the readily available ligature material and water bodies. City of Kota is situated at the bank of Chambal River, which is having canals, and big ponds made it more convenient for suicidal deaths.

In Kota city, suicidal deaths among tender ages is more because it is a coaching city where stress of studies, loneliness, parental pressure, and emotional weakness are the most probable predisposing factors for suicide among the youth. Burden to earn money, unemployment, failure in love issues, study and emotional instability may be the possible reasons for more involvement of this age group. In our study 107 cases had committed the act of suicide due to educational stress, which was not consistent with other studies. Gopal et al. observed that financial problem was the main reason to commit suicide¹⁰. In Kota city, students from all over India come and stay for preparation of competitive medical and engineering entrance examinations. The coaching students are mostly aged between 17 to 25 years, and they are the ones who frequently encounter stress due to education related issues as they are burdened with family expectations and pressure to perform well in competitions.

Conclusion

The study reports young males as the most vulnerable population. The study points at the frustration of the younger population and family and societal pressure they have to deal with. The suggestions of this study to prioritized suicide prevention by raising awareness of suicide as a public health issue. Suicides are preventable, and so an integrated multi-sectorial suicidal strategy is needed. Suicide amongst coaching students may be prevented by proper counselling and positive communications between students and their parents.

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Estimation of age based on dental developmental stages – Exploring the population specific models

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Abstract

Demirjian's method of dental age estimation is widely used for age estimation in children and adolescents. However, it's applicability in population groups other than French Canadians still remains questionable. Vastly prevalent, cultural and ethnic variations in India warrant development of population specific regression models in India. Hence, the present research is planned to develop the regression models for population groups residing in South eastern region of India. The present study was conducted on the orthopantamographs of 336 individuals (160 males and 176 females) in the age group ranging between 7 and 25 years that comprised of study group (N=336) and control group (N=36). The mandibular left permanent teeth including third molar were scored according to the ten stage scoring criteria, maturity score was calculated using gender specific weighed scores. The regression models were developed using chronologic age as dependent variable and maturity score as independent variable for males, females and total study groups. The regression models were tested for accuracy based on the mean absolute error and for reliability by calculating the percentage misclassifies using 99% of confidence intervals. The study observations, suggest that the quadratic regression models developed in the present study can be used for forensic as well as clinical age estimation with accurate and reliable results.

Key words

Forensic science; Forensic odontology; Dental age estimation; Quadratic regression models.

Introduction

Age assessment is one of the major challenges faced by the forensic experts.¹ The age estimation is usually based on the development of secondary sexual characters and degree of skeletal and dental maturation.² Dental age estimation is considered more reliable than the others as dental development is largely controlled genetically and is less influenced by exogenous influences.3 The most frequently used dental age estimation methods are based on the radiographic analysis of dental developmental stages in form of calcification.⁴ One of the widely employed methods of dental age assessment in this regard was the Demirjian's method. Though, the Demirjian's method of dental age assessment was widely used, studies have shown a significant overestimation in age assessment, when applied in population groups other than French Canadians.^{5,6} This led to the modification of original Demirjian's method in several ways such as by exclusion of the maturity score and inclusion of third molars, modifications in the scoring criteria of developmental stages etc.⁷⁻⁹

Chaillet and Demirjian modified the original Demirijian's method by inclusion of third molars and derived regression

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Received: 13th April, 2019; Revision received on: 28th May, 2019 Accepted: 11th June, 2019 models for age estimation.⁹ The inclusion of third molars in calculating the maturity score is advantageous for it can help in the estimation of dental age even up to 16 to 23 years.¹⁰ Several researchers further tested the reliability of these models in different population groups.^{11,12} Owing to population variations, it is suggested that population-specific regression models are derived for increased reliability and accuracy in age estimation.¹¹⁻¹⁴ Considering the fact that diverse ethnic groups reside in India,¹⁵ there is a need to derive population specific regression models for age estimation. The present research is hence, carried out to derive population specific regression models for estimation of dental age based on radiographic analysis in the south-eastern part of India.

Materials and Methods

The present research was conducted at a dental college, and Hospital, in Visakhapatnam, Andhra Pradesh, India. The orthopantamographs (OPGs) along with dental records were retrieved from the Department of Pedodontics and Preventive Dentistry that included the information on the date of birth and date when the OPG was taken. The OPGs included in the present investigation belonged of 300 individuals (150 males and 150 females) aged between 7 and 25 years. The distribution of study group by age and gender is shown in Table 1. Only the good quality OPGs within formation on the date of birth were included in the study. Individuals with any history of medical or surgical deformity affecting the left mandibular teeth visualization, known systemic diseases, consanguineous anomalies, hypodontia of teeth, and premature birth histories were excluded from the study.

Table 1: Age and sex	distribution	of study	sample
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Age	<11	11	12	13	14	15	16	17	18	10	20	21	>22	Total
(years)	~11	11	14	15	17	15	10	1/	10	1)	20	41	- 22	Total
Males	8	11	12	12	13	12	13	12	12	11	10	10	14	150
Females	13	11	11	10	13	11	16	12	17	10	9	8	9	150
Total	21	22	23	22	26	23	29	24	29	21	19	18	23	300

Radiographs were evaluated under the OPG viewer in a dark room, and calcification stages were given using the formational stages described by the modified Demirjian's scoring criteria comprising of the 10 stage scale (0 – 9 stages), and maturity score for each OPG was calculated using the standard tables given by Chaillet et al.⁹

The inter-observer variability was evaluated on the first 100 OPGs and intra-observer variability was assessed in 50 randomly selected OPGs that were re-examined by the same observer two months after the first examination. Wilcoxon matched pair signed ranks did not reveal any significant difference between inter and intra-observer rating for developmental stages of tooth. No interobserver and intra-observer variability was evident and hence, the scoring was done by a single observer who had no information on the age and sex of the OPGs included in the study. Chronologic age of each individual was calculated by subtracting the date of birth from the date on which OPG was taken.

The gender specific regression models were derived for males and females. A regression model was also derived for the total sample that was independent of the sex of the participants. The regression models thus, derived in the study population were evaluated for their accuracy and reliability using a control group of 36 individuals (10 males and 26 females) belonging to the same population. The control group was randomly selected, and comprised of individuals aged between 7 and 25 years who visited the dental OPDs in the months following the derivation of regression models.

Statistical analysis

Inter and intra observer variability was evaluated by using Wilcoxon matched pair signed ranks test. Quadratic regression models were derived for estimation of age from dental developmental stages by taking chronologic age as dependent variable and maturity score as independent variable. For calibrating the accuracy of regression models, Mean error (ME) was calculated to quantify the direction of error (under estimation or over estimation); Mean absolute error (MAE) was calculated to quantify the magnitude of error; and Root mean square error (RMSE) was calculated to quantify the variance in errors (larger the value higher the variance of error). The reliability of estimation is evaluated by calculating the percentage of individuals whose real age isn't with in the 99% confidence interval. All the statistical analysis were performed using the SPSS software (version 16.0), and p-value < 0.05 was considered as statistically significant.

Results

Descriptive statistics for chronologic age and maturity scores in the present investigation are shown in Table 2. The mean chronologic age and maturity scores were observed to be relatively lower among females than males. However, the sex differences were not found to statistically significant for chronological age (p=0.93) and maturity score (p=0.181). A statistically significant correlation was observed between the chronologic age and maturity score in males (R=0.86), females (R=0.88) and the total study group (R=0.87). Quadratic regression analysis revealed high values for coefficient of determination (R^2) among males ($R^2 = 0.75$), Females ($R^2 = 0.78$), and the total participants ($R^2 = 0.76$). The regression models developed for males, females and total study group in the present study are shown in the Table 3. Standard error of estimate observed in these models was 1.78 years for males, 1.67 years for females and 1.74 for the total study group.

Table 2: Descriptive statistics of chronologic age and maturity score for study sample

	Chro	nologic age	Maturity score				
	Range	Mean ± SD	Range	Mean ± SD			
Males (N=150)	10.1-25.1	16.68 ± 3.57	54.54-100	91.30 ± 9.92			
Females (N=150)	8.1-25.6	15.98 ± 3.59	50.52-100	89.79 ± 9.57			
Total (N=300)	8.1-25.6	16.33 ± 3.59	50.52-100	90.54 ± 9.76			

Table 3: Quadratic regression models derived in the present research

	Quadratic regression model	R	\mathbf{R}^2	SEE
Males (N=150)	66.392-1.556 (MS) + 0.011 (MS) ²	0.868	0.75	1.78
Females (N=150)	$42.516-1.029 (MS) + 0.008 (MS)^2$	0.886	0.78	1.67
Total (N=300)	$54.227-1.287 (MS) + 0.009 (MS)^2$	0.875	0.76	1.74

MS - Maturity Score; R - Correlation coefficient; R2 - Coefficient of determination; SEE - Standard Error of Estimate

Quadratic regression models overestimated the dental age for males and underestimated the dental age for females by 0.41 years and 0.64 years respectively. The observed MAE between the chronologic and estimated dental age with regression models were 1.51 and 1.38 in males and females respectively. For the total participants, regression model shows an underestimation of dental age by 4.0 years with MAE of 4.02 years in the present study group (Table 4).

 Table 4: Estimation of age (years) based on the quadratic models derived

in the present research							
	CA (M ± SD)	EA (M ± SD)	MD (EA - CA)	MAE	RMSE	Number of Misclassifies (99% CI)	
Males (N=150)	16.68 ± 3.57	$\begin{array}{c} 17.09 \pm \\ 3.17 \end{array}$	0.41	1.51	1.81	0.37	
Females (N=150)	$\begin{array}{r} 15.98 \pm \\ 3.59 \end{array}$	$\begin{array}{r}15.34\pm\\3.06\end{array}$	-0.64	1.38	1.78	0.35	
Total (N=300)	16.33 ± 3.59	12.33 ± 2.40	-4.0	4.02	4.42	0.28	

CA - Chronologic age; M - Mean; SD - Standard Deviation; EA - Estimated age; MD - Mean difference; MAE - Mean absolute error; RMSE - Root mean square error

Distribution of participants in the control group according to their age and sex are shown in the Table 5, and the descriptive statistics for the maturity score and chronologic age are presented in Table 6. When the quadratic regression models derived in the present study when applied on the control group, an overestimation of dental age in males (1.06 years) and under estimation of dental age in females (0.49 years) was observed. The magnitude of error (MAE) observed by the quadratic regression models in the control group were 1.63 for males and 1.51 for females. In the study group irrespective of the sex, the regression models showed an underestimation of dental age by 3.55 years with MAE of 3.57 years in the control group (Table 7).

Table 5: Age and sex distribution of control samples

Age (years)	<11	11	12	13	14	15	16	17	18	19	20	21	>22	Total
Males	0	0	1	4	1	0	0	4	0	0	0	0	0	10
Females	0	2	7	3	5	0	2	3	2	0	0	0	2	26
Total	0	2	8	7	6	0	2	7	2	0	0	0	2	36

Table 6: Descriptive statistics for chronologic age and maturity scores in control sample

	Chrono	logic age	Maturity score		
	Range	Mean ± SD	Range	Mean ± SD	
Males (N=10)	12.1 - 17.8	13.74 ± 2.23	79.17 - 98.34	91.12 ± 5.92	
Females (N=26)	11.2 - 25.1	15.01 ± 3.39	76.89 - 97.8	88.31 ± 7.96	
Total (N=36)	11.2 - 25.1	15.04 ± 3.08	76.89 - 98.34	89.09 ± 7.48	

Application of the derived quadratic regression models in the total control group showed a lesser number of misclassifies (0.91) when compared to male (1.8) and female controls (1.2). The observed variance of error (RMSE) in the total control group (4.07) however, is more than that observed in the male (2.03) and female (2.22) controls (Table 7).

 Table 7: Estimation of age (years) for control sample based on the quadratic models derived in the present research

	CA (Mean±SD)	EA (Mean±SD)	MD	MAE	RSME	Number of Misclassifies (99% CI)
Males (N=10)	13.74±2.23	14.80±2.23	1.06	1.63	2.03	1.8
Females (N=26)	15.01±3.39	14.52±3.01	-0.49	1.59	2.22	1.2
Total (N=36)	15.04±3.08	11.49±2.24	-3.55	3.57	4.07	0.91

CA - Chronologic age; SD - Standard Deviation; EA - Estimated age; MD - Mean difference; MAE - Mean absolute error; RMSE - Root mean square error; CI - Confidence Interval

Discussion

Radiographic analysis of tooth development is one of the reliable methods of dental age estimation in Forensic investigations.¹⁰ The people of India exhibit different social, cultural, linguistic and ethnic diversity,¹⁵ which further emphasizes on the need to derive regression models specific for

population groups in different regions of India. Hence, in the present research, regression models were developed for individuals residing in the South Eastern region of India who specifically belongs to the Australoid/ Dravidian ethnicity.¹⁶

In the present study, quadratic and cubic functions were derived for establishing the correlation between are and dental development, and it was observed that regression models for dental age estimation gave better coefficient of determination (\mathbf{R}^2) values with the quadratic functions than cubic functions which is in contrast to the study of Chaillet et al.,⁹ who observed better results with cubic than quadratic functions. Dental development is not uniform from infancy through adolescence 10 and hence, the variability in regression models derived in various studies can be attributed to the differences in the age group of participants included in the studies. Chaillet et al.,⁹ have included the subjects with age ranging between 2 and 18 years, where as in the present study, the age range was 8 to 25 years. Differences in the age of study samples in the two studies can be the reason for differences in the regression models derived in the studies.

In the present study, accuracy of the developed regression models was evaluated by calculating the MAE, which has been advocated by different researchers as a better measure of accuracy.^{17,18} Accordingly, Timme et al., suggested that the MAE of more than ± 2 years should be considered inaccurate in dental age estimation methodologies.¹ MAE for the quadratic regression models derived for males and females in the present study were well below ±2 years (MAE=1.51 years for males and MAE=1.38 for females) and hence, confirms the accuracy of the derived quadratic regression models. The number of males (0.37) and females (0.35) falling outside the 99% CI in the present study are less than 1, which suggests that the quadratic regression models developed for males and females in the present study are reliable. As per the aforementioned criteria, hence it can be said that the gender dependent quadratic regression models derived in the present study are both accurate and reliable.

The quadratic regression models developed for the total study group irrespective of the sex showed a MAE of 4.02 years, which is much higher to the criteria suggested by Timme et al.,¹ and hence, this model can be considered as 'inaccurate'. These observations emphasize on the use of gender specific regression models for accurate age estimation in clinical perspectives. Our observations are in accordance with the Chaillet et al.,⁹ who reported a significant error of mean difference between estimated dental age and chronologic age, by using sex dependent weighed scores for males and females. Chellait et al.,⁹ based on these observations had further suggested the use of gender independent maturity scores developed by Nystrom et al.,¹⁹ for dental age estimation in cases of unknown sex. The lower misclassifies percentage is suggestive of higher reliability of the derived models.¹⁵ Irrespective of the lower accuracy levels of gender independent quadratic regression models, it was observed that only 0.28 percent of individuals of the study group were outside the 99% confidence interval, thus signifying the reliability of these gender independent quadratic regression models. The gender independent models derived in the present study thus, showed low accuracy and high reliability. Chaillet et al., have recommended the use of regression models with high reliability in forensic applications.⁹

In order to test the applicability of regression models developed in the present study, they were evaluated on a control group too. The observations regarding the reliability and accuracy of gender specific and gender independent models is in concurrence with the observations made in the study group.

Conclusions

The development of quadratic regression models using the developmental stages of tooth, showed an accurate and reliable results of dental age estimation for both males and females in the present study. These quadratic regression models derived in the present study can be used for forensic as well as clinical needs of dental age estimation. Though the present investigation derived the regression models in a study group and attempted to analyze its applicability in the test or control group, smaller sample size may still be considered a limitation of the present study. We suggest the need of future studies on larger sample sizes for deriving population specific models in different population groups. The authors also suggest the need of conducting studies to evaluate the applicability of quadratic regression models in age estimation. An important concern in the research being conducted on age estimation from dental development worldwide is that the maturity scores utilized in these studies is based on the maturity standards of the South France children developed by Chaillet et al.9 Reliability in age estimation is likely to improve if the maturity standards are analyzed for different populations and utilized in deriving the regression models for age estimation.

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Knowledge, Attitude and Practices of self-medication among medical students of Government Medical College, Baroda, Gujarat

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Abstract

Self-medication is a commonly found behaviour world-wide in which the people use drugs to self-administered treatment for their physical or psychological illness. Self-medication involves obtaining medicines without a prescription, resubmitting old prescriptions to purchase medicines, sharing medicines with relatives or members of one's social circle or using leftover medicines stored at home. Self-medication is an essential part of self-care, which is quite common in India due to easy availability of drugs without prescription. It is considerably high in medical students and paramedics due to their knowledge of medicine. The drugs, which are most frequently used for self-medication are antibiotics, analgesics, antipyretics, antihistaminics, antitussives, multivitamins, anthelmintics, etc. The prevalence of self-medication among medical students in Central Gujarat is not known and hence this project was undertaken to assess the prevalence of self-medication among the undergraduate students of Government Medical College, Baroda and to assess their knowledge, attitude and practices of self-medication.

Keywords

Self medication; Self care; self-administered treatment.

Introduction

Self-medication is a commonly found behaviour world-wide in which the people use drugs to self-administered treatment for their physical or psychological illness. It involves obtaining medicines without a prescription and is common in India due to easy availability of the drugs even without prescription. It is also common practice in many other countries due to lack of access to health care, easy availability of drugs and poor drug regulatory mechanism.¹⁻³ Self medication is commonly practiced by the individuals for the minor symptoms or well known medical disorders. The medicines may be recommended by a family member or a friend or can be taken directly from the pharmacist.⁴ Self medication is common among the people due to various reasons like socioeconomic status, lifestyle, and ready access to drugs, and greater availability of medicinal products. The practice of self medication should be controlled and to avoid irrational use of drugs which, in turn can cause wastage of resources, increased resistance of pathogens and can lead to serious health hazards like prolonged sufferings, drug reaction and drug dependence.⁵ The World Health Organization (WHO) has also pointed out that self medication can help to treat the common illnesses, which do not require medical consultation and can be a cheaper alternative for the users. However, it should be accompanied by appropriate health information.° Self-medication is an essential part of self-care and it is considerably high in medical students and paramedics due to their knowledge of medicine. The drugs, which are most

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Received: 14th April, 2019; Revision received on: 19th November, 2019 Accepted: 13th December, 2019 frequently used for self-medication are antibiotics, analgesics, antipyretics, antihistaminics, antitussives, multivitamins, anthelmintics, etc. The prevalence of self-medication among medical students in Central Gujarat is not known and hence this project was undertaken to assess the prevalence of selfmedication among the undergraduate students of Government Medical College, Baroda and to determine the pattern of self medication and to assess their knowledge, attitude and practices of self-medication.

Materials and Methods

This prospective and cross-sectional, questionnaire-based study was carried out among the undergraduate medical students of government medical college, Baroda, Gujarat during 2018. The aims and objectives of this study were to assess the prevalence of self-medication among the undergraduate students of government medical college, Baroda and to assess the students' knowledge, attitude and practices of self-medication. The permission was taken from the institutional ethical committee before commencement of the study. The participants were selected by simple random sampling method from the undergraduate 2nd and 3rd year students. The students were informed about the aims and objectives of the study and a written informed consent was obtained from those who were willing to participate in the study. A pre-designed semi structured questionnaire was given to fill up by medical students who were ready to participate in the study and the relevant informations were collected regarding the study variables. The questionnaires were assessed for their completeness and only the completed questionnaires were considered for the final analysis. Conclusions was drawn after comparing the results with Indian and foreign authors.

Results

A total of 100 medical students (46 males and 54 females) were assessed regarding their practice, attitude and perception of self medication behaviour. The distribution of self-medication practice according to the gender shows that 46% participants were males and 54% were females. Our study shows that the higher number of the females was self medicating, as compared to the males.

Table	1:	Reasons	for	self	Medi	cation
rabic		reasons	101	son	wicui	cation

Reasons for Self Medication	N
It was a minor problem	82
Having Sufficient Knowledge	09
To save time	05
To avoid OPD crowd	04
Total	100

Table1 shows that the most of the study participants selfmedicated because of the illness was too minor for consultation (82%). While in the other reasons for self medication, study participants were having sufficient pharmacological knowledge in 9% cases and want to save their time in 5% cases and to avoid the OPD crowd in 4% cases. More than half of the study participants (52%) used their academic knowledge for information about the drugs followed by use of old prescriptions for the same illness as a source of information in 28% cases, as shown in Table 2.

Table 2: Source of Information about the Drugs

Source of Information	Ν
Old Prescription	28
Academic knowledge	52
Pharmacist	19
Friends	01
Total	100

Table 3:	Indications	for the	self medication

Indications	Ν
Fever	75
Headache	69
Cold	51
Pain	43
Sore Throat	36
Vomiting	29
Diarrhoea	24
Mouth Ulcers	06
Rash/Allergy	15
Insomnia	09

The fever (75%) was the most common indication among the all indications, for which self-medication was done by the students (Table 3). The next common indications for which self-medication was done was headache (69%) followed by cough/cold (51%) and pain (43%). Sore throat (36%) was the most common indication for self-medication with antibiotics.

Table 4: Drugs which were commonly used for the self medication

Indications	Ν
Antipyretics	70
Analgesics	66
Antibiotics	53
Antihistaminics	24
Antidarrhoeal	26
Tonics/Vitamins	25
Antiemetics	14
Antitussive	09
Antiulcer	05
Antispasmodic	13
Sedatives	08

Table 4 shows the category of drugs, which were commonly used for self medication by the medical students and we observed that the Antipyretic (70%) drugs were most commonly used for the self medication by the study participants, followed by Analgesics (66%) and Antibiotics (53%). It was also observed that Antihistaminics, Antidiarrhoeal and Tonics/Vitamins were also used almost in same quantity.

Table 5: Attitude of the medical students towards encouragement of the self medication

Attitude	N
Strongly Agree	08
Agree	35
Do not Know	26
Disagree	29
Strongly Disagree	02
Total	100

Table 5 shows attitude of the medical students regarding the self medication and majority of them (43%) believe that the self medication is a part of self care and it should be encouraged, while the 31% participants donot agree with that. Surprisingly around one fourth of the participants were not able to opine about the same weather the self medication should be encouraged or not.
Discussion

The International Pharmaceutical Federation defines selfmedication as the use of non-prescription medicines by people on their own initiative.⁷ As per the World Health Organization,⁸ "Self-medication is the selection and use of medicines by individuals to treat self-recognised illnesses or symptoms." Self-medication is one of the important and necessary parts of self-care, which includes health-related decision-making of individuals and family members.⁶ Given limited access to health care system and scarcity of health care providers in resourceconstrained settings; self-medication has been well recognized as an alternative option to relieve symptoms associated with minor illnesses.⁹ Self-medication by itself has both dangers and benefits and it depends on the person who is doing self medication and what drug he is using.¹⁰

The present study was conducted to evaluate the knowledge, attitude and practices of self medication among medical students of Government Medical College, Baroda, Gujarat. The prevalence of self-medication in our study was higher and found to be 100%. In studies conducted within India, the prevalence of self-medication among the medical students was ranging between 57.1% and 92%.¹¹⁻¹⁶ Even the studies conducted on non-medical students in India are also showing a high prevalence of self medication of 80.1% in Tamil Nadu¹⁷ and 87% in Uttar Pradesh.¹⁸ The prevalence of self-medication in studies conducted in developing countries was shown to be 25.4% and 43.2% in Ethiopia,¹⁹⁻²⁰ 51% in Slovenia,²¹ 55.3% in Pakistan,²² 55% in Egypt,²³ 56.9% in Nigeria²⁴ and 80.9% in Malaysia.²⁵

The distribution of self-medication practice according to the gender in our study shows that the number of the females who were self medicating was higher as compared to the males, which is similar to the observations of other Indian¹¹⁻¹⁴ and foreign authors.²¹ In this study, the most of the participants used self-medication because the illness was too minor for consultation (82%), which was also observed by other authors.¹¹⁻¹⁴ The time saving was the leading reason of self medication in a study done at Tamil Nadu,¹⁷ while the quick relief was observed in majority in a study conducted at Punjab.²⁶

In this study, more than half of the participants (52%) used their academic knowledge for information about the drugs followed by the use of old prescriptions for the same illness as a source of information, while in the study conducted at Ethiopia¹⁹ Karachi²² and Malaysia²⁵ prior experience with the illness was found to be the most common reason for self-medication. Old prescription for the same illness was also found the most common reason for self medication in the studies conducted in South India.¹⁴⁻¹⁵

In the present study, Antipyretic (70%) drugs were most commonly used for the self medication by the study participants, followed by Analgesics (66%) and Antibiotics (53%). Similar observations were found in studies conducted in South India¹⁴⁻¹⁷ and Ethiopia.¹⁹ However, in studies done at Pakistan,²² Egypt,²³ Iran,²⁷ Mozambique²⁸ Analgesics were the

most common group of drugs, which were used for the self medication.

Fever (75%) was the most common indication for self medication in our study, which was also found in studies done in South India¹⁴⁻¹⁷ and Ethiopia,¹⁹ while Banargee et al¹¹ and Badigar et al¹³ found cough and cold as a most common indication for self medication in their studies. We observed that Antipyretic drugs were most commonly used for the self medication by the study participants, followed by Analgesics and Antibiotics, while Antibiotics were most common in studies done in India^{11,13-14} as well in other developing countries.^{23-24,29}

In present study, we also tried to find out the attitude of study participants towards the self medication and found that majority of them believe that the self medication is a part of self care and it should be encouraged, while other participants donot agree with that. Similar findings were also observed in studies done in South India,¹⁴ Ethiopia²⁰ and Pakistan.²² The majority of the participants believe that the self medication should be encouraged, which was also observed by others.¹⁴

Self-medication as part of self- care can be justified only when there is a judicial use of medicines. There is always a risk of using expired drugs, sharing them with friends or taking medicine that have been originally prescribed for some other problem. Irrational use of drugs may result in accidental drug poisoning. Antimicrobial resistance is another difficulty worldwide particularly in developing countries where antibiotics are frequently available without a prescription.³⁰

The present study shows that to check the growing trend of selfmedication, strong policies should be applied eliminating the supply of medicines without a valid prescription. The common people especially the youth should be educated and made aware about the use of self-medication and its pros and cons. This study was conducted on a single centre of Gujarat and hence, the study observations cannot be generalized per se. More multicentric studies need to be carried out among medical students and general population at large to understand the various factors influencing the practice of self-medication in India. The role of socio-economic status and its influence on practice of selfmedication needs to be explored in future studies.

Conclusion

The present study shows that the prevalence of self medication is higher in medical students because they believe that self medication can help to treat the common and minor illnesses, which do not require medical consultation and can be a cheaper alternative for the users, however, it should be accompanied by appropriate health information. Majority of the study participants believe that it is a part of self care and hence it should be encouraged. More and more multi-centric studies need to be carried out among medical students and general population at large to understand the various factors influencing the practice of self-medication in India. Acknowledgments: The author is thankful to the study participants, who voluntarily took part in the study, and thanks the Government Medical College, Baroda, Gujarat for giving necessary support and encouragement for completion of this research project.

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ORIGINAL ARTICLE

Profile of perpetrators of alleged sexual assault

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Abstract

Sexual assaults are an important global health problem threatening people of all age groups. There are no reported studies regarding the profile of perpetrators of alleged sexual assault in this part of the country. Thus, the present cross sectional study was conducted at the M. S. Ramaiah Medical College, Bangalore, between January 2013 and December 2015 to analyze the age distribution of perpetrators of alleged sexual assault, correlation between the victim's version, victim's parent's version and the perpetrators version of the incident, relationship between the victim and the perpetrator. Descriptive statistics for qualitative type of data were summarized using frequency and percentage. A total of 87 perpetrators were brought for medical examination alleged to have been involved in 82 sexual assault incidents. All of them were males. Majority of them were in the age group of 18-24 years (40%). In most of the incidents a single perpetrators were either victim's friends (N=34, 39%) or acquaintances (N=31, 35.6%). There was allegation of rape in 67 cases, molestation in 15 cases and sodomy in 5 cases. In 55 incidents, assailant's claimed it to be consensual and in 21 cases to be a false allegation. Though the victim had consensual sexual intercourse in many cases, she agreed to that only in 38 cases. Most of the incidents took place in perpetrator's home (20 cases).

Keywords

Sexual assault; Perpetrator's profile; Victim-Perpetrator relationship; Location

Introduction

Sexual assaults are an important global health problem threatening people of all age groups. Sexual assaults can be of various natures ranging from indecent assault to rape. Youth and students may have higher rates of sexual assault because of lifestyle factors. These individuals tend to engage more frequently in recreational activities, and are in close proximity to many different individuals at any given time. While females are disproportionately the victims of sexual offences, males are disproportionately the accused. In India the reported cases represent only a tip of iceberg.¹ Many cases go unnoticed either due to their dignity and reputation in the society. The victims feel the society looks at them in a different way if they come to know that she has been sexually assaulted.

Further, a woman is often ostracised just for being the victim of rape. Yet, society often blames the victim for delays in complaining about the offence, giving less importance to the heinous act of the accused and the mental and physical trauma that the woman has to overcome before registering a complaint. Though the details of the victim are kept secret, yet the victims would not come forward to report to the law enforcing agency.²

Under the Indian Penal Code Section 228-A (Disclosure of identity of the victim of certain offences etc) Sub Section (1): Whoever prints or publishers the name or any matter which may

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Received: 13th September, 2019; Revision received on: 26th November, 2019 Accepted: 17th December, 2019 make known the identity of any person against whom an offence under section 376, section 376A, section 376B, section 376C, or section 376D is alleged or found to have been committed (hereafter in this section referred to as the victim) shall be punished with imprisonment of either description for a term which may extend to two years and shall also be liable to fine.

Even in a recent judgment pronounced by the apex court, "No person can print or publish in print, electronic, social media, etc the name of the victim or even in a remote manner disclose any facts which can lead to the victim being identified and which should make her identity known to the public at large," the bench said in its judgment. The court said that in the society, an "innocent" victim of sexual offence, especially rape, was unfortunately treated worse than the perpetrator of crime and "for no fault of the victim, society instead of empathizing with the victim, starts treating her as an 'untouchable'". "A victim of rape is treated like a 'pariah' and ostracized from society. Many times, even her family refuses to accept her back into their fold. The harsh reality is that many times cases of rape do not even get reported because of the false notions of so called 'honour' which the family of the victim wants to uphold," the bench said.³

Research suggests that many victims continue to perceive sexual victimization as a private matter and most do not disclose their victimization to any formal source.⁴ Sexual assault incidents are most likely to occur when a victim and offender are known to each other. Victim and offender are likely to have had a prior relationship as family members, intimates, or acquaintances. One major fallacy regarding victim–offender relationships is that of "stranger rape." Media attention is drawn mostly to rape and sexual assault of college-aged women, focusing specifically on the crimes committed by strangers.⁵ This gives the impression that strangers are the most likely

perpetrators of these crimes. This, however, is not true, as is shown by NCVS data, according to which 79% of women knew their offender in rape and sexual assault cases.⁶

Earlier the perpetrators were dealt with under Sec 376 IPC for rape, Sec 354 IPC for indecent assault. It is clear from this review of recent policies enacted to protect communities from sexual violence that the proliferation of well intentioned political efforts to curb sexual violence has led to the creation of newer laws like POCSO Act (Protection of Children from Sexual Offences Act), which is intended to protect the children against sexual assaults.

There are no reported studies regarding the perpetrators of alleged sexual assault in this part of the country. Hence, the present study was taken up to analyze the age distribution of perpetrators of alleged sexual assault, correlation between the victim's version, victim's parent's version and the perpetrators version of the incident, relationship between the victim and the perpetrator.

Materials and Methods

The present prospective cross sectional study was conducted in the Department of Forensic Medicine, M. S. Ramaiah Medical College Bangalore from January 2013 and December 2015. The approval was taken from the institutional ethics committee. All perpetrators of alleged sexual assault brought for medical examination to the Department of Forensic Medicine were interviewed through a detailed questionnaire after taking consent. The age of the perpetrators was considered based on the documents supporting their claim like school certificate, Voter ID, Aadhar card, Driving license etc in correlation with the dental and physical examination. Only in cases where the perpetrators claimed to be minors they were also subjected for radiological examination apart from dental and physical examination to confirm the age. Relevant information was also sought from the victim and the victim's parents (only in cases where the victim was a minor) after taking consent. Descriptive statistics for qualitative type of data were summarized using frequency and percentage.

Results

During the study period from January 2013 and December 2015, 87 perpetrators were brought for medical examination alleged to have been involved in 82 sexual assault incidents. All of them were males. The majority of them were in the age group of 18-24 years (46%) followed by 25-34 years (36.8%). Only 12 perpetrators were aged more than 35 years and 3 were aged less than 18 years (Table 1).

Most of the perpetrators were single/unmarried (N=60) constituting 69% of total cases. Married individuals constituted 28.7% (N=25) of total cases. One perpetrator was a widower and the other one was in a live-in relationship with the victim. Most of the married men (N=22) were more than 24 years. In the majority of the cases, perpetrators were either victim's friends (39%) or the

acquaintances (35.6%). In twenty cases (20.7%) they were relatives viz. uncle, father, cousin, in laws, etc. Only in two cases the perpetrators were strangers to the victim (Table 2).

able 1: Age distribution of perpetrate	tribution of perpetrators
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Age Distribution	N	%
7- 11 yrs	1	1.1
12 – 17 yrs	2	2.3
18- 24 угз	40	46
25- 34 угз	32	36.8
>35 yrs	12	13.8
Total	87	100

Table 2:	Relationship	of perpetrator
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Relationship	Ν	%
Intimate	5	5.7
Other relatives	15	17.3
Friend	34	39
Acquaintance	31	35
Stranger	2	3
Total	87	100

(Intimate- closely acquainted/ familiar; Other relative- Other than parents and siblings; Friend- a person with whom one has a bond of mutual affection, typically one exclusive of sexual or family relations; Acquaintance- a person one knows slightly, but who is not a close friend; Stranger- a person whom one does not know or with whom one is not familiar)

In our study there was allegation of vaginal rape in 62 incidents and molestation in 18 cases and sodomy in 2 cases. Amongst 67 cases, in 26 cases the victim accepted that it was consensual. In 6 cases the victim claims that she did not consent for sexual intercourse. In remaining 35 cases though the victims accepted that it was a consensual sexual intercourse. In 55 incidents, assailant's claimed it to be consensual and in 21 to be false allegation. Though the victim had consensual sexual intercourse in many cases, she agreed to that only in 38 cases (Table 3).

 Table 3: Correlation of alleged versions of assailants, victims and their parents for all incidents (N=82)

	1	()	
Types of versions	Victim's version	Parent's version	Assailant's version
Penetrative sexual assault	24	68	5
Non Penetrative sexual assault	12	12	1
Consensual sexual intercourse	38	1	55
False allegation	8	1	21

Most of the incidents took place in perpetrator's residence (20 cases) followed by the victim's residence (16 cases) and residence shared by the victim and perpetrator (16 cases). In 14 cases the incidents took place in other private places. In 7 cases the incident took place at other public places. In another 7 cases the incident

took place in multiple places on multiple occasions and in the remaining two incidents took place at work place (Table 4).

Location	N	%
Victim's residence	16	19.5
Shared residence	16	19.5
Assailant's residence	20	24
Other private place	14	16
Other public place	7	9
Work place	2	3
Multiple places	7	9
Total	82	100

Table 4: Location of alleged occurrence of sexual assault

In 61 cases it was the parents who reported to the police and in remaining 21 incidents it was reported by the victims themselves. In most of the cases (N=40, 46%) the incident was reported after 3 days of alleged occurrence; in 26 cases (29.9%) the incident was reported within 6-24 hours of alleged occurrence; in 11 cases the incident was reported immediately (less than 6 hours) and in remaining 10 cases the incident was reported between 1-3 days after the incidence. The perpetrator was brought for examination after 3 days of alleged incident in majority of the cases (58 cases) and within 6-24 hours in 17 cases and 1-3 days in nine cases and only in three cases the perpetrator was brought for examination immediately (6 hours). The victims were allegedly threatened by the perpetrators in 19 cases (21.8%).

In one case four men were alleged to have sexually assaulted a married woman. The incident was reported too late and the perpetrators denied the same. In this particular case, the victim's husband had filed a case against those four men; as he had borrowed money from then and didn't want to repay. In another two separate incidents girls were alleged of having consensual sexual intercourse with two men; but when they were caught by victim's parents the girls denied it to be consensual.

The majority of the individuals (77%) were employed in small firms like garments or other factories, bakeries, departmental stores etc. or self-employed as auto rickshaw drivers, cab drivers, mechanics etc. Most of them belonged to lower socioeconomic group. 17 individuals were students; most of them were in love with the victims and had eloped. Few of them were married to each other and were living together. Since the victims in such cases were minors, legally the marriage is considered as null and void. Hence, the case of alleged kidnapping and sexual assault were registered by the victim's parents. Five were unemployed and the remaining two were retired.

Discussion

In most of the individuals (N=85) the alleged age correlated with the age determined by physical, dental examination. Since physical and dental examination is done as a part of routine

medical examination of the perpetrator, the opinion was framed based on these findings and correlated with the alleged age of the perpetrators. In cases where the perpetrator was a minor apart from physical and dental examination they were also subjected for and radiological examination for the confirmation of the age. In a study by Synder, 23% of sexual assault offenders were under age 18 and 77% were adults. 16% of juvenile offenders were under the age of 12.⁷ In another study by Brennan and Taylor – Butts, rates of sexual offending were highest among persons aged 12 to 17 (90 per 100,000 population), followed by 18 to 34 year olds (55 per 100,000 population) and 35 to 44 year olds (42 per 100,000 population).⁸

In a study done in Australia, a substantial majority of offenders had not completed secondary education. There were no differences in education between offender subgroups, but less educated offenders were significantly less likely to agree to participate in the study. There were differences between offender subgroups with respect to their marital status. Perhaps the most striking of these is that extra familial offenders were significantly more likely than the other offenders to have never been married.⁹

In two cases where the perpetrators were strangers to the victim, they met in a public place and got close and allegedly had sexual intercourse with mutual consent but the victims allegedly changed their version when interrogated by their parents. In a similar study conducted, Synder observed that about one-quarter (27%) of all offenders were family members of their victims.⁷ Brennan and Taylor – Butts observed that extended family members (10%), the victim's parents (10%), or some other immediate family member (7%) were identified as the accused most frequently.⁸ Whereas it was observed in Jordan that in most cases, offenders were strangers.¹⁰

In another study on elderly victims of sexual abuse, 74 cases (26.1%) the suspect was not known to the victim. e.g., the stranger category. In 66 cases (23.2%) the offender had a familial relationship with the victim, e.g., the incestuous category. In 44 cases (15.5%) the offender was a marital or common-law partner. In 31 cases (10.9%), the offender was an unrelated care provider. In 17 cases (6%) the offender and victim were residents in a nursing home and in 21 cases (7.4%) the offender was known but had no familial or care providing relationship.¹¹

In Forensic Markers study, forced vaginal rape was in 78% of the cases, forced oral rape in 13.4% of the cases, forced anal rape in 23.9% of the cases and forced digital rape in 11.6% of the cases.¹² The Forensic Marker (FM) study (n=125) included a convenient sample of elder cases from the files of 15 forensic nurses, law enforcement, prosecutors and clinicians. The majority of cases were reported to law enforcement. It included an older sample of elders and higher percentages in terms of recorded intentional injury, forced sex acts, use of weapons, perpetrator known to victim, rape reported to authority and prosecution success. Whereas amongst the elderly victims of sexual abuse, 59% elders had genital injury and 18% had anal injury and in 15.7% elders had oral or throat injury.¹¹

In 26 cases where the victim accepted that it was consensual, but on promise of marriage; but later when the perpetrator changed the mind, the victim or victim's parents registered the case against the perpetrators. In six cases though the victim claims that she did not consent for sexual intercourse, it was not reported by her as the perpetrator either threatened (two cases) or consoled her that he would marry her (four cases). In remaining 35 cases though the victims accepted that it was a consensual sexual intercourse the consent was regarded as invalid as the victims were minors. In few cases the minor

victims were lured by offering toys, books, chocolates etc. Most of the incidents took place in perpetrator's residence (20 cases) followed by the victim's residence (16 cases) and residence shared by the victim and perpetrator (16 cases), since the victim and perpetrators were known to each other in most of the cases. In 14 cases the incidents took place in other private places. Other private places in the study included hotels, vehicles, friend's residence, relative's residence etc., the victims were taken there and had sexual intercourse either by promising her of marriage or threatening her. In seven cases the incident took place at other public places. Other public cases in the study meant places like park, school/college, ashram, play ground etc. The perpetrators in such cases were either strangers or the acquaintances. In cases where the incident took place in multiple places on multiple occasions the perpetrator was either friend who had sexual intercourse upon promise of marriage. In the incidents which took place at work place, they were colleagues who indulged in the acts on multiple occasions again upon promise of marriage by the perpetrator.

According to the 2004 General social survey (GSS), more than half (51%) of sexual assault incidents occurred in a commercial or institutional establishment,12 followed by a residence or surrounding location (31%), a street or other public place (12%), or in another location (6%).⁸ As reported by Levenson and Cotter in their study of registered sex offenders' perceptions of residency restrictions, "Most abuse happens in homes or with family or close friends, not at bus stops or schools."¹³

Brennan and Taylor – Butts observed that many victims of sexual assault did not report their victimization to police; still many did turn to other informal sources of support, such as friends (72%), family (41%), co-workers (33%), or doctors or nurses (13%).⁸ In majority of cases the victim's parents had reported due to their honor and pride (26 incidents), or to get their daughter married to the assailant. In majority of self reported cases the main intention was to marry (23 incidents) the assailant who had sexual intercourse upon promise of marriage, but subsequently changed the mind. In 16 incidents it was to punish the assailant and in remaining 17 cases it was to take revenge or monetary gain.

The victim had to muster the courage to register a complaint against the accused in a police station of the correct jurisdiction. There could be inordinate delays in this, considering the social obstacles that women face in coming out in the open against the accused. Further, a woman is often ostracized just for being the victim of rape. Yet, society often blames the victim for delays in complaining about the offence, giving less importance to the heinous act of the accused and the mental and physical trauma that the woman has to overcome before registering a complaint. Only after this delayed registering of a complaint against the accused would the police investigation be initiated and a requisition forwarded to a doctor at the government hospital asking for medical examination of the victim of rape.²

In view of recent amendments to the existing rape laws in India and ignorance of such laws and minimum age for marriage to be valid, young males need to be made aware. It is suggested that resources must be utilized to identify first-time offenders through community and school-based educational programs, provide counseling to young people with risk factors or tendencies for sexual violence. Research on such studies and on evidence-based laws should be encouraged and funded.¹⁴

Conclusion

Sexual assaults are an important global health problem threatening people of all age groups. Alongside making efforts to identify such crimes and bring it to the knowledge of law enforcement agencies, it's important to educate young males about the age of marriage and rape laws in India. It is suggested that resources must be utilized for community and school-based educational programs, provide counseling to young people with risk factors or tendencies for sexual violence.

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ORIGINAL ARTICLE

Liver pathology: An autopsy based study from Southern Odisha

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Abstract

The liver is vulnerable to a wide variety of metabolic, toxic, microbial, and circulatory insults. Most of the chronic liver diseases, even in advanced stages, may cause no prominent clinical signs or symptoms. Autopsy remains one of the most useful tools to validate the clinical diagnosis. A total of 152 consecutive medico-legal autopsy cases were included in the present study, among which 107 cases were males, and 45 were females. Age groups involved in the study were from the third decade to the eighth decade. Out of the 107 cases among the males, 32.89% were of normal histology, 32.29% were steatosis, 13.16% were chronic venous congestion liver, 11.89% were due to steatohepatitis, 2.63% were cirrhosis, 5.27% showed features of chronic hepatitis and 1.97% showed features of hepatocellular carcinoma. Out of the 45 female cases, 18% were of normal histology, 15% were steatosis, 11.1% were steato-hepatitis, 8.9% showed features of chronic hepatitis. There was no case of cirrhosis and cancer among females.

Keywords

Cirrhosis; Disease; Hepatitis; Histological; Medico-legal

Introduction

The liver is one of the most important organs in the human being, which plays a vital role in metabolism and detoxification. Most of the liver diseases go undiagnosed or are found incidentally during general check-ups, investigation of other illnesses, surgery, or autopsy. The underlying causes of chronic liver diseases vary in different geographic areas and are based on various factors like lifestyle, diet, infections, and other endemic diseases.¹Autopsy remains one of the most useful tools to validate the clinical diagnosis. The effects of viral hepatitis and drug-related toxicity on the liver is evident only in post mortem studies. An autopsy study is useful to monitor the cause of death and to plan medical strategy.²

The major diseases include hepatitis, alcoholic liver disease, circulatory disturbances, and neoplasm.³ These diseases can be seen as "silent liver disease" in the histological findings during the autopsy. Alcohol abuse generally leads to three pathologically distinct liver diseases; these are fatty liver, hepatitis, and alcoholic cirrhosis. Any one or all three can occur at the same time in the same patient.⁴

Materials and Methods

Ethical approval was obtained from the Institutional Ethical Committee of M.K.C.G. Medical College and Hospital, Berhampur. The core material forming the basis of this study comprised of 152 specimens of liver obtained from post mortem

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Received: 23rd September, 2019; Revision received on: 11th December, 2019 Accepted: 25th December, 2019 examinations done in the Forensic Medicine and Toxicology department of M.K.C.G. Medical College and Hospital, Berhampur. The study was a prospective one done during a period of two years from October 2016 to September 2018.

All livers were examined carefully for gross abnormalities and weight measured for all livers. Specimens were fixed in 10% formalin and random bits taken from each specimen, one bit from the right lobe, one bit from the left lobe, and another bit from the grossly abnormal-looking area. Histologic sections (5 to 6 um) were routinely stained with hematoxylin and eosin stains. Special stains like Reticulin, Masson's trichrome were used where ever required. The cases were sub-grouped, based on the age of deceased as; Group A: 21years -30years (35 cases), Group B: 31years-40years (51 cases), Group C: 41years-50years (37 cases), Group D: 51years-60years (18 cases), Group E: 61years-70years (8 cases), Group F: 71years-80years (3 cases).

Results

A total of 152 specimens of liver were subjected to histopathological examination in the Department of Pathology, during the study period. Out of the 152 cases, 50 (p=0.0001, CI=20.27 to 47.62) showed normal histology. Rest of the cases showed various morphological features. Fatty change was the most predominant finding amounting to 44% (only steatosis in 49 cases (32.24%, p=0.0001, CI=19.6 to 47.11) and 18 cases (11.84%, p=0.0029, CI=1.62 to 35.63) showing accompanying hepatitis component. Chronic venous congestion was the next common morphological finding which was seen in 20 cases (13.16%p=0.0004, CI=2.4 to 35.67). Eight cases (5.27%, p=0.0004, CI=0 to 44.14) showed features of chronic hepatitis, four cases (1.97%, p=0.9983, CI=0.07 to 62.89) of cirrhosis and three cases (1.97%, p=0.9970, CI=0.03 to 72.35) of carcinoma.

Group A: From the 35 cases in the age group of 21-30 years, 24 were males, and 11 were females. Nine cases showed features of steatosis (25.71%, p=0.0001, CI=4.09 to 63.33) in which seven

were males (20%) and two were females (5.7%). Two cases showed features of steatohepatitis and both were males (5.72%, p=0.7071, CI=0 to 86.93). Three cases (8.57%, p=0.4163, CI=0 to 77.2) showed features of chronic venous congestion in which two were males and one was a female. Remaining 21 cases (60%, p=0.0001, CI=36.65 to 80.43) showed normal histology (Table 1).

Name	Male	Female	Total	%	p value
Normal	13	8	21	60.00	0.0001
Steatosis	7	2	9	25.71	0.0001
Steatohepatitis	2	0	2	5.72	0.7071
Venous congestion	2	1	3	8.57	0.4163
Chronic hepatitis	0	0	0	0	0
Cirrhosis	0	0	0	0	0
Total	24	11	35	100	0.0001

Table 1: Sex wise distribution of liver pathology in 3rd decade

Group B: In the age group of 31-40 years, there were 51 cases in which 35 were males and 16 were females. 18 of these cases showed normal histology (35.29%, p=0.0001, CI=14.70 to 60.89). Of the rest 33 cases, 16 showed steatosis (31.37%, p=0.0001, CI=11.09 to 58.78), of which 11 were male, and five cases were females. Eight cases (15.69%, p=0.0057, CI=0.76 to 56.06) showed features of steatohepatitis in which six were males and two were females. Five cases showed features of chronic venous congestion (9.8%, p=0.2128, CI=0.01 to 62.67) in which there were four males and one was a female. Four had features of chronic hepatitis (7.84%, p=0.4041, CI=0 to 67.72), in which two were males, and two were females (Table 2).

Table 2: Sex wise distribution of liver pathology in 4th deeperture	cade
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Name	Male	Female	Total	%	p value
Normal	12	6	18	35.29	0.0001
Steatosis	11	5	16	31.37	0.0001
Steatohepatitis	6	2	8	15.69	0.0057
Venous congestion	4	1	5	9.8	0.2128
Chronic hepatitis	2	2	4	7.84	0.4041
Cirrhosis	0	0	0	0	0
Total	35	16	51	100	0.0001

Group C: In the age group of 41-50 years, there were a total of 37 cases in which 24 were males, and 13 were females. 14 cases showed features of steatosis (37.8%, p=0.0001, CI=14.14 to 66.74) in which there were eight males (21.6%) and six females (16.2%). Four cases showed features of steatohepatitis (10.8%, p=0.0001, CI=0 to 70.24) of which three were males (8.1%) and one was a female (2.7%). Six cases showed features of chronic venous congestion (16.1%, p=0.0136, CI=0.36 to 63.60) in which five were males (13.5%) and one was a female (2.7%). Two cases showed features of cirrhosis (5.4%, p=0.7313, CI=0 to 86.79) and both are males. Two cases showed features of chronic hepatitis (5.4%, p=0.7313, CI=0 to 86.79) in which one was a male and

another one was a female. Remaining nine cases showed normal histology (24.5%, p=0.0001, CI=3.62 to 62.19) (Table 3).

Table 3: Sex wise distribution of liver pathology in 5th decade

Name	Male	Female	Total	%	p value
Normal	5	4	9	24.5	0.0001
Steatosis	8	6	14	37.80	0.0001
Steatohepatitis	3	1	4	10.80	0.0001
Venous congestion	5	1	6	16.10	0.0136
Chronic hepatitis	1	1	2	5.4	0.7313
Cirrhosis	2	0	2	5.4	0.7313
Total	24	13	37	100	0.0001

Group D: In the group 51-60 years, forming a total of 18 cases, 14 were males, and four were females. Three males and two females showed features of steatosis (27.78%, p=0.0001, CI=1.75 to77.52). Two males and two females showed features of steatohepatitis (22.22%, p=0.0039, CI=0.37 to 78.77). Three males showed features of chronic venous congestion (16.67%, p=0.0695, CI=0.02 to 82.33). One male showed features of chronic hepatitis (5.56%, p=0.7993, CI=0.08 to 98.10). One male showed features of cirrhosis (5.56%, p=0.7993, CI=0.08 to 98.10). One male showed features of cirrhosis (5.56%, p=0.7993, CI=0.08 to 98.10) and two males showed features of carcinoma (11.11%, p=0.3574, CI=0 to 89.22). The rest two cases (11.11%) showed normal histology (Table 4).

Table 4: : Sex wise distribution of liver pathology in 6th decade

Name	Male	Female	Total	%	p value
Normal	2	0	2	11.11	0.3574
Steatosis	3	2	5	27.78	0.0001
Steatohepatitis	2	2	4	22.22	0.0039
Venous congestion	3	0	3	16.67	0.0695
Chronic hepatitis	1	0	1	5.56	0.7993
Cirrhosis	1	0	1	5.56	0.7993
Carcinoma	2	0	2	11.11	0.3574
Total	14	4	18	100	0.0001

Group E: This group consists of a total of eight cases in which there were seven males and one female. Four males (50%, p=0.0001, CI=6.76 to 93.24) showed features of steatosis. One male and one female showed features of chronic venous congestion (12.5% each, p=0.0202, CI=0.02 to 93.92). One male showed features of chronic hepatitis (12.5%, p=0.4533,CI=0 to 98.69) and another male showed features of cirrhosis (12.5%, p=0.4533,CI=0 to 98.69) (Table 5).

Group F: In this group of 71-80 years there were a total of three cases and all were males. One male showed features of steatosis; another male showed the feature of chronic venous congestion and the last one showed features of carcinoma (33.33% each, p=0.252, CI=0.0 to 99.71) (Table 6).

Name	Male	Female	Total	%	p value
Normal	0	0	0	0	0
Steatosis	4	0	4	50	0.0001
Steatohepatitis	0	0	0	0	0
Venous congestion	1	1	2	25	0.0202
Chronic hepatitis	1	0	1	12.5	0.4533
Cirrhosis	1	0	1	12.5	0.4533
Total	7	1	8	100	0.0001

Table 6: : Sex wise distribution of liver pathology in 8th Decade

Table 5: : Sex wise distribution of liver pathology in 7th decade

Name	Male	Female	Total	%	p value
Normal	0	0	0	0	0
Steatosis	1	0	1	33.33	0.0252
Steatohepatitis	0	0	0	0	0
Venous congestion	1	0	1	33.33	0.0252
Chronic hepatitis	0	0	0	0	0
Cirrhosis	0	0	0	0	0
Carcinoma	1	0	0	33.33	0.0252
Total	2	0	2	100	0.0001

Discussion

The liver is the site of many diseases, many of which become symptomatic, while some are diagnosed only during the autopsy. Silent liver diseases, which are becoming an emerging threat to health, have to be studied in detail to identify them earlier and provide appropriate treatment. The exact incidence or prevalence of these diseases is unknown because most of these need an invasive investigation in the form of a liver biopsy, which is usually not done on a routine basis. In the USA, Steatosis is identified to be the significant silent liver disease, while non-alcoholic steatohepatitis constitutes a considerable minority, whose incidence is increasing. A meta-analytic study to estimate the prevalence of NASH showed that the global prevalence is around 25.24%. The term NASH has been coined by Ludwig et al.,5 with the disease process ranging from uncomplicated steatosis to steatohepatitis to steatonecrosis to liver cell failure.

In India, alcohol-related liver disease is a significant health problem. Alcoholic liver disease has been reviewed by many and mentioned in great detail by McSween, Maddrey WC, Rabin, and Ishak et al.⁶ However, the true incidence of alcoholic hepatitis is not known owing to the late presentation to the clinician, ending up in cirrhosis. The susceptibility of patients to alcohol-related liver disease has been studied by Saunders et al. and Sorensons et al.⁷ Short term ingestion of 80 gm alcohol produces mild and reversible fatty liver. Daily intake of 80 gm or more increases the risk for severe hepatic injury, and daily ingestion of 160 gm or more is associated with severe injury.

In this present study, a total of 152 cases of medicolegal

autopsies were included that were done in the Forensic medicine and toxicology department of M.K.C.G. Medical College and Hospital, Berhampur. The study was a prospective one done during a period of two years from October 2016 to September 2018. The causes of deaths were due to road/railway accidents, poisoning, burns, and hanging, etc. No medical history was available in any of these cases. The liver tissue obtained was processed as described earlier and screened for various morphological parameters such as fatty change, necrosis, fibrosis, cirrhosis, etc.

The particular characteristics of forensic autopsies are the relatively young age of subjects and usually better general health condition before death. Thus, this sample may not be representative of the general population.

The incidence of liver diseases was found to be more in males that were 106 in number. M.S.Bal et al.⁹ and Poonam Singal et al.¹⁰ also found maximum cases are males in their study.

The maximum incidence of liver diseases (51 cases) was found in the age group of 31-40 yrs. Other studies conducted by M.S.Bal et al.⁹ and Poonam Singal et al.¹⁰ showed a maximum number of cases that occurred in the 41-50 yrs age group.

In this present study, the histologically normal liver is found in 50 cases (32.89%). This finding correlated well with the study of M.S.Bal, S.P.Singh et al. $^{\circ}$, which was 30% and with the study by M.A.Sameer et al. 8 which was 28.66%.

Steatosis was the predominant histological abnormality seen in 32.24% of all cases in the study. It was dominating in the 4th-decade, accounting for 37.50% and 27.78% in the 6th decade. Males were the most affected gender. This is because a large percentage of people in this region take alcohol, which is a major causative factor for developing fatty change. Regular intake of alcohol between 40-80 gm increases the liver weight and frequency of fatty changes in the liver.

This finding correlated well with the study of M.S.Bal, S.P.Singh et al.,⁹ where steatosis was seen in 53.85% in 5th decade falling to 35.99% in 6th decade in their study which included cases > 40 years of age and Sotoudehmanesh, Sotoudeh et al., ¹² steatosis was noted in 31.6% in a study of 896 autopsies.⁹ However, a study by Ghazala Hanif, Hannan et al. ¹¹ on incidental findings in 110 liver autopsies fatty change was noted in only 4.5% of cases. They attributed this to the lower incidence of alcohol intake in their country.

Steatohepatitis was mostly seen in the 4th and 6th decade comprising about 15.69% and 22.22%, respectively. The study of Sotoudehmanesh, Sotoudeh, et al., ¹² wherein steatohepatitis was seen in 2.1% compared well with our observation though on the lower proportion, which may be because of social and racial differences. M.A.Sameer et al. ⁸ reported 17 cases, which was 11.33%. However, the study of Bal et al. did not report any in their research.

Chronic Venous Congestion of liver was the next common abnormality closely following the fatty change in our study accounting to 20 cases. Out of the total 20 cases, 16 were males, and four were females. Bal et al. reported a higher percentage of 77.8% in the 5^{th} decade. Copelands (1985) study reported

congestion with a fatty change in 3.4% of liver autopsies of alcoholics⁹, and Ghazala Hanif, Hannan et al.¹¹ reported venous congestion in 2.7%.

Cirrhosis of the liver was seen in four cases (2.63%) in our study. Grossly, two were micronodular, one macronodular, and one was mixed in type. Ghazala, Hannan, et al.¹¹ reported cirrhosis in 4.5%, and Sotoudehmanesh, Sotoudeh et al.,¹² reported cirrhosis in only 0.8%.

Chronic hepatitis was seen in eight cases (5.26%) in total. The significant bulk was seen in 31-40 years of group accounting to 50%. Bal et al.⁹ reported 3% cases of hepatitis, Sotoudehmanesh, Sotoudeh et al.,¹² reported chronic hepatitis in 2.6%, and Ghazala Hanif Hannan et al.,¹¹ reported in chronic hepatitis 12.7%.

Both benign and malignant epithelial and mesenchymal neoplasms arise in the liver. Of the malignant tumors, metastatic are more common than the primary cancers; rarely, a hamartomatous mesenchymal lesion can occur in the liver. Three carcinoma cases were detected in the present study.

Conclusion

This study takes the available data i.e., age, sex and cause of death, histological features, and special staining in arriving at the following observations. No clinical data what so ever was available.

- Steatosis was the most common entity found in all age groups, and more frequent in males.
- Steatosis was observed as early as 22 years of age.
- Steatohepatitis was noted in three females without a history of alcoholism, probably suggesting these to be cases of non-alcoholic steatohepatitis (NASH).
- The earliest phase of steatohepatitis was noted as early as in the third decade.
- The earliest phase of chronic hepatitis was seen in the fourth decade.
- Cirrhosis was noted only among the male population in our study.
- Cirrhosis was observed as early as in the fifth decade.

This study reiterates the importance of the clinical autopsy in understanding the magnitude of clinically silent liver lesions. A substantial percentage of cases were found to be harbouring hepatitis, which would have far-reaching consequences, both clinically and socially. The high incidence of NASH among the female population shows that metabolic syndrome among women continues to be underdiagnosed. The study also highlights the unexpectedly high prevalence of steatohepatitis among the younger generation.

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ORIGINAL ARTICLE

Autopsy analysis of custodial deaths in RNT Medical College, Udaipur

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Abstract

It is seen that death in police and judicial custody is increasing with time especially at tertiary care centers where central jail has larger capacity to keep prisoners and sick prisoners are referred to tertiary care centers for better treatment. National Human Rights Commission of India has laid down strict guidelines to be followed after custodial deaths, these deaths include death in police custody and in judicial custody (both under trial prisoner and those convicted). A retrospective autopsy based study on custodial deaths was conducted at RNT Medical College Udaipur for duration of 5 years from 2014 to 2018 to know about the possible reasons of their death and what could be the possible remedies to the issue under study. Among the 54 custodial deaths in the study, 50 were male and four female, with maximum cases 17 being from the age group of 41- 50 years. Tuberculosis as cause of death accounted for 14 (24.92 %) deaths, followed by other lung diseases. Three cases of unnatural deaths occurred (two of hanging and one of head injury). This study emphasizes on better implementation of medical services and tuberculosis control program in prisons. And also on overcrowding of prisoners in jail to curtail communicable diseases, proper nutritive input to diseased person. Promoting meditation, yoga, and suicidal awareness among custody staff may help in early detection of suicidal tendency in prisoners.

Keywords

Custodial death; Human rights; Videography

Introduction

Custody is defined as any point in time when a person's freedom of movement has been denied by law enforcement agencies, such as during transport prior to booking, or during arrest, prosecution, sentencing, and correctional confinement.² Death in custody is defined as death occurring in some form of custodial detention, such as police cell or prison¹ in the legal parlance.

Death in custody usually leads to intense media scrutiny and considerable public unease. Relatives of the deceased may express understandable concerns about the propriety of police behavior. Not that at each time the death is due to violent causes. but at times, may be due to natural causes or due to inadequate medical facilities or medical attention and diagnosis, or negligent behavior of authorities or may be due to physical abuse and torture.⁴ National Human Rights Commission (NHRC) of India has hence laid down strict guidelines to be followed after custodial deaths. Whole investigation reports after investigation is completed by the magistrate is send to this commission with his conclusion to ensure no lacuna is left or fowl play has taken place. Videography of the postmortem is done with the laid guidelines. It is found that the major reasons behind custodial deaths are mainly unawareness and carelessness on the part of custodial authorities on the health status of the inmates and poor condition of the cells.⁵ A number of studies have been done on custodial deaths by various

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Received: 21st October, 2019; Revision received on: 20th December, 2019 Accepted: 24th December, 2019 international agencies and authors in western countries ^{4,6-9} but only a few studies have been done in India.

Materials and Methods

This retrospective, autopsy based study on custody-related deaths, during the period of five years from the year of January 2014 to December 2018, was conducted in the Department of Forensic Medicine and Toxicology, RNT Medical College Udaipur.

Udaipur which is tertiary health care centre in southern Rajasthan and is one of the autopsy centre authorized by the NHRC in custodial death enquiries. The post-mortem examination of these cases was conducted in the mortuary of the institute, as per the guidelines laid out by the NHRC. Postmortem is written on Performa which is given in end videography of whole postmortem is done according to guidelines of NHRC. The records were analyzed for demographic profiles, previous history of disease or medication, signs of torture, cause, manner and place of death, and other relevant findings were taken in account. Study was done in different parameters as cause of death, age group involved, admitted in hospital before death or brought dead. The categorization was based on the inquest conclusion, autopsy reports and laboratory investigation.

Results

A total of 54 cases of custodial death were analyzed. Of these, 50 were males (93%) and four female (7%). Maximum cases 17 (31.48%) were from age group of 41 to 50 years; the eldest prisoner being 78 years old. 29.62% of custodial deaths occurred in judicial deaths (jail). Natural causes accounted for 79.62% deaths, whereas 20.38% cases were of unnatural and undetermined and reversed causes. Pulmonary tuberculosis was

the most common cause followed by other lung disease among natural cause of death in unnatural causes of death hanging was the most common form though only two cases were reported in five-year study.

Year	N
2014	08
2015	12
2016	09
2017	18
2018	07
Total	54

Table 2: Age wise distribution of cases

Age (in decades)	N
0-10 years	00
11-20 years	01
21-30 years	07
31-40 years	15
41-50 years	17
51-60 years	07
> 60 years	07
Total	54

Fable 3: Distribution	of cases	according to	cause	of death
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Cause of death	Ν
Tuberculosis	14
Lungs disease other than tuberculosis	12
Carcinoma	04
Hanging	02
Septic shock	02
Subarachnoid haemorrhage	01
Cerebro vascular accident	01
Liver disease	02
Cardio respiratory failure	02
Myocardial infarction	01
Anaemia with tuberculosis	02
HIV with tuberculosis	02
Head injury	01
Undetermined/reserved	08
Total cases	54

Discussion

Custody of a person is defined as when his freedom of movement is denied by law enforcing authority. A person in the custody is under the supervision of the authorities and is dependent on them. So, any death occurring in the custody is considered to be a fault, in one way or other, on the part of the concerned authority. ⁵ As per 2011 NHRC report, there were

14,231 custody related deaths in India during the period of 2001 to 2010. 1250 prison deaths occurred in Maharashtra state during years 1999 to 2008, 1200 amongst them were males. ¹² These alarming trends in deaths in custody warrant detailed analyses. An attempt was made in the present study to analyze custody related deaths according to demographic data, their cause and manner of death.

In the present retrospective study, we have analyzed 54 cases of custodial deaths during the period 2014 to 2018. Maximum cases (n=18, 33.33% were observed in 2017, much more than the previous years. Males constituted maximum cases (93%). Rarity of female custodial deaths is recorded by National Crime Records Bureau (NCRB) and also globally.^{7,8} Bardale et al.⁴ and Dogra TD, et al. ¹² observed no female deaths in custody and attributed rarity of crimes by female as a reason for it. It was discovered that the most frequently affected age group was 41-50 years, followed by 31-40 years. Comparable findings were observed in India and Canada ¹³ where 21 to 40 years was most common age group. This age group can be explained by the fact that whose committed crime in their young ages get debilitated disease in elderly ages with lack of proper nutrition (as per Prison Statistics of India-National Crime Bureau Record.)

With respect to manner of death, out of 54 cases, maximum cases (79.62%) were of natural deaths. Other researchers also found that natural deaths are more common than unnatural deaths,^{5,15,16} but some workers^{14,15} reported that unnatural suicidal deaths were more prevalent. Natural deaths were also observed to be common amongst 1702 custodial deaths (1507 natural and 195 unnatural) during the year 2014 by NCRB. Among the natural deaths, most of the deaths were due to respiratory system involvement with pulmonary tuberculosis being commonest. This finding was supported by various researchers including Bhana BD.¹⁶ However, Wobeser, et al.¹³ found that the majority of deaths were due to cardio-vascular diseases, which was only one in our study. Apart from pulmonary tuberculosis, other lung disease, ischemic heart disease, persons died due to cerebral infarction, cirrhosis of liver, meningitis and carcinoma. Tuberculosis control program within prison should be given greater emphasis by the Public Health establishment to curb higher prevalence of tuberculosis.

Suicide was the most common unnatural manner of death in present study was in form of hanging. The present study is in line with that of Bansal, et al.¹⁴ who found that suicide is the most common unnatural manner of death; however they found that fall from height was the cause in most of suicidal cases, as opposed to poisoning in present study. Poisoning and hanging ^{7,10} were also observed to be most common method of suicide by other studies. Hanging, drowning and stab injury to abdomen were other suicidal modes observed in this study. Past history of psychiatric illness or deliberate self-harm should be sought from detainees as they are independent risk factors for suicide in custody.⁶ Promoting suicidal awareness among police/jail surgeons and custody staff should increase likelihood of detecting suicidal tendency of a prisoner.

All these cases, be it natural deaths or unnatural deaths, show

some sort of carelessness and disrespect for human life on the part of authorities. Authorities are not aware about any history related to health of inmates and they take action only when the condition deteriorates and the inmates ultimately succumb to death. Limitation of study may be apparent due to slightly older data. An investigation of a custodial death is multipronged and involves additional agency like NHRC. Scientific conclusions drawn may be inappropriate or at times inadequate when case is sub-judice which may remain so for protracted period. This study holds relevancy as it has evaluated cause and manner of death of custodial deaths which come to fore after conclusions of investigation and confirmation by judiciary.

Conclusions

Maximum deaths occurred due to natural causes, with tuberculosis being the leading killer. This highlights the importance of stringent pre-arrest health check-up of convicted persons. Proper ventilation and frequent fumigation of detention cells can be a preventive measure to curb respiratory ailments. Emphasis should be placed for better implementation of tuberculosis control programme in prisons. Immediate diversion of prisoners to the hospitals when their condition appears to require urgent medical attention should be practiced.

Amongst violent death, most of the deaths were by suicide and poisoning remained the method. Common problem faced by postmortem conducting doctor is this investigation is done by judicial magistrate who are generally not doing routine inquest so number of times medical board has to explain them about procedures like who will deposit viscera taken during postmortem to FSL and how videography is to be done and its production in court as evidence of choice. Higher rate of suicide with poisoning and hanging reflects importance of identifying suicidal tendencies among prisoners. Question should be addressed as to how individuals obtain poisons and lethal weapons such as knives, ligature materials, etc. It throws light on the loose security of jails leading to access of prisoners to such agents. This study illustrates the range of diversity present in regard to human behaviour and disease and offer new directions for understanding some of the needs and conditions of those in custody.

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ORIGINAL ARTICLE

Age estimation from radiological examination of epiphyseal union of upper end of humerus in girls from Ahmedabad region

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Abstract

Age estimation of an individual is of medicolegal importance. In criminal cases, the judgment is based on the opinion about age given by the forensic physicians. In the present study fusion of the proximal end of the humerus in 100 girls of Ahmedabad region is studied on the radiographs. The digital X-ray of shoulder joint in AP view was taken to study the appearance and fusion of ossification centres of proximal end of humerus. The observations were made and compared with previous studies.

Keywords

Age estimation; Girls; Proximal end of humerus; Shoulder joint; Radiograph

Introduction

Identification is determination of individuality of a person based on certain physical characteristics i.e. exact fixation of personality.¹ It may be complete (absolute) or incomplete (partial). Complete identification means the absolute fixation of individuality of a person. Partial identification implies ascertainment of only some facts about the identity while others remain unknown.² For identification certain facts are determined like race, age, sex, stature, etc. Article 6 of the universal declaration of human rights states that everyone has the right to recognition everywhere as a person before the law.³ The question of identification of a living person is mostly the concern of the police and is raised in criminal courts in connection with absconding soldiers and criminals, or persons accused of assault, rape, sodomy, or murder, or when there is a mix-up of new born babies in hospital, or young lost children; and occasionally, in adults who have lost their memory. It is also frequently raised in civil courts owing to impersonation practiced by people to secure unlawful possession of property, insurance claims or to obtain the prolongation of lapsed pension.4

Estimation of age is a role that a forensic physician often has to play, particularly in developing countries, where many births take place in rural settings, without the benefit of expert supervision by a trained obstetrician. Such births are poorly recorded or more often not recorded at all in terms of exact dates. In many other cases, records are fraudulently falsified with the prospect of financial gain, e.g. to obtain government posts or pensions. Developed countries, where ordinarily birth records are meticulously maintained, are not immune to this

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Received: 7th November, 2019; Revision received on: 20th December, 2019 Accepted: 29th December, 2019 problem either. Estimation of the age of living individuals may be needed in the case of refugees/asylum seekers or other persons who arrive without acceptable identification papers.⁵

The age of an individual can be determined from teeth, ossification of bones, and secondary sex characteristics and general development in case of children.¹ In ascertaining the age of a person, radiograms of several main joints of the upper or lower limbs of one or both sides should be taken. Owing to the variation in climatic, dietetic, hereditary and other factors affecting the people of the different states of India, it cannot be reasonably expected to formulate a uniform standard for the determination of age of the union of epiphysis for the whole of India. Considering these variations, this study is an effort to determine the status of ossification of shoulder joint which would be helpful for age determination of girls between 14-20 years age group in Ahmedabad region.

Materials and Methods

The present study is prospective, cross sectional study which was conducted in the department of Forensic Medicine and Toxicology at B.J. medical college and Civil Hospital, Ahmedabad. This study was carried out on total 100 female individuals between age group of 14 years to 20 years of Ahmedabad region. Individuals with valid documentary proof of date of birth like birth certificate, school leaving certificate, ration card, election card ID, aadhar card, school ID, driving license, etc. were included. The subjects having pathology or bony deformity, congenital malformation, nutritional deficiency, endocrinal disorders, history of chronic drug intake (e.g.) anti-epileptic drugs, steroids, chronic illness and pregnancy were excluded. Written and informed consent for Xray of shoulder joint was taken. The X-ray of the shoulder joint was taken in antero-posterior (AP) view using a factor 55 KVP and 9 MAS. Care was taken for the centering of x-ray tube over the epiphyses as it is quite easy to give ununited epiphyses the appearance of union by directing the cone of rays obliquely. Adequate precautions were taken to avoid unnecessary x-ray exposure of subjects by providing them lead gown. Skeletal

maturity was evaluated according to the Jits and Kulkarni's classification of four stages i.e. appearance, non fusion, partial fusion and complete fusion. X-Rays showing clear gap between the epiphysis and diaphysis, showing saw tooth like appearance end were designated as "Non-fusion" (NF) X-rays. The X-rays showing a line replacing the hiatus between the epiphyseal and diaphysial ends and not showing saw tooth like appearance were designated as "Partial Fusion" (PF) X-rays. X-Rays showing the same bony architecture in the diaphysis and epiphysis and showing scar of the previous stage were designated as "Complete Fusion" (CF).⁶ The master chart was prepared and tabulated as per code number given above.

Results

Proximal end of humerus in female showed non fusion in 100% and 78% cases in 14-15 years and 15-16 years age group respectively. Proximal end of humerus in females showed partial fusion in 22%, 100%, 16% and 6% cases in 15-16 years, 16-17 years, 17-18 and 18-19 years respectively. Complete fusion was seen in 84% and 94% cases in 17-18 years and 18-19 years of age groups respectively, whereas 100% cases showed complete fusion in 19-20 years age group. It was completely fused in all 100 % cases between 20-21 years of age group. Results are depicted in Table 1 and Figure 1.

 Table 1: Percentage of Fusion in female cases

Age (yea	urs)	Non-Fusion (NF)	Partia (PF)	l-Fusion	Complete (CF)	Fusion	Total
14-1	15	15(100%)	0(0%)		0(0%)		15(100%)
15-1	16	7(78%)	2(22%))	0(0%)		9(100%)
16-1	17	0(0%)	14(100	%)	0(0%)		14(100%)
17-1	18	0(0%)	3(16%))	16(84%)		19(100%)
18-1	19	0(0%)	1(6%)		15(94%)		16(100%)
19-2	20	0(0%)	0(0%)	0(0%)		13(100%)	
20-2	21	0(0%)	0(0%)		14(100%)		14(100%)
Total 22(22%)		20(20%)		58(58%)		100(100%)	
PARTICIPANTS (%)	100	0 22	0 100	0 16 84	0 0 6	0 0	0 0
,	14-15 AGE (IN)	15-16 (EARS)	16-17	17-18	18-19	19-20	20-21

Figure 1: Graph showing percentage of fusion in different age groups

Discussion

In the present study it is evident that, fusion of head of humerus does not begin below 16 years of age and number of candidates showing greater stage of fusion increased with the advancing age. Complete fusion was seen earliest in the age group 17-18 years in 84% of cases and in the age group 18-19 years in 94% of cases. It was seen in 100% of cases in the age group 19-20 years and 20-21 years.

Comparative analysis of previous studies from India and other parts of the world shows that in significant number of cases, the age of fusion of head of humerus is 17-18 years in females, which is in accordance with those reported by Reddy (Andhra Pradesh 1973)¹, Saini (Jaipur-2005)⁷, Agarwal (Delhi 2006)⁸, Pimple (Mumbai 2013)⁹, and Tirpude (Maharashtra-2014).¹⁰ This is in contrast with studies by Galstaun (Bengal-1937)¹¹ study which showed the fusion at 14-16 years, and Flecker (Melbourne-1932)¹² that showed fusion of upper end of humerus at 17 years in female. However, studies conducted by Davies and Parson (England-1927)¹³ and Cardoso Hugo (Spain-2008)¹⁴ showed delayed fusion by one to two years. The observations of previous researchers regarding ossification of proximal end of humerus are shown in Table 2.

 Table 2: Comparison of ossification of proximal end of humerus with other studies in different parts of India and world

Study	Age of ossification
Hepworth (Punjabi-1929)	17-18
Pillai (Madras-1936)	14-17
Galstaun (Bengal-1937)	14-16
Reddy KSN (Andhra Pradesh-1973)	17-18
Sahana S N (Bengal-1986)	18
Saini O P (Jaipur-2005)	17-18
Agarwal Anil (Delhi-2006)	17
Pimple D H (Mumbai-2013)	17-18
Tirpude B H (Maharastra-2014)	17-18
Paterson (Manchestor-1926)	18
Davies and Parson (England-1927)	19-21
Flecker (Melbourne-1932)	17
Krogman (USA-1960)	18-19
Cardoso Hugo (Spain-2008)	20
Memon et al (Pakistan-2008)	16-17
Present study	17-18

Conclusion

The present study showed that the complete fusion of head of humerus occurs at the age of 17-18 years in the girls of Ahmedabad region. This study can be used as reference for age estimation in the Ahmedabad region. This study also emphasizes on the use of ossification centres in the shoulder joint for age estimation while dealing with various medicolegal cases. Results of this study are mostly in accordance with various Indian studies. However there was regional variation with few studies from India and abroad. Hence it can be concluded that ethnic, dietary, climatic factors, etc affects the ossification of various centres. To determine these changes in every region of India, studies are recommended at regular time period. **Ethical clearance:** A prior approval was obtained from the Institutional Ethics Committee

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REVIEW ARTICLE

Application of facial soft tissue thickness for facial reconstruction using Cone-Beam Computed Tomography: A Review

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Abstract

Facial reconstruction using the measurement of soft tissue depth relies directly on the relationships between the facial features like the profile, thickness of subcutaneous soft tissues and the underlying bony shape and skull structure. The soft tissue thickness values vary significantly in different geographical areas due to the unique facial features of the individuals in that particular location. Thus there is a requirement to assess population-specific values those reported for comparable groups based on geographical locations and various ethnicities. This literature review is an attempt to shed some light on the need for soft tissue thickness facial reconstruction in various populations for the purpose of Forensic identification. This knowledge helps when there is no clue for potential identification of an individual, and as a result, the comparison of the same remains with any familiar material becomes impossible. In such cases, the recreation of antemortem appearance by face reconstruction becomes vital to positive identification. The radiographic examination can be used to examine the human cranium for qualitative or quantitative identification, directly or indirectly. At present a variant of medical Computed Tomography (CT) is applied in dentistry called Cone-Beam Computed Tomography (CBCT) which uses lower levels of radiation but produces a similar resolution in skull imaging as well as digitization. At present, it is also being used in contemporary facial reconstruction studies. Through this review, we are trying to establish the use of an assessment of facial soft tissue thickness for the purpose of facial reconstruction using CBCT.

Keywords

Facial soft tissue thickness; Identification; Facial reconstruction; Cone-Beam Computed Tomography

Introduction

In the Legal Medicine Institutes, the importance of forensic dentistry has become evident and effective in the identification of unknown bodies, the victim and criminal identification, estimation of age, race, stature sex, esthetic and functional loss.¹ Identifying human remains of undisclosed origin continues to be a challenge for Law enforcement and humanitarian agencies worldwide. In such cases with lack of positive identification, a technique called as 'facial approximation' (usually referred to as facial reproduction, facial reconstruction, and facial restoration) is made. The technique of developing a portrayal of the face from the skeletonized skull of an individual is referred to as Facial approximation.²⁻⁴ The human skull is unique as well as complex and also distinct as a fingerprint. After retrieval of an unknown skull, assessment of properties such as race, ancestry, approximate age, sex, and stature is done. The human cranium can be identified through qualitative or quantitative methods. It can be studied directly or indirectly using radiographic examination. These radiographic images may provide

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Received: 13th April, 2019; Revision received on: 23th November, 2019 Accepted: 10th December, 2019 consistent data which can be used in human identification. The various aspects which be analysed are teeth, alveolar bone, trabeculated bone, anatomic variations and contours and volume of sinuses and cavities, etc.⁵

Facial reconstruction and approximations

Forensic science and archaeological research can use computed soft-tissue shape outline from skeletal remains by the application of facial tissue approximation method. The aim of these researches is to correlate the craniofacial shapes, with soft-tissue outlines and to estimate and analyze the extent to which it may be practicable to envisage and formulate the latter from the former. Theoretically, this can be achieved by the incorporating artificial intelligence functionally cognitive to a human artist who creates facial reconstructions manually by past experiences. The relationship between facial form and skull structures is demonstrated by ideal relationships based on a database of the existing craniofacial models. In a living person, an example relationship exists as the skull corresponds with an actual face that is observed.6 This relationship is preserved accurately during skull digitization using CT as well as in CBCT imaging due to the anatomical accuracy being preserved.7

In the present scenario where highly sophisticated offenses are committed, there is a need for emergence or invention of new technologies in forensic investigation to check the crime rate. This will ensure better application of the benefits and the emergence of new technological resources. 3D modelling developed Facial approximation technique, would be improved by the availability of consistent, current, well-defined and statistically vigorous soft tissue data with respect to various world populations—a research which is still in emerging phases in craniofacial soft tissue depth analysis.⁸ In such a scenario, CBCT offers discrete advantages over other techniques, as a non-invasive and economical, in developing facial approximations for forensic identification utility.

Facial Soft Tissue Thickness (FSTT)

The construction of ante-mortem face from the human skull is a scientific art which is known as forensic facial reconstruction. The reconstruction of the facial contours enables facial recognition which is made by the aid of Facial Soft Tissue Thickness (Capulometric measurements). The probable face reconstruction requires the FSTT data of the particular anthropological landmarks which vary in different ethnic groups.⁹ An example is a study conducted by Steyn M and Iscan MY among white South Africans, from cadaver collections to find out differences between males and females using mandibular measurements obtained results which showed that the most discriminatory finding was of the was bigonial breadth as it obtained an average accuracy of 82% for mandible.¹⁰

The process of identification uses a comparison between past and present data. It is a set of various methods to identify a person living or dead, and is of great importance not only for judicial reasons but also for social purposes. The applications are also part of the archaeological process in terms of identification of race or sex of an individual or any other identify parameters which can be availed based on the existing data. Hence more number of studies relating to facial soft tissue depth measurements have to be conducted categorizing the individuals based on ethnicity, race, sex, age, etc. the data of which can be applied for facial reconstruction database.²

An Analytical Review conducted by Stephan et al. on 66 publications related to the mean facial soft tissue depths. The studies analyzed were broadly accumulated under two age groups: adults (equal to or greater than 18 years) and sub-adults (at single integer age groups 4–8 years). This study demonstrated that the multitude of data available of FSTT for adults in the literature can be integrated to provide a simplified yet statistically potent data set. This article also demonstrated that newer studies and more research would increase their value to beat the limitations inherent in the existing data (in dealing with primary problems like those associated with standardization, application error and measurement error). They also highlighted the need for storing raw data for more comprehensive analyses to be conducted in the future.¹¹

The second paper by Stephan et al produced five studies reporting mean values for sub-adults. The results showed that the graphs revealed that, with advancing age FSTT for sub-adults increased and/or decreased even though the trends were minimal.¹²

Imaging as an aid to facial reconstruction

The identification of a decomposed body is extremely difficult and has significant legal and social consequences. Earlier the studies on FSTT were carried out manually on cadaver samples, like those by Steyn M.¹³ The comparison between radiographic images of parts or the whole of the body to those of the missing person especially is very crucial for identification. Halazonetis DJ conducted a study on 170 Lateral cephalograms of orthodontic patients, out of which 22 soft-tissue and 2 dental landmarks were processed and digitized by applying Procrustes superimposition as well as principal component analysis. A correlation analysis was derived for the principal components of the soft-tissue shapes and skeleton. Correlations were found to be significant between the skeletal and the soft-tissue measurements. The 7 anterior skeletal landmarks used in the study excluding nose, resulted in predictive power of 38%. They concluded that data obtained from the anterior dental and skeletal landmarks could be applied to predict soft-tissue profile shape with a 50% power in adolescents and children.¹⁴ In conventional two-dimensional radiography, changes in the direction of rays of X-ray beam can cause variations on the resultant images and hence may prove deleterious for positive comparison as it may lead to wrong identification.²

Three-Dimensional Imaging

The Limitations that arise out of two-dimensional imaging have to be managed with technological up-gradation of the imaging procedure. In this regard, the use of three-dimensional imaging represents a substitute method with greater precision, and it has numerous advantages over the conventional radiographic examination. The study conducted by Parks et al. using threedimensional imaging technique consisting of cranial CT scans of 388 living adults from the FBI sample collected from 2003-2009 is one such example. The scans included males and females ranging in age from 18 to 62 years. The sample population consisted of four self-identified ancestry groups from the United States. The CT scans were acquired under a variety of scanning protocols, from multiple institutions. The slice thicknesses ranged from 0.98 mm to 6.00 mm, slice increments ranged from 0.10 mm to 5.00 mm, pixel size ranged from 0.449 mm to 0.586 mm, and three X-Y image resolutions were used in the protocol. Statistical test results noticed that the tissue depths collected from the samples evaluated in this article have consistently and significantly larger sample size than those published by Stephan 2012. The dataset presented in this particular study were representations from modern American adult population and were appropriate for use in constructing contemporary facial approximations of that particular race.¹⁵

Application of Cone Beam Computed Tomography

Among the various techniques used to determine the FSTTs, CBCT imaging provides a non-invasive alternative.⁹CBCT is a modification of medical CT frequently used in dentistry which can produce a similar resolution in digitization of the skull using lower levels of radiation three-dimensionally. CBCT imaging is now also being used in forensic identification for the purpose of facial reconstruction studies. CBCT is a non-invasive technique in forensic dentistry as compared with other techniques.¹⁶

Sexual dimorphism was evaluated in a study conducted by Kharoshah et al. on mandibular images by using anthropometric measurements obtained by performing CBCT. Six measurements (gonion-gnathion length, ramus length, gonial angle, minimum ramus breadth, bicondylar breadth and bigonial breadth) were used for the analysis of sexual dimorphism. Out of the six mandibular measurements, three of them (bicondylar breadth, gonial angle and minimum ramus breadth) showed marked higher mean values in males than in females.¹⁷ Oliveira et al. performed anthropometric measurements on 159 CBCT scans of Brazilian population collected from individuals aged 18-60 years out of which 74 were males, and 85 were females. Five reviewers analyzed all the CBCT images. Six measurements (gonion-gnathion length, ramus length, bigonial breadth, bicondylar breadth, gonial angle and minimum ramus breadth) were analyzed for sexual dimorphism. The rate of correct sex identification was 95.1% using these four variables. In forensic settings, they suggested that sex estimation can be made using the formula developed in this study.¹⁸

Advantages of CBCT in facial soft tissue depth measurement techniques

The use of CBCT ensures that the projectional magnification is computationally correct during primary reconstruction, and the corrected orthogonal image forms a 1:1 ratio. Hence, images are dimensionally accurate.¹¹ CBCT has numerous advantages over disadvantages of soft tissue depth measurement techniques made by Computed Tomography (CT), Magnetic Resonance Imaging (MRI) or any other methods¹⁹ one among them is the image produced with the subject in erect seated position. The patient is in a supine position when scan with CBCT is performed, and this negates the gravitation deformation of soft tissues which is found in CT scans.¹⁴ The use of CBCT represents a substitute method with greater precision, and it has numerous advantages over the conventional radiographic examination. Another advantage is the probable facial reconstruction from the FSTT data of an unknown individual, is that it aids the victim's family and associates in easier and welldefined visual identification.

Significance of facial soft tissue depth determination using CBCT

The identification of a decomposed body is extremely difficult and has significant legal and social consequences. The comparison between radiographic images of parts or the whole of the body to those of the missing person especially is very crucial for identification. In conventional two-dimensional radiography, changes in the direction of rays of X-ray beam can cause variations on the resultant images and hence may prove deleterious for positive comparison as it may lead to wrong identification.² Such limitations have to be managed with technological up-gradation of the imaging procedure. In this regard, the use of CBCT represents a substitute method with greater precision and it has numerous advantages over the conventional radiographic examination. Another advantage is the probable facial reconstruction from the FSTT data of an unknown individual, is that it aids the victim's family and associates in easier and well defined visual identification.

Conclusion

There is abundant literature pertaining to facial reconstruction using soft tissue depth determination. But the application of CBCT as an aid in this art is sparsely studied. This review suggests the use of CBCT data for determination of FSTT with emphasis on definite advantages of the same over other methods. This method can be applied in countries like India where ante-mortem records are rarely maintained, using which facial profile of an unknown skull can to be manually or digitally reconstructed. Hence population-based studies gathering FSTT databases have to be conducted which can be utilised for individual forensic identification.

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CASE SERIES

Gang rape: An analysis of a series of nine cases

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Abstract

Rape is a heinous crime against women, and gang rape occurs when a group of people participate in the rape of a single victim. In this paper, nine cases of gang rape have been analyzed. Most of the victims in this series were young teenagers. Further, in seven of these nine cases, the perpetrators were young boys, and most of these assailants were not known to the victims. Involvement of intoxicating agent was observed in two of the victims. Six of the nine cases of gang rape occurred outdoors in isolated areas in evening hours, and one girl was raped inside a hotel room. This case series is an analysis on the pattern of gang rape cases in this part of the country. Profiling of victims and perpetrators may be vital in devising preventive strategies.

Keywords

Gang rape; Teenagers; Perpetrators

Introduction

Gang rape is when a group of people participate in the rape of a single victim and involve at least two or more violators. Under Section 376(2)(g) IPC, where a woman is raped by one or more in a group of persons acting in common intention, each of the persons shall be deemed to have committed gang rape. As per the National Crime Records Bureau (NCRB), rape cases in India have increased by 12.4 per cent from 34,651 cases in 2015 to 38,947 in 2016. Gang rape cases are also on the rise with 2167 cases reported in 2016 as compared to 2113 cases in 2015.¹

There are limited studies on gang rapes in India. The presented series is a preliminary analysis of nine gang rape cases in the capital city of a North-eastern state of India.

Case series

This case series includes a total of 9 cases. These cases were brought from in and around Imphal by the police for medicolegal examination in the Department of Forensic Medicine, Regional Institute of Medical Sciences, Imphal between May, 2016 to March 2018. The age of the victims ranged from 12 years to 34 years. The number of accused involved in these incidents ranged between 2 and 6. Case no. 4 and 5 were of the same incidence involving 6 perpetrators in which 3 of them took turn to commit the offence of rape while the other 3 were taking pictures of the act. In four cases, the accused were known to the victims. In case no. 1, there is history of alcohol intake and in case no. 3, unknown drug was injected into the buttock of the victim. Most of the cases occurred in the

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Case	Age of victim	Number of Accused	Age of accused	Time of incident	Place of incident	Relation with accused
1	15 years	2	18 years each	Evening	Hotel	Friends
2	12 years	4	45, 33, 15 & 13 years	Morning	House of accused	2 Uncles & 2 cousins
3	18 years	5	50, 50, 35, 35 & 45 years	Evening	Isolated place	Neighbours
4	17 years	6	All less than 20 years	Not known	Isolated bushy area	Unknown
5	17 years					
6	22 years	2	40 and 22 years (Father and son)	Afternoon	Out-skirts of town	Unknown
7	14 years	3	Not known	Evening	Isolated place	Unknown
8	34 years	2	Not known	Evening	Inside mini truck at roadside	Handyman & driver
9	19 years	3	Young adults	Evening	Cemetery	Unknown

Table 1: Details of the cases of gang rape included in the study

Table 2: Details of genital and other body injuries

Case	Body injuries	Genital findings
1	Bruises on chin and other parts of body.	Labia minora: Abrasions present Fourchette: red and tender Hymen: fresh tear in 5 and 9 O'clock positions.
2	Absent	Labia minora: red, tender and abraded.
3	Multiple patterned bruises on body	Labia minora and hymen: red and tender. Hymen: Old tears at 5 & 7 O'clock positions.
4	Absent	Hymen: Old tears at 7 & 9 O'clock
5	Absent	Hymen: Old tears at 6 & 8 O'clock positions.
6	Absent	Hymen: Old tear at 6 O'clock position with tenderness.
7	Multiple abrasions and bruises on the face, upper and lower on the face, upper and lower limbs. CT scan shows skull fracture and intracranial haemorrhages	Fourchette was abraded Hymen: fresh at 3 and 11 O'clock positions.
8	Absent	Hymen: Old tears at 3 and 9 O'clock positions.
9	Absent	 Labia minora: abrasions Fourchette: torn. Hymen: Fresh tear at 3 o'clock position

evening time and outdoors. The details of all the cases are summarized in Table 1.

Out of total 9 cases, fresh genital injuries were present in 4 cases. In case no. 6, hymen showed old tear with tenderness whereas in case 4 and 5 only old tears of hymen were present. The signs of physical violence were present in 3 cases. In case 7, head injury was present along with multiple abrasions and bruises. In case 1 and 3 as well, bruises and abrasions were noted. The general physical signs of violence and genital injuries are summarized in Table 2.

Discussion

Approximately one in 10 sexual assaults reported in the United States involves multiple perpetrators.² Gang rape is closely related to heightened masculinity and masculine aggression.^{3,4} Gang rape cases are on the rise in India i.e. it has increased from 2113 cases in 2015 to 2167 cases in 2016.¹ Nearly six in ten of the multiple perpetrator rape victims were below 26 years in a study by Vetten and Haffejee.⁵ In another study by Ullman⁶, it was observed that victims and offenders in gang rape incidents were younger. In our series also, most of the perpetrators were either teenagers or in their early twenties, and eight of the nine victims were teenagers.

In this series, most of gang rapes were committed during the evening hours, and involvement of drug and alcohol was present in two cases. Only three of the victims sustained multiple blunt force injuries. Ullman⁶ also observed that gang rapes are characterized by more alcohol and drug involvement, more night attacks, less victim resistance, and more severe sexual assault outcomes compared with individual rapes. Of the rapes committed by multiple perpetrators, only one in 10 involved perpetrators known to the victim.⁵In our series also, seven of the nine victims were raped by stranger assailants. Interestingly, one victim met her perpetrator through the social networking sites (Facebook). Six of the nine cases of gang rape

occurred outdoors in isolated areas, and one girl was raped inside a hotel room. It was observed by Vetten and Haffejee that the greatest proportion of gang rapes occurred in public spaces, with 31% taking place in open spaces like parks, stretches of field and parking areas. It was also observed that only 30% of women who were gang raped reported the attack to the police compared to the approximately 70% of women who reported being raped by single perpetrator. Hence, underreporting of gang rape cases is also a possibility in this part of the country.⁵

Conclusion

The case series analysis provides a preliminary pattern of gang rape cases in a north-eastern city of the country. Further studies are recommended on the subject in different parts of the country, as profiling of victims and perpetrators has a vital role in devising preventive strategies.

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CASE REPORT

Fatal pulmonary embolism due to asymptomatic right atrial myxoma: A case report

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Abstract

A case of sudden death of 24-year-old male was brought for medico-legal autopsy. The deceased had history of sudden onset of chestpain and breathlessness and was brought dead to hospital within two hours of initiation of symptoms. He was a healthy young adult and had no any previous illness or complaints. Autopsy found two large soft whitish, gelatinous, friable pedunculated tumors arising in the right atrium. We also found a large embolus of same characteristics obstructed at the bifurcation of pulmonary trunk. It was concluded that the embolus was the fragment originated from the atrial tumor and the cause of death was pulmonary embolism. Although, pulmonary embolism due to asymptomatic right atrial myxoma is extremely rare condition; it should be considered among differential diagnosis of sudden unexpected death as reported in the present case.

Keywords

Sudden death; Embolus; Right atrial myxoma.

Introduction

Sudden death of apparently healthy young person always had a devastating impact on their families, the close persons and the society. Very often the sudden natural deaths were subjected to medico-legal autopsy to determine cause and manner of death. The term 'sudden death' generally denotes unexpected, natural non-traumatic death. Sudden deaths can be instantaneous; sudden but not instantaneous, or cases where the individual is found dead.¹ The definition of sudden death is variable and it changes according to authority and convention. It is based on the amount of time between the onset of symptoms and death. The World Health Organization (WHO) defines the sudden death as, "A death, which occurs within 24 hours from the onset of symptoms".²

Primary cardiac neoplasms are rare entities, with an autopsy incidence ranging from 0.001% to 0.03%.³ Myxomas account for 50% of primary cardiac tumors and are usually found in the left atrium. A right atrial myxoma is a rare finding.⁴ The right atrial tumors can progress silently or have varied clinical presentation. Sudden death due to fatal pulmonary embolism originating from the mass can be first presentation of this pathological entity. In forensic literature, very few cases of death due to fatal pulmonary embolism of right atrial myxoma have been described.

Here, we report a rare case of sudden death of a healthy young male due to pulmonary embolism of right atrial myxoma which was discovered on autopsy.

Case report

A young 24-year-old unmarried male was brought dead to the Casualty Department of Government Medical College,

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Received: 21st September, 2019; Revision received on: 10th December, 2019 Accepted: 15th December, 2019 Aurangabad. He had history of sudden breathlessness and chestpain. He was a healthy person with no any previous disease or morbidity complaints. Being a sudden death, case was informed to Police who carried out inquest and subjected the body to medico-legal autopsy to know cause and manner of death.

The autopsy was conducted in Department of Forensic Medicine on same day. At autopsy, he was moderately built and wellnourished person. During autopsy, no any visible external or internal trauma was evident. We found a soft whitish mass at bifurcation of pulmonary trunk of size $4 \times 3.5 \times 1.5$ cm. The heart weighed 335 g with normal size and patent coronaries. The right atrium showed two large pedunculated, ovoid shaped whitish, soft tumor masses measuring 2.5 x 2 x 1 cm and 3 x 2 x 1 cm with multiple small nodules attached to endocardium. The right atrium was dilated; however, hypertrophy or dilatation of the right ventricle was not obvious as shown in Figure 1.



Figure 1: Two large pedunculated tumor masses in right atrium



Figure 2: Multiple small nodules in the right atrium

The tumor masses in right atrium and soft tissue mass from pulmonary trunk were very friable and had gelatinous consistency. The large masses arose from the margin of the fossa ovalis and small nodules distributed in surrounding areas as shown in Figure 2.

Abnormal growth or mass was not evident in other chambers of heart. Lungs were congested and oedematous without evidence of infarction. The meticulous dissection of pulmonary vasculature did not show any other emboli in major pulmonary arteries or branches. No any pathology in other organs was detected. All organs along with heart and soft mass recovered from pulmonary trunk were subjected to histological examination which confirmed growth to be myxoma. The final opinion as to cause of death was given as, "Pulmonary embolism of right atrial myxoma."

Discussion

The main objective of a medico-legal autopsy is to determine cause and manner of death and to reveal important evidences to prosecute the case in the court of Law. However, in sudden, unexpected natural death cases under medico-legal consideration, the autopsy has crucial role to detect the precise cause of death, helps to exclude the possibility of unnatural cause/ relative contribution of crime or trauma towards death which facilitate the investigation. This is report of sudden death due to fatal pulmonary embolism of right atrial myxoma.

As in our case, the typical myxomas on gross examination present as polypoid, ovoid, papillary, or pedunculated tumors with a gelatinous consistency. These tumors have a distinct stalk which may be broad or narrow. The usual site of attachment of atrial myxoma is the fossa ovalis or base of the interatrial septum.⁵ Tumors range from small to large with diameters varying from 1 to 15 cm.⁶ Two large tumor masses measured 2.5 cm and 3 cm in the greatest dimension were observed in our case. Also a large fragment with greatest dimension of 4 cm was detected in pulmonary trunk indicating presence of larger tumor in right atrium during life. Clinical manifestations of cardiac myxomas depend on the tumor size, location, mobility and friability.^{3,7} Symptoms may be of valvular obstruction, pulmonary/systemic embolic phenomenon leading to syncope/sudden death at times, or non-specific constitutional symptoms.

The term 'emboli' is used to describe detached intravascular mass that is carried by the blood to a site distant from its point of origin. Being intravascular and friable myxomas account for most cases of tumor embolism. Embolization has an estimated incidence of 30-40% and is more common with villous/papillary friable myxomas as in present case.⁷ Depending on the site of origin, emboli may lodge in pulmonary or systemic circulations from which the clinical outcomes are best understood. The fatal pulmonary embolism

from asymptomatic myxoma in the right atrium is an uncommon occurrence as in the present case which was diagnosed on autopsy. The large emboli lodged either in the pulmonary trunk or main pulmonary artery causes severe hemodynamic compromise leading to rapid death.

First case of cardiac myxoma in the right atrium was reported in 1908 and the association of pulmonary emboli with right atrial myxoma was first described in 1931.⁶ A vast majority of myxomas are sporadic which are usually solitary. While, about 10% of myxomas are passed down through families (inherited). The cardiac myxomas arise more frequently in women and usually present between ages of 50 to 70 years.⁷ In present case, deceased was a 24-year-old young male.

Histologically, cardiac myxoma consist of a myxoid matrix composed of an acid mucopolysaccharide rich stroma. Polygonal cells arranged singly or in small clusters are scattered throughout the matrix. Fibrocytes, smooth muscle, lymphocytes and plasmacytes can be seen occasionally in the matrix. A peculiar observation is the presence of illformed vascular channels. Cardiac myxomas are thought to arise from embryonic rests, which may differentiate into several cell types.⁴

Conclusion

Pulmonary embolism should be considered in the differential diagnosis of sudden death cases brought for medico-legal autopsy. Though rare, the right cardiac myxoma could be the reason for pulmonary embolism which should be actively searched as sudden death among asymptomatic right atrial myxoma is a known phenomenon.

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CASE REPORT

A rare injury pattern on heart in a lightning death – A case report

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Abstract

Lightning strikes are one of the leading causes of death due to natural disaster in Odisha, India. This is a case report describing an elderly female who died on the spot along with a co-worker while working in the field due to lightning strike. No specific keraunopathologic features were found externally. However, on heart, a linear contusion along the interventricular groove with rupture at its apex was observed. Since the event was witnessed, the cause and manner of death could not be disputed.

Keywords

Lightning bolt; Ruptured heart; Myocardial contusion; Kerauno-pathology

Introduction

Lightning is a huge spark, due to electrical discharge taking place between the clouds, within the same cloud or between cloud and earth.¹ A lightning strike especially cloud to earth can injure or kill its victim in either three ways: direct hit, side flash or conduction through another object.² With a direct hit, death is probably inevitable, because of burns and injury to the respiratory centre of the brain.³ Odisha is often called the country's natural disaster capital because of the frequency with which calamities such as floods, droughts and cyclones hit the State. Statistics show that of all the calamities that befall the State at regular intervals lightning claims more human lives than any other.⁴ In Odisha the frequency of lightning during pre-monsoon and monsoon period is high and it claims the lives as estimated at an average 325 per year with greatest incidence among farmers, daily labourers and self-help groups.⁵ It is observed that the greatest number of lightning strikes usually happen in the afternoon and early evening in the period between the end of summer and whole of rainy seasons. Here we report an unusual case where contusion and tear of heart without any distinguished external injuries to the victim resulting from thunderstorm is emphasized along with our discussion review on the effect of it on human and the ways in which death due to lightning can be prevented.

Case Report

A 55-year-old average built female was brought to the mortuary for post mortem examination with history of death due to lightning. The history as stated by the relatives and the investigating officer was that the deceased along with a co-

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Received: 24^{th} September, 2019; Revision received on: 15^{th} December, 2019 Accepted: 19^{th} December, 2019 worker succumbed to death after striking of sudden thunderstorm while working in an open cultivated farming land during the period of harvesting. The inquest report indisputably mentioned that the cause of death is lightning. Moreover, it did not mention any electrical, thermal or mechanical injury over the body.

The height of the deceased was around 172 centimetres. The whole body was unhurt with features of congestion on face and both conjunctivae. The nail beds of the upper limbs were intensely bluish. There were no perceptible burn injuries over the body of any type as seen in lightning. Body was damp along with the untorn and undisturbed sari.

On examining the cranial cavity, a moderate degree of congestion of meninges and brain were seen. The pericardial cavity was intact, untensed and contained faint red colour blood around 100 ml. A ruptured wound with oozing of blood was observed on the apex of the heart in between the ventricles with a line of redness almost separating the heart into two halves (Fig.1 and 2).



Figure 1: Anterior surface of heart

The chest wall with the rib cage was found to be intact without any form of mechanical injuries either on the front or back. The findings of visceral organs were nonspecific but with a moderate degree of congestion without any specific pathological changes. While opining the injuries and cause of death we considered the circumstantial evidence of thunderstorm with the findings of heart. The contusion and the rupture of heart were antemortem in nature and were consistent with lightning. These injuries are necessarily fatal to cause death in ordinary course of nature.



Figure 2: Posterior surface of heart

Discussion

Before the famous "Kite" experiment by Benjamin Franklin in 1752, Lightning used to be considered as an act of God. He proved that the lightning stroke is because of the discharge of electricity.⁶ Large amount of static electricity built up in cloud gets discharged to earth by a lightning bolt containing direct current of about 20,000 amperes and about a million-volt over a period of 30 microseconds.⁷ Clothes are usually torn or burnt at the point of entry or exit with some exceptional cases, where clothing is not damaged even though the person has been killed.⁸ Punctate full-thickness burns, linear charring, contact burns from overlying metal objects are common cutaneous findings associated with lightning, though majority cutaneous injuries are superficial and heal without sequelae.9 Branching or ferning marks called Lichtenberg figures are uncommon and unusual cutaneous manifestations.9 When a person is struck by lightning, his body gets electrically charged then the current passes through the body and gets dissipated into the ground.¹⁰ This passage of current results in mechanical trauma to any organ on its path. For instance, a strike whose path crosses the chest can result in localized myocardial contusion.¹¹ In our case, a linear contusion almost separating the heart into two halves are seen in the Figure 1, and Figure 2. Wetli, Charles V et al analysed 45 victims of fatal lightning strikes revealing that

craniocerebral injuries and cardiac contusions can be a serious direct consequence of lightning strike.¹² Lightning injuries can be prevented by taking various precautions like avoid going outside, stay away from tall trees, electrical gadgets and metallic substance during the thunderstorm.¹³ Adults and children are to be educated about the danger of lightning.¹

Conclusion

Lightning can cause instantaneous or delayed death by causing the injury to almost all organs. The injury to heart without causing any externally mechanical trauma from lightning is a rare possibility. It is important that the health authorities create awareness and educate the public about the potential danger of lightning.

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CASE REPORT

Foreign body ingestion and precautions during imaging (Button battery case)

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Abstract

Foreign body ingestion is a common problem seen in toddlers and in some the habit may go up to a little long. The most commonly ingested foreign bodies are: coins, magnets, batteries, small toys, jewelry, buttons and bones. Prompt identification and localization of ingested foreign bodies is essential in determining the appropriate treatment, as several types of commonly ingested foreign bodies require urgent removal and others can be managed conservatively. The most common age group includes toddlers and young children. But many a time they present with atypical history. The history may be from sibling who has not witnessed exactly or from the child himself who in turn due to fear might have told some other material as the offending item expecting to escape from parent's scolding! It is essential that every clinician should rule out all possibilities in such case scenarios especially by doing imaging of the commonly impacted areas.

Keywords

Button battery; Foreign body; Autopsy

Introduction

Foreign body ingestion is a common problem seen in toddlers and in some the habit may go up to a little long. When a foreign body aspiration comes to casualty, most of the times parents may not be aware what the child had taken, only thing they must have seen is the child is ingesting something out of the reach of parents and many times it may be from the history of sibling. The child also won't be ready to tell what he ingested and what difficulties he/she is experiencing.

According to the National Hospital Ambulatory medical care Survey, there were approximately 5,35,000 emergency department visits with foreign body-related primary diagnosis in the United States in 2010. ¹ Emergency department is usually the first point of contact for patients who present with symptoms of foreign body aspiration. So it is important for the clinician who is working in emergency medicine to keep open all the possibilities presented with atypical history of foreign body ingestion. We are reporting such a case where the doctors were in a dilemma or they couldn't arrive at a conclusion due to atypical history and by missing the necessary investigations a precious life was lost.

Case Report

Case history: A six-year-old girl presented in emergency medicine department of Safdarjung Hospital, New Delhi with complains of 2-3 episodes of vomiting. Parents were having the doubt of Pepsi bottle cap ingestion as her sibling told she ingested something and she had the habit of ingestion. On

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Received: 5th October, 2019; Revision received on: 20th December, 2019 Accepted: 20th December, 2019 examination the patient was conscious and stable. Her pulse rate was 24/minute, respiratory sounds clear. Per abdominal examination revealed non-tender and not palpable.



Fig. 1A: Oesophagus showing the perforation; 1B: Button battery recovered

The emergency medicine doctor advised for injection Emeset stat and injection Rantac 10 mg stat and advised for X ray abdomen and USG abdomen and for paediatric surgery and ENT reference. Both studies were normal and so they left home. Later on she was complaining of difficulty in eating (dysphagia) but the family thought it because of treatment she underwent. On 10-3-18 she had an episode of haematemesis and she collapsed in bathroom. The girl was taken to AIIMS trauma center emergency where she was declared brought dead at 8.53 am. Later on police was intimated of unnatural death and body was shifted to mortuary.

Autopsy findings: Autopsy was conducted on requisition of the concerned police. The child measured 105 cm length, and was moderately built and nourished. There were no external antemortem injuries. All the internal organs were pale. On careful dissection a button battery of diameter 20 mm and with marking CR 2032 was recovered 6 cm above the gastro-oesophageal junction (Fig 1A and 1B). The button battery was marked with a voltage of 3V and was at the level of the second constriction of the oesophagus or at the level of aortic arch.



Fig. 2A: H&E stain, 4x, Showing transition from normal esophageal mucosa to loss of mucosal layer, with underlying granulation tissue and foreign body particles; **2B:** H& E (40 x) Higher magnification of esophageal damaged mucosa, areas of necrosis, granulation tissue and foreign body particles

Severe necrotic changes were noted in the oesophagus (Fig 2A and 2B) with a perforation measuring 1 cm in diameter. An aortoenteric fistula was noted which resulted in the haemorrhage. The stomach contained about 800 gram of blood clot (Fig 3) and blood mixed fluid was noted in the small intestine throughout and in the mediastinum. The cause of death was due to haemorrhagic shock due to an arteroesophageal fistula resulting from button battery ingestion.



Fig. 3: Blood clot present in the stomach



Fig. 4A: Abdominal X-ray taken in emergency; 4B: Double ring on zoom in image

Discussion

From 2000-2009, 92% of disk batteries from fatal ingestions or those with major outcomes were 20 mm lithium cells. Most were imprint code CR 2032 (71%) or CR 2025 (21%).² "CR" represents the battery chemistry, "20" is the diameter and "32" indicates the thickness (3.2 mm) of the battery. The specific electrode arrangement of a button cell, such as type CR2032, with a relatively large surface area and a very small insulation

distance of 0.5 mm is responsible for the distinct electrolysis reaction within a moist mucous membrane, and thus the corrosive damage of the physiological structures.³ Although the incidence of BBI has been fluctuating, there is no clear incidence trend observed. However, the number of severe complications and fatal injuries has shown a 6-7-fold increase in 25 years.⁴

The most common place disk where the disc batteries become lodged, in turn resulting in clinical sequelae, is the esophagus. Batteries that successfully transverse the esophagus are unlikely to lodge at any other location. 94% of fatal cases or those with major outcomes involve batteries 20 mm or more in diameter. Esophageal damage can occur in a relatively short period of time (2-2.5 hours) when a disk battery is lodged in the esophagus. ^{5,6}

Analysis of clinical cases showed that button battery cells over 18 mm in diameter can get trapped in one of the three anatomical esophagus constrictions if swallowed. The increasing number of such cases seems to be a result of the common use of 20 mm lithium button batteries in many electronic devices in our daily life, which are used in calculators, watches, remote controls, computers and children's toys. In healthy adults, the gag reflex usually prevents the accidental ingestion of foreign bodies or corrosive substances. Since this reflex has not been fully developed in young children, the risk of accidental battery ingestion is particularly high for them.⁷

Liquefaction necrosis may occur because sodium hydroxide is generated by the current produced by the battery (usually at the anode which is the flat surface without an imprint code or '+' sign). Perforation has occurred as rapidly as 6 hours after ingestion. The 20 mm lithium batteries are 3V cells compared with 1.5V for other disk batteries. They have a higher capacitance and generate more current, which results in the production of more hydroxide rapidly.⁵

Deaths due to button battery ingestion are rare. From 1985-2009, only 13 of 56,535 reported ingestions were fatal cases (0.02%). Ingestion of a disk battery was initially missed by providers in 7 (54%) of the cases due to no initial history of ingestion and nonspecific presenting symptoms such as vomiting, fever, lethargy, poor appetite, irritability, wheezing, cough, and or dehydration. Exsanguination due to esophageal fistulae occurred in 9 cases (69%), of which 7 were aortoesophageal.⁵ Most children who ingest a disk battery remain asymptomatic and pass the battery in their stool within 2-7 days.⁸ Lodging of lithium cells is associated with disproportionately more adverse effects than lodging of other types of batteries due to their larger size and increased likelihood of impaction as well as their ability to generate more current.⁹

Imaging plays an important role in the workup and treatment of paediatric patients with suspected foreign-body aspiration or ingestion, and a familiarity with the appropriate imaging approach as well as the imaging appearances for common and dangerous foreign bodies is essential for the practicing radiologist. The first imaging step in suspected foreign-body ingestion is generally radiography. The initial standard imaging protocol includes frontal and lateral radiographs of the chest, neck (often included on the chest radiographs), and abdomen. Including the neck and abdomen in the imaging evaluation is important because using chest radiographs alone may result in failure to detect multiple foreign bodies, objects higher than the thoracic inlet or objects that have passed the pylorus. Lateral views are also important to confirm location.¹⁰ In this case X-ray of abdomen was taken (Fig 4A) but didn't take X-ray chest or neck. The edge of the button battery can be seen in the X-ray at the level of D6. If it would have covered little more upward it could have been easily noted. On zoom in the picture showing the double ring (Fig 4B). When looking at any round, opaque foreign body on anterior-posterior x-ray, it is useful to zoom in and look for a double ring or halo sign to distinguish it from a coin.

Impaction most commonly occurs in the esophagus and typically happens in one of the three locations. The first and most common is the upper esophageal sphincter, which is visible at approximately the thoracic inlet on a frontal chest radiograph. The second is the mid esophagus at the aortic arch impression. The third is the lower esophageal sphincter at the gatroesophageal junction. Other locations of possible impaction in the gastrointestinal tract are the pylorus, duodenum, and ileocecal valve.

Disk batteries in particular carry a high risk for corrosive injury to the gastrointestinal tract, including esophageal burns, fistula formation, and perforation. High-efficiency disk batteries can produce currents that cause liquefaction necrosis and thermal injury to the esophagus. Even "dead" batteries retain enough voltage to generate an external current and need to be removed promptly. Esophageal damage can occur in as little as 1-2 hours; urgent endoscopic removal is therefore indicated.¹⁰

In the particular case the clinicians have done every step to rule out it in the stomach and abdomen. X-ray abdomen and abdominal ultrasound was done. But the X-ray chest or neck could have saved the precious life. It shows the importance of imaging in foreign body ingestion, especially in a young child, where it is absolutely necessary to visualize the commonly impacted areas.

Conclusion

So in any case where the child presents with atypical history of ingestion of some foreign body which has not been witnessed and when neither the child is ready to reveal it because of fear and unaware of complications at a too young age, it is important for the clinician to rule out in each and every aspect. Performing X-ray is of utmost importance and the X-ray should include the commonly impacted areas or areas of constrictions in esophagus. Prompt identification and localization of ingested foreign bodies is essential in determining the appropriate treatment, as several types of commonly ingested foreign bodies require urgent removal while some others can be managed conservatively.

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OPINION

Consumer Protection Act, 2019 and its implications for the medical profession and health care services in India

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Abstract

The Consumer Protection Act, 2019 passed to address e-commerce and online trade challenges, product liability, and safety and dispensing consumer justice in alternative dispute redressal mechanism. The amending law had a seminal bearing on the medical profession and health care system as apparent from the express verbis exclusion of healthcare from the purview of 'service.' This provision exonerates the doctors from liability for defective services, and negligence of duty is a moot question to be examined. A careful perusal of the law reveals that it means service of any description made available to potential users to encompass the medical profession and health care service as well. The statutory interpretation and judicial enunciations are wide open in the context of the Indian Medical Association v. V.P. Shantha Case decided by the Supreme Court in 1996 also necessitated to be interpreted de novo. Under this backdrop, the paper takes a legal stance on the impact of the Consumer Protection Act, 2019 on the medical profession and health care delivery system in India.

Keywords

Doctor's liability; Health care; Consumer justice; Beneficial legislation; Wednesbury review.

Introduction

More than three decades of working in the Consumer Protection Act, 1986 necessitated a paradigm shift in the postglobalization and digitization phase of India. The Consumer Protection Act, 2019, passed and received the presidential assent on 9th August 2019, repealing the Consumer Protection Act, 1986, to strengthen consumer rights and dispensing consumer justice. It envisages a robust grievance redressal mechanism in the context of e-commerce and e-governance. The slew of legal measures entails the inclusion of e-commerce, Central Consumer Protection Authority (CCPA), alternative dispute resolution (ADR), suo moto action against unfair trade practices, pecuniary jurisdiction, amplifying of grounds of complaints, penalties to deceptive advertisements and product safety and liability. From the standpoint of the medical profession, it is worthwhile to inquire that the new law has excluded the health care system. The provision legislation has been targeted to appease medical fraternity in a bid to assuage the medical fraternity, which has expressed apprehensions over its detrimental application.¹ The medical profession is unnecessarily feeling excited about this change in the euphemistic tone of the Consumer Protection Act, 2019. On the contrary, a careful perusal reveals that there is ample scope of filing case against the deficiency of health care services by aggrieved persons for medical negligence and redressal.

The moot question is as to whether to *express verbis* exclusion of healthcare from the purview of 'service' did exonerate the

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doctor's liability? Secondly, the services provided free will seems to have excluded, which too is a question of fact and will have to be evaluated on a case to case basis. Thirdly the Consumer Protection Act, 2019, is spacious enough to include healthcare under 'all goods and services' as well? The assertion that 'service of any description made available to potential users' under the Consumer Protection Act, 2019 can be statutorily interpreted and liberally construed as a useful piece of legislation. In such a case, absolving doctor from the purview Consumer Protection Act, 2019 will be a travesty of consumer justice.²One should not forget that the Consumer Protection Act, 2019 does not even bar the judicial enunciations in Indian Medical Association v. V.P. Shantha Case by Supreme Court in 1996 being a good piece of law. The Consumer Protection Act, 2019, and its implications for the medical profession and health care services in India have discoursed in legal pragmatism.³ The study applies an analytical method of legal research by undertaking the legislative survey and scrutiny of consumer laws under the Parsonian Effect theory in the context of health care services.⁴ The Consumer Protection Act, 2019, is interpreted in the light of established canons of statutory interpretation with harmonious construction of a beneficial piece of legislation.

Definition of Consumer

The Consumer Protection Act, 2019 enlarged the definition of 'consumer' to include 'persons who engage in offline or online transactions through electronic means or by teleshopping or direct selling or multi-level marketing.⁵ It envisages remedy for the multi-level marketing to only the manufacturer of the product but all entities involved at various stages of production and marketing. On the other hand, services that are provided for free will not be considered as consumers which squarely exclude medical services of government hospitals, centres, and dispensaries. The CPA 1986 ⁶ prescribed six major grounds to

file complaints, seven whereas CPA 2019 has added new grounds to the count to seven grounds.⁸The two key changes are the introduction of unfair contracts & the expansion of unfair trade practices in the context of competition law. ⁹ In the previous legislation, a complaint could be filed only if an unfair trade practice or a restrictive trade practice was adopted by any trader or service provider. ¹⁰Now 'unfair contract' has also been added, which further broadens the ground to file complaints and allows consumers to challenge contracts that are unfair, unilateral, and unreasonable.¹¹ This has direct impact on the financial institutions such as banks, and in line with ruling of supreme court in Vimal Chandra Grover Case.¹² On a comparative scale, the assessment and working of the CPA 1986 in freedom to operate (FTO) analysis is yet to be evidenced empirically the success and failure of the CPA 2019 is too premature to be commented given enlargement of grounds of complaint.

Central Consumer Protection Authority

The central regulatory authority known as CCPA has been established to protect and enforce the consumers' rights in cases of victimization of misleading advertisements and unfair trade practices. A separate authority has been constituted under CCPA to investigate matters relating to consumer rights, unfair trade practices, and misleading advertisements.13 The CCPA is empowered to 'promote awareness and research on consumer rights' and 'adopt best international practices on consumer rights' to foster consumer right and justice.¹⁴ For the first time the district collectors have conferred power to conduct consumer investigations considered to be detrimental to interests of consumer class.¹⁵ This provision augur citizen standing and public participation in consumer decision making and enforcement.¹⁶ This is guite pertinent to note that globally, we see a churning in legal liability reforms in doctor-patient relationship and consumer justice syndrome.¹⁷ This fact is duly acknowledged by the CCPA by adopting best international practices and incorporation of international covenants.¹⁸ The Consumer Protection Act, 2019, has a symbiotic relationship in refurbishing medical governance in the enhancement of professionalism and expert. This will eventually lead to efficient medical services and delivery. That is why the Indian Medical Council (Amendment) Act, 2018, put an alternative mechanism by supersession of the existing MCI by vesting its powers in a Board of Governors until the said Council is reconstituted.¹⁹ It also envisages for the reconstitution of the Council within one year by adding proven administrative capacity and experience for nomination of members for the Board of Governors.²⁰ The Board of Governors which is assisted by a Secretary-General who shall be appointed by the Central Government on deputation or contract basis and shall be the head of the secretariat in the Council.²¹ Thus it can be safely concluded that MCI as a statutory body and most significant medical assemblage of the country will take care of professional negligence of doctors under the Consumer Protection Act, 2019, with far clarity and fairness.

Deletion of Healthcare Services

The Consumer Protection Act, 2019 does not contain healthcare in the list of services under the definition of 'service.' The healthcare was included in the original Consumer Protection Bill, 2019, and was passed by the Lok Sabha also. The deletion of healthcare from services is in line with the concerns expressed by doctors and medical associations. The Cabinet approves this by way of the "technical amendment" in the proposed law. Since the Consumer Protection Act, 2019 has been passed one year after the legislative initiative of the Indian Medical Council (Amendment) Bill, 2018and 2019 which could not see the light of the day. This law has been supplanted by the National Medical Commission Act, 2019 with the objective of equitable and universal healthcare in community health perspective. It enjoined medical professionals to be abreast with latest research and observe ethical standards in all aspects of medical services besides having an effective grievance redressal mechanism.²² It is not surmised that a new directorate will look into medical negligence and deficiency of service matters. But evident from the Act which envisages an Ethics and Medical Registration Board to regulate professional conduct and promote medical ethics. Be that as it may, be, it is unclear whether healthcare as a service is included in the ambit of the CPA 2019.²³ It appears that the legislative intent was not to exclude the health care services and left the matter open-ended with the courts to interpret about the health care services for its inclusion. The logic that the medical profession and health services being excluded from the GST dragnet automatically impels that the medical profession is also excluded from the Consumer Protection Act, 2019 does not seem tenable. The Wednesbury review iconized by Associated Provincial Picture Houses Ltd. v. Wednesbury Corporation,²⁴ will be applicable. The ratio of the case sets standard of unreasonableness used in assessing an application for judicial review of a public authority's decision. It applies that a reasoning or decision is Wednesbury unreasonable if it is so unreasonable that no reasonable person acting reasonably could have made it. The test is an effective remedy of due process, procedural fairness under rule of law. The application of the Consumer Protection Act, 2019, and its implications for the medical profession and health care services in India are to be seen in the context of India's socio-economic inequalities.

Relevance of V. P. Shantha Ruling

The Supreme Court, in the case of Indian Medical Association v. V.P. Shantha,²⁵ had read healthcare into the definition of services of doctors and applied Consumer Protection Act, 1986. The apex court maintained that patients are consumers as long as they are making some form of payment for the medical service rendered. The Consumer Protection Act, 2019, does not contradict this finding of the Court but has consciously excluded healthcare from the definition of services. The healthcare is excluded from the definition of services, but the patient is not barred from the definition of consumer. The legal

position is that the Parliament certainly has the power to overturn a judgment by passing a law as long as such law is applied with prospective effect.²⁶ It is for the courts to dwell as to whether the intent of the Parliament in explicitly removing healthcare from the list of services under the CPA 2019 will have any bearing on this decision. One should not forget that the judicial enunciations in Indian Medical Association v. V.P. Shantha Case by the supreme court in 1996 being a good piece of law is not even barred by the Consumer Protection Act, 2019. This is manifested by the Supreme Court's realization in Novartis judgment 27 which fortified the right to health and access to medicine in public interest than that of commercial interest.²⁸ The broader ramifications of the Supreme Court's pronouncements in Shantha and Novartis judgments are to be seen from the prism of public health and equalization of health care opportunities.

Consumer Disputes Resolution

One of the salubrious provisions under the Consumer Protection Act, 2019 is the expeditious consumer disputes resolution by courts as well as alternative dispute resolution (ADR) such as mediation, conciliation, and arbitration. This has wider ramifications for the medical profession by developing an inbuilt and in-house ADR mechanism in all hospitals to adjudicate medico-legal cases. The Consumer Protection Act, 1986 also promised for the expeditious consumer disputes resolution, but sordid experiences of the delay and latches are well known. The medical services being under essential services are often couched with litigation labyrinths, often resulting in undue harassment of medical fraternity. On this count, the Consumer Protection Act, 2019 seems progressive in settlement of disputes by way of mediation. This opens the possibility of settlement at the stage of admission of a complaint by mutually acceptable terms between parties. As per the provision, a mediation cell will be attached to each district, state, and National Commission and its regional Benches for quick resolution of disputes.²⁹ This is supplemented by the increasing the pecuniary jurisdiction of all three commissions.³⁰ It is opined that the increase in the pecuniary jurisdiction will arrest the tendency of frivolous claims and fasten disposal of cases at appellate levels. The quantum of monetary penalty in case of defiance of any order of commissions has also been raised to deter vexatious litigants.³¹The drastic increase of fines ranging from USD 350 to USD 1400, whereas earlier they could have only imposed fines in the range of USD 28- USD 140 will be having a salutary impact on the litigation flow and fostering consumer justice in expeditious manner.³²

Conclusions

Thus according to the Consumer Protection Act, 2019services which are provided for free per se will not be considered as a consumer and complaint against the deficiency of service cannot sustain generally. Even the services which are free are not barred by the judicial scrutiny if there is a severe miscarriage of consumer justice. On this analogy, the paid medical services to patients will automatically come under the purview of the Consumer Protection Act, 2019. The new law did not intend to put a curtain on the doctors-patient health services deficiency a dampener for medical negligence or malpractice. Law comes heavily on unfair trade practices, which will eventually allow private hospitals to undergo consumer auditing rigorously.³³ At the same time, the Consumer courts need to undergo Wednesbury review as it is inherently ill-equipped to judge complex medico-legal litigation and often leads to a serious miscarriage of consumer justice to doctor and patient. According to an estimate, access to health care services is compounded by the high out-of-pocket expenditures of more than three-quarters of the population. These results in the increasing financial burden of health care and exacerbate poverty to about 39 million additional people falling into the poverty trap every year.³⁴ It raises the vital question of equity in health care services and public health delivery systems. It will be a misnomer to consider the Consumer Protection Act, 2019, as medical negligence blind law; rather it sets the tone for the ethical and patient-oriented medical professionalism to curb unfair medical practices and undue enrichment.

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