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Contents

From Editor's Desk

Dear All,

Excess heat is on, environmental temperature is rising and so the is political temperature, after lok sabha elections. Amidst this heated environment, just to give some soothing effect to our IAFM members and other authors, we thought to come up with a supplementary issue of volume 46 (1), so that we could clear the backlog of articles remaining with us since long. This action was taken after due permission from EC.

I once again thank my editorial team specially **Dr. Narendra Singh Patel; Dr. Vishal Seán Baveja; Dr Vaibhav Agarwal** and **Mr. Chain Singh Lodhi,** who are tirelessly devoting day and night to release this issue on time. I also thank **Dr. Siddhartha Das** as Joint Editor, **Dr. Mandar Sane** and **Dr. Vivek K. Chouksey,** who had been helping me in this endeavour of publishing the journal since 2022.

As was decided in GBM 2024, we are in final stages of agreement signing with SAGE publication Pvt Ltd; a step towards better position of the journal in the international arena. The agreement has been thoroughly discussed with president, secretary and floated in the EC, for comments. Many points were amended in the benefit of the academy and IAFM members.

For improving the number of citations from JIAFM and somehow increase the impact factor, we are regularly requesting the authors to cite the articles of JIAFM in the references of their article for which they are getting an upper hand in publication and many authors have started doing it. May be this is the reason of substantial improvement and hence we had 53 citations and 308 documents in the initial few months of 2024, against total of 73 citations and 308 documents between 2020-2023, having cite score as 0.2 in Scopus website as on 07.06.2024.

All the manuscripts had undergone a double-blinded review process; grammar and plagiarism check (wherever required), and separately the reference check. We responded to all the queries of the authors in our official email ID of the editorial team. I am thankful to all the **authors** for keeping their patience and feel sorry, as sometimes I may not have responded to your calls or messages due to varied reasons, but the editorial team had been very vigilant and serious in responding to all the emails received. I need to especially thank our reviewers, without whom we would not have come up with a quality issue as was desired

Best wishes!

Sincerely

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EDITORIAL

Shifting Evidence: The Impact of Climate Change on Forensic Medicine

Dr. Dipayan Deb Barman

Climatic change which is causing abrupt changes in weather patterns has become a major cause of concern over the past several years as it has affected multiple facets of the nature and human lives. Amidst the several fields which have been impacted forensic science is one area which too got impacted by swinging climate change patterns. This has led to challenges in the functioning of forensic investigation as well and requires development of few tangible and adjustable means to ensure the standard and reliability of forensic techniques. This editorial tries to examine the various ways in which forensic investigative process is affected by the changes of climatic patterns as well as to explore the means which can be used to mitigate these challenges.

Rate of decomposition and calculation of time since death: One of the main effects of climate change on the methods used in forensic investigations has been identified as variations in the pace of decomposition. The amount of time after death, or the autopsy interval (PMI), is one of the most important aspects of forensic pathology. Previous research indicates that PMI is influenced by several important elements.[1] Recent trends from the southern hemisphere of the globe suggest that the PMI and the time since death are highly impacted by climate variations. Furthermore, there's a good chance that day-to-day temperature changes observed in temperate regions would yield inaccurate results if replicated elsewhere.[1,2]

The estimation of the Postmortem Interval (PMI) may be challenging due to unpredictable climate patterns brought about by climate change, which include higher temperatures and varying amounts of precipitation. Additionally, certain postmortem processes, like the decomposition rate, may be greatly impacted by climate changes.

Elevated temperatures have the potential to accelerate the decomposition process by stimulating the growth of bacteria and insects, both of which are essential to the body's breakdown process. Conversely, this approach may be hindered by an unanticipated drop in temperature or changes in humidity. Due to these conditions, conventional techniques for estimating PMI which rely on historical data and common environmental standards may also become less reliable. Therefore, forensic experts should develop and update new techniques that consider the changing climate by using real-time environmental data to increase accuracy.

Temperature variations will have an impact on some important methods, as those employed in the recovery of human remains. For example, the differences in temperature between the air around an active maggot mass and the surrounding air are the primary focus when using thermal imaging to locate human remains.[3] Therefore, there's cause for concern that this technique's efficacy might be impacted by rising ambient temperatures.

Safeguarding the evidence: The preservation of forensic evidence is also impacted by climate change. Blood, semen, and saliva are examples of biological evidence that are prone to changes in their surroundings. DNA profiling has proven to be incredibly useful for forensic investigators and law enforcement in both identity verification and crime investigation.[4] Samples are frequently taken from crime scenes for DNA analysis, which is used for paternity testing and human identification from human remains.[5]

When surfaces are left outside, where average temperatures and relative humidity are 18.8°C, 71% at night and 24.1°C, 63% during the day, DNA cannot survive on them for as long as it can in the lab when they are left in the dark and at room temperature.[6] In an investigation, Lee et al.[7] discovered that DNA was more durable on a range of surfaces under controlled settings, such as 19–25°C and 50–77% relative humidity, as opposed to higher temperatures (22–34°C) and 50–99% relative humidity, under uncontrolled conditions. Furthermore, physical integrity of non-biological evidence might be affected by climate change. For example, extended droughts and rising temperatures may cause wildfires to occur more frequently, which may destroy outdoor crime scenes and evidence. In a similar vein, evidence that is exposed to heat and sunshine for an extended amount of time may deteriorate. The development of resilient evidence preservation systems and procedures that can withstand the effects of climate change is required considering these environmental challenges.

Evolving aspects of Forensic Entomology: Another field that is rapidly being impacted by climate change is forensic entomology, which is the study of insect activity on decomposing remains. Climate change will affect all the various fields of entomology, which include forensic, veterinary, and agricultural. The effects of climate change on forensic entomology have already been discussed. For instance, Atencio-Valdespíno and Collantes-González discussed alterations to entomological distributions in the context of Panama's emerging profession.[8]

When calculating PMI, the consistent succession of insect species on a corpse is a significant consideration. On the other hand, several insect species are seeing changes to their seasonal patterns and geographic ranges due to rising global temperatures. The effects of species extinction because of shifting settings are one of the difficulties entomologists faces.[9]

Certain species that were previously believed to be unique to tropical areas have been discovered in temperate zones, and other species are adapting their reproductive strategies. Because the current models are based on established species patterns, these modifications may introduce errors into forensic entomological examinations. As a result, forensic entomologists need to carry out continual research to record these modifications and modify their techniques.

Implications for the Study of Aquatic Forensics: The phenomena of climate change pose specific challenges for forensic investigations involving aquatic environments. Changing salt levels, increasing sea levels, and warmer water can all influence the disintegration of corpses in water. The

distribution and activity of marine organisms that aid in decomposition are likewise impacted by these changes in the environment. Forensics specialists must adapt their methods to account for these variations. This entails developing methods for estimating PMI in aquatic settings. To construct comprehensive models that accurately depict the current and future conditions of aquatic environments, it may be necessary to integrate data from the fields of hydrology, climate science, and marine biology.

Strategies to adjust forensic investigations to the changing climate: The forensic expert community must be proactive and interdisciplinary to address the many challenges posed by climate change. Some strategies to mitigate the impact of climate change on forensic investigations include the following:

More Accurate Environmental Tracking: Forensic teams should use advanced environmental monitoring equipment to collect data on temperature, humidity, and other relevant characteristics at crime scenes in real time. With the use of this data, forensic models can be altered, and PMI and other important estimations' accuracy can be raised.

Collaboration Across Disciplines: Experts such as climatologists, entomologists, forensic scientists, and others must work together. Forensic procedures can be enhanced to better account for environmental changes through information sharing and the integration of specialists from many fields.

Continuous Learning and Instruction: To stay abreast of the latest discoveries and advancements regarding climate change and its implications for forensic science, experts in the field of forensic medicine must stay informed. Regular training sessions and seminars help ensure that practitioners have the necessary skills to adapt to evolving situations.

Creation of Novel Technology: Financial support for the development and use of novel forensic technology is vital. This includes powerful data analysis software, complex DNA preservation techniques, and inventive methods for recreating crime scenes in dynamic environments.

Changes to the Protocol and Policy: Forensic agencies should review and amend current policies and procedures to account for the consequences of climate change. This means developing methods for obtaining and storing evidence during extreme weather and ensuring that forensic practices are resilient to environmental disruptions.

To sum up: The impact of climate change on forensic investigations is one novel subject that requires immediate attention. The community of forensic experts must adapt to changing conditions to maintain the precision and consistency of its methods. Forensic specialists should embrace inter-disciplinary collaboration, continuous education, and technological innovation to overcome these challenges and continue providing essential insights into criminal investigations. The stakes are so high that there has never been a more urgent need for adaptable, creative solutions. Together, the forensic science community can continue to advance justice in a world that is always evolving while also adapting to the effects of climate change.

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Introduction to the author of the editorial:

My name is Dr. Dipayan Deb Barman and I am currently the Associate Dean of Research and Professor, as well as the Head of the Department of Forensic Medicine and Toxicology at Shri Sathya Sai Medical College & Research Institute in Tamil Nadu. My primary concentration is on forensic toxicology and clinical forensic medicine services. In the near future, I see a promising opportunity to combine forensic medicine with sciences like as bioinformatics, epigenetics, and artificial intelligence. This convergence promises major advances and potential for novel research and practical applications in the field.

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ORIGINAL ARTICLE

A Cross-sectional Study on Medicolegal Post-mortem Examination Conducted in a Tertiary care Medical College of West Bengal

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Abstract:

Unnatural and suspicious deaths are grounds for performing medicolegal autopsy examinations. It is performed by forensic medicine experts and doctors trained in autopsy to determine the cause of death which is the prime objective of medicolegal autopsy. Apart from that, manner and mode of death, time since death, identification of the deceased are other important objectives. Mortality data from various unnatural deaths gives important information regarding the different violent incidents prevailing in society. The following study aims to make a cross-sectional observation on various unnatural deaths in a medical college police morgue in a particular time of the year. The police inquest reports and the autopsy reports were reviewed before starting the post-mortem examinations in the police morgue. It was a prospective study done over two months for the study time in the initial months of covid lockdown. All the cases during that period were included in the study. Data were tabulated first, then subjected to appropriate statistical methods and published as results. Of the 103 cases a male predominance of 69 cases was observed, and majority (90.2%) were Hindu by religion. The majority of the deceased were of age range 21 to 30 years followed by 41 to 50 years. Poisoning (35.3%) and hanging (33.3%) were found to be the most common causes of death whereas natural disease caused death in 6.9% of cases. The suicidal rate was the highest (81.1%) Suicidal death continues to be the majority of unnatural deaths. Poisoning and hanging claimed most of the lives whereas road traffic accidents, and accidental falls, caused significant mortality.

Keywords: Autopsy; Postmortem examination; Medicolegal; Unnatural death; Tertiary care; West Bengal.

Introduction:

Medicolegal autopsy or post-mortem examination is done in all cases of sudden, suspicious, and unnatural deaths as per the law of our land.[1,2] Unnatural death stands for all death cases where death is not due to any disease, the definition of natural death being where death is solely due to a diseased or pathological condition where death is not intended attempted or accidental.

According to National Crime Records Bureau (NCRB) data, total 4,37,396 road accidents occurred in India in 2019, resulting in death of 1,54,732 people as one of the leading unnatural deaths circumstances.[3] Suicide was the leading cause for over 300 "non-coronavirus deaths" reported in India due to distress resulting from lockdown.[4]

Apart from unnatural death, suspected sudden deaths are also the cases where post-mortem examination has to be conducted. It means death occurring within 24 hours of onset of terminal illness in an apparently healthy individual without having any known history of disease, injury or poisoning.[5] In some unfortunate case where a patient suffering from a disease or pathological condition reaches the emergency ward of a hospital or nursing home and is presented unconscious and found to be dead , i.e declared brought dead at presentation is yet another circumstance where compulsory medicolegal post-mortem or autopsy examination has to be conducted. In the covid era we have witnessed a huge pandemic sweeping our country and state. The lockdown and temporary unemployment scenario has caused a social and health burden on the health system of the country.

The prevailing scenario has also increased a sense of anxiety and depressive thoughts in a section of society leading to an increased burden of unnatural deaths. The present study has been carried out to analyze the pattern of such deaths requiring medicolegal autopsy in this part of the country, both due to natural and unnatural causes using autopsy database to determine distribution of deaths in different category in this part of the country.

Materials and methods:

The study has been conducted in Police morgue of College of Medicine and JNM Hospital, Kalyani, West Bengal over a period of two months during initial first phase of covid era autopsied in the police morgue. The police inquest reports, and autopsy reports were reviewed and various demographic parameters were considered including age, sex and cause of death. All the cases coming for medicolegal autopsy have been included in the study. The results were subjected to tabulation in MS Excel spreadsheet and analyzed in the same.

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Table 1. Age wise distribution of cases (n=102).

Age (years)	Number of cases	Percentage (%)
0-10	4	3.9
11-20	15	14.7
21-30	22	21.6
31-40	11	10.8
41-50	21	20.6
51-60	16	15.7
61-70	6	5.9
71-80	5	4.9
81-90	2	2.0
Total	102	100

Table 2. Distribution of cases according to cause of Death (n=102).

Cause of death	Number	Percentage (%)
Natural disease	7	6.9
Burn Injury	4	3.9
Drowning	8	7.8
Electrocution	3	2.9
Fall from Height related injuries	3	2.9
Hanging	34	33.3
Poisoning	36	35.3
Road traffic injury	1	1.0
Snake bite	5	4.9
Homicidal chop injury	1	1.0
Total	102	100

Table 3. Distribution of cases according to manner of deaths (N=95).

Manner of death	Number	Percentage (%)
Suicidal	77	81.1
Accidental	17	17.9
Homicidal	1	1
Total	95	100

Results:

A total of 102 cases of unnatural deaths were studied over two months of period. Among all the cases majority (67.65%) were male and 33 were female (32.35%). According to religion, majority (n=92, 90.2%) were of Hindu religion, only 9 cases were Muslims (8.8%) and one case was from Christian (1%) community. Regarding age wise distribution of cases, it ranged from 7 years to 82 years. Category wise distribution is shown in Table 1. Highest frequency was noted in 21 to 30 years age group followed by 41 to 50 years. Least cases were in the age group 81 to 90 years.

Of all the cases, 7 cases found to be from natural disease and rest are unnatural deaths. The detailed distribution of cases has been shown in Table 2. Poisoning cases were highest in frequency (35.3%) followed by hanging (33.3%) and drowning (7.8%) cases. Death due to injury was seen to be least among all (only two cases). Regarding manner of death, most of the cases were suicidal (81.1%) followed by accidental variety (17.9%). Only one case of homicide was noted during the study period. The results are shown in Table 3.

Discussion:

Among the autopsy cases during the study period, a male predominance was noticed. Similar results were obtained in a study conducted on demographic profile of autopsies in Punjab showing 79.8% male predominance by Munir et al.[1] In the present study, we got an increased number of males compared to females. It appears keeping in mind the increased number of suicidal deaths that financial stress may play a major role in increased number of unnatural deaths in males. Moreover increased outdoor activities, though restricted during the covid lockdown period, also made the males more prone to unnatural death. Road Traffic accidents, falling from height and homicidal death are also seen commonly in men. In our study however the number of road traffic accident death claimed less lives than hanging and poisoning. It can be justified from the fact that the study period includes initial months of lockdown during first phase of covid era. So the vehicular movement was very less. Due to that fact, catering population from the developing area were less in connection to their professional work and daily labour job which led them to psychological stress and leading to suicidal tendency.

Our study also points to the fact that age between 21 to 50 were most common victims of unnatural death. In the study by Munir et al. age 21-40 were the most common victims.[1] Increased aggression and emotional stress makes this age more vulnerable to unnatural deaths.

Also majority of the unnatural deaths are Hindu. As the area around the medical college mostly are inhabited by Hindu population this is an obvious finding. Hanging and poisoning deaths were found to be maximum. Suicidal deaths were found to be on an increase after lockdown.[6] Insecurity, employment loss fear of being tested positive played a major role in people opting for committing suicides. Hanging in its face value goes in favour of suicides unless proved otherwise on the basis of circumstantial evidences. In a autopsy based study on hanging by Rao it was found that most of the victims suffered from self suspension.[6] the variations in dressing material in hanging and ligature material is found to be varying with occupation, social status culture and geographical location. Poisoning death is very common and popular in the country. Suicidal pesticide poisoning, is the most common mode of poisoning in India.[7]

Corrosive ingestion remains a common problem in India due to its use in toilet cleaning and lack of strict enforcement of laws.[8,9] weed killers or paraquat poisoning is also very commonly seen. The literature on paraquat poisoning in India is still not much and the proper evidence on management is lacking and so is survival reports.[9]

Burn claims a huge number of lives in India. Self-immolations accidental burn injury and multi organ failure following septicemia are commonly observed. In this study burn deaths were low. India recorded 25,467 deaths due to burns during the year 2000.[8] In this study the number of burn deaths have been found to be less. This can be due to the time of lockdown most people remaining at home and extra care by family members and lack of hurrying to work may have contributed to lesser burn injuries.

A few cases turned out to be natural cause after autopsies. In a study by Sanchez ollalo et all cardiac causes amounted to 56.87% of deaths in autopsied bodies with non violent causes of death.[10,11]

Conclusion:

Suicidal deaths continue to be the majority of deaths in unnatural deaths .Poisoning and hanging claimed most of the lives whereas

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road traffic accidents, accidental falls, caused significant mortality. A number of drowning and burn cases have been observed. Also a few of the autopsy studies revealed death due to natural disease condition.

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ORIGINAL ARTICLE

Estimation of Age from Cranial Suture Fusion- an Autopsy based Study

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Abstract:

The need for identification of a deceased arises in civil and criminal cases. Skull being a whole compact bone is almost always the best preserved and the one that could be best utilised. Over the years, there has been enough and more controversies regarding the methodology and predictability of the same. The primary objective of the study was to estimate age from fusion of cranial sutures in wet specimens of cranial vault during autopsies. Cross sectional study was done at Department of Forensic Medicine, Government Medical College Thiruvananthapuram for a period of one year after approval from Institutional Ethics Committee. The study sample of 168 was divided uniformly among each decade from 11-80 years, thus coming to 12 males and females in each. Fusion of cranial sutures were scored both endocranially and ectocranially using the Acsadi- Nemeskeri scale. Reliability of various subdivisions of each cranial suture were assessed. Regression formulas from various cumulative scores were then formulated. There was no significant variation in fusion of cranial sutures between males and females. Every subdivision of each cranial suture showed variation with age and cannot be used as a good predictor of age. The cumulative scores of endocranial subdivisions, ectocranial subdivisions, subdivisions around Bregma and Lambda showed uniform distribution and reliability of prediction. Greatest predictability was from the sum of endocranial scores. The methodology in determining age from cranial suture fusion is of utmost significance in establishing identity. An objective scoring technique is more dependable than a subjective analysis.

Keywords: Acsadi-nemeskeri scale; Age estimation; Cranial sutures; Ectocranial fusion; Endocranial fusion; Forensic anthropology.

Introduction:

According to Forensic pathology, 'Identification' is recognition of an individual by means of various unique physical features and biological parameters. Among the integral parts of a biological profile, 'age' has the utmost importance.[1] According to Iscan, "nearly every bone contains an age marker, but it is important to know where to look and how to recognize and interpret them".[1] The methods to estimate age before the age of 25 years (like epiphyseal-diaphyseal closure of long bones and the order of tooth eruption) are reliable and have been proven to have almost 90% accuracy. But the anthropological estimates after the age of 25 has been haphazard. The principal macroscopic changes used are metamorphosis of pubic symphysis, closure of cranial sutures and degenerative changes in vertebral body and joints.[2] Of these, cranial sutures have always been a centre of considerable debate and its reliability has not been conclusively demonstrated by any researchers.[3]

Beginning in the sixteenth century, the sutures were believed to change morphologically with age. Over the years many authors like Singer (1953),[4] Brooks (1955),[5] Herschkovitz et al. (1997)[6] could not correlate their studies with suture fusion and hence asked for a removal of it from the medicolegal protocol. But modern forensic anthropologists like Acsadi and Nemeskeri (1970),[7] Meindl and Lovejoy (1985)[8] support this analysis and say that only a systematic approach would help and the accuracy would be more than 80%. The confusions have not led to a dismissal of interest in cranial sutures but have ignited a flame in the modern anthropologists. Thus, depths of pursuit for finding the relationship between the structural and functional changes of cranial sutures has given rise to trials of newer methodologies.

The primary aim of the study is to estimate age from fusion of cranial sutures in wet specimen of cranial vault during autopsy.

Materials and methods:

The study was conducted on cases coming for medicolegal post-mortem examination to the Mortuary wing of Department of Forensic Medicine, Government Medical College, Thiruvananthapuram from 01-03-2018 to 28-02-2019.

Sample size calculated was 150.47. In order to have a uniform statistical distribution, sample size was spread uniformly between different age decade groups. Sample size was fixed as 168 in order to have an equal distribution of 12 males and 12 females in each of the seven decade groups (11-20 years, 21-30 years……71-80 years).[8]

Data Collection: The age of the deceased was verified with Aadhar card/ Voter's id/ Driving license. The routine dissection protocol was followed. Each suture was subdivided into parts of equal length for the study. The divisions were based on previous studies according to their variability in fusion with age.[7,9] The subdivisions were as follows:

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Table 1. Comparison of predictability of various cumulative scores.

Sl no	Cumulative Score	R	R2	p value	Predictability %
1	Endocranial scores	0.698	0.487	<0.0001	48.7%
2	Ectocranial scores	0.218	0.048	0.004	4.8%
3	Total Cumulative	0.613	0.376	<0.0001	37.6%
4	Bregma	0.607	0.368	<0.0001	36.8%
5	Lambda	0.574	0.329	<0.0001	32.9%

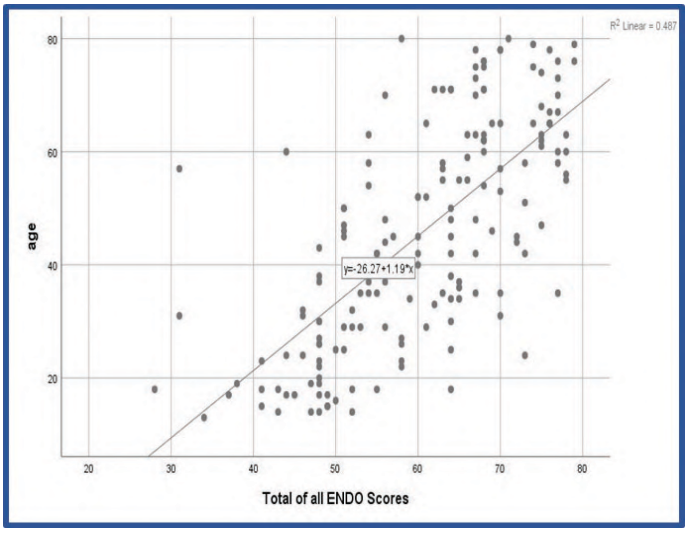

Figure 1. Graph depicting correlation of sum of endocranial (ENDO) scores with age.

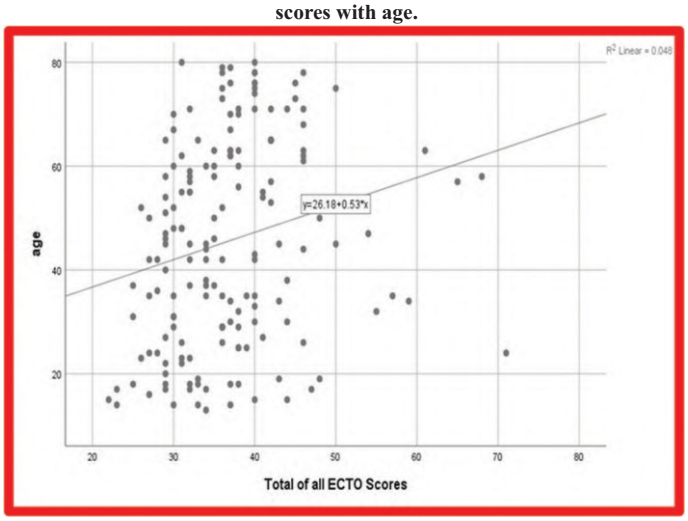

Figure 2. Graph depicting correlation of sum of ectocranial (ECTO) scores with age.

1. Sagittal suture (S1, S2, S3, S4) Whole length of sagittal suture was divided into four portions of equal length, S1 being anterior-most and S4 being the posterior-most.

2. Coronal suture (C1, C2, C3) Whole length of coronal suture was divided into three portions of equal length, C1 being medial-most and the C3 being the lateral-most. Right and left side were scored separately.

3. Lambdoidal suture (L1, L2, L3) Whole length of lambdoid suture was divided into three portions of equal length, L1 being medial-most and the L3 being the lateral-most.

4. Tempero-parietal suture (T1, T2) whole length of the suture was divided into two portions of equal length, T1 being anterior and the T2 being the posterior.

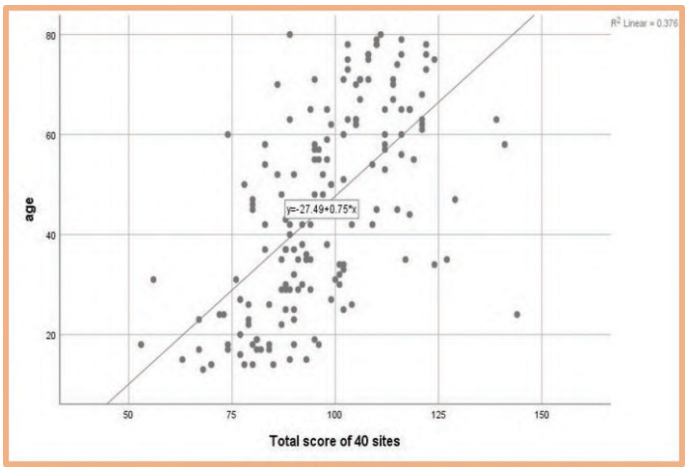

Figure 3. Graph depicting correlation of sum of all scores (40sites) with age.

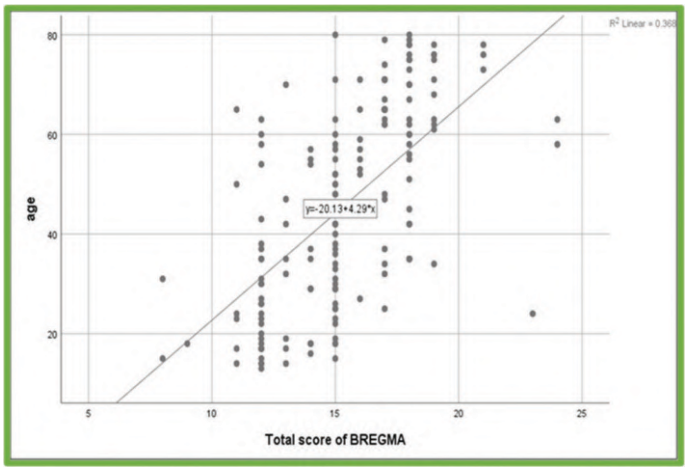

Figure 4. Graph depicting correlation of sum of scores of sutural subdivisions around Bregma with age.

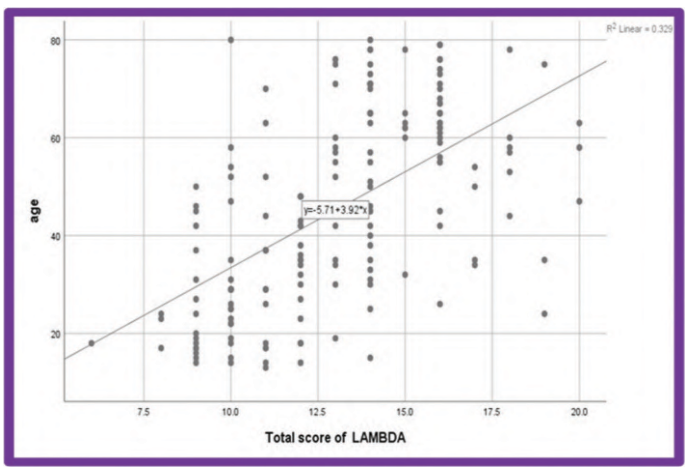

Figure 5. Graph depicting correlation of sum of scores of sutural subdivisions around Lambda with age.

The length of each suture was first measured using a calliper and then divided into equal parts. After reflecting the scalp, the scores of each ectocranial sutural subdivision was noted. The endocranial scores were noted after removing the vault in the

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routine method. Brain was removed following the routine procedure and the base of skull examined for fusion of basi-sphenoid with basi-occiput.

In cases, where an interobserver variation was necessary for validation, another reader determined the score of fusion in a similar manner and entered into a separate data sheet. Throughout the confidentiality between the two readers was maintained.

The scoring of each subdivision of the cranial sutures was done according to the Acsadi-Nemeskeri scale ectocranially and endocranially.

Scale for closure: Acsadi- Nemeskeri complex scale

0= Open. There is little space between the edges of adjoining bones.

1= Incipient closure. Clearly visible as a continuous often zigzag line.

2= Closure in process. Line thinner, less zigzags, interrupted by complete closure.

3= Advanced closure. Pits indicate where the suture was located.

4= Closed. Even location cannot be recognized.

Tools used were metre scale (for measuring height in centimetres), Vernier Calliper (for precisely measuring the length of the sutures), Acsadi-Nemeskeri[7] complex scoring scale and pro-forma for data collection.

Statistical analysis: All the data collected were entered into a Microsoft Excel Spreadsheet and analysed using statistical software statistical package for social sciences (SPSS) version 25.0. Firstly, each subdivision of each cranial suture was separately analysed for its correlation with age.

In order to assess the inter-observer variability, kappa test was performed in 89 cases. These scores were compared to quantify the amount of reliability and hence verify the significance of the study. Kappa coefficient analysed was 0.911. This indicates a good agreement between two observers.

Institutional ethics committee clearance was obtained from Human Ethics Committee, Government Medical College, Trivandrum dated (IEC: 14/07/2017/MCT).

Study design: Cross-sectional study involving cases brought for medicolegal autopsy within a definite time interval. Cases of known age between the age of 11 to 80 years were included. Cases suspected of head injury or with any previous head trauma or surgeries were excluded.

Results:

A. Age vs scores of each subdivision of cranial sutures.

(i) Endocranial fusion: The study methodology adopted was a scoring technique of four gradations which denotes an ordinal variable. Hence, Spearman's correlation was used to analyse each subdivision endocranially. Almost all sutural subdivisions had a significant probability of increase in its score with age. Along with this, an absence of normal distribution of scores for each subdivision among the study subjects indicate that it cannot be used as a predictor of age when used alone.

(ii) Ectocranial fusion: The findings of the ectocranial fusion has shown reliability only in the first two subdivisions of sagittal and all subdivisions of lambdoid and tempero-parietal. But similar to the endocranial sutures, there are only four gradations which do not have normal distribution in the study population. Even though there are subdivisions which have a positive relation to advancing age, this cannot be used to predict the age.

B. Age vs Cumulative scores of fusion of individual cranial suture

(i) Endocranial fusion: The cumulative score of all endocranial sutural subdivisions showed a positive correlation with age. But this correlation did not have a definite uniform pattern and hence prediction of age from such a score would be difficult.

(ii) Ectocranial fusion: Except for coronal, the other three sutures had significant correlation with advancing age. But, the variance from normal distribution and the limitation of gradations against a wide variety suggest that the prediction of age was difficult from this score.

(iii) Sum of endocranial and ectocranial scores of fusion of each cranial suture: The sum of endocranial and ectocranial scores of each suture shows correlation with age with a significant probability. But being a non-parametric correlation, it could not be considered as a good predictor of age.

C. Age vs Cumulative scores of fusion of all sutures

When computing total scores of multiple sutures, it had a more uniform distribution among the study subjects. The possibility of multiple scores against a variable like age was statistically analysed and was found to be reliable for prediction of age as parametric correlation was applied. The results of Regression ANOVA applied for various cumulative scores derived the following results.

(i) Sum of scores of all endocranial sutures: As the p value of F was found to be <0.0001, it indicates that there is a significant correlation as depicted in Figure 1. The t test was applied, R^2 value was 0.487 which indicates that it has a predictability of 48.7%. From the various values got from regression ANOVA a regression equation for the age prediction from the endocranial cumulative scores was formulated.

Age (y) = -26.27 + (1.19 x total of all endocranial scores)

(ii) Sum of scores of all ectocranial sutures: The sum of all ectocranial scores showed a wide permutation and combination of scores with normal distribution. Hence, was concluded to be a good predictor of age as depicted in Figure 2. A regression ANOVA was done, a line was plotted and a regression equation for the prediction of age was formulated. The R^2 value was 0.048 which indicates that it has a predictability of 4.8%. The regression equation formulated was

Age (y) = -26.18 + (0.53 X total of all ectocranial scores)

(iii) Total of all cumulative scores of fusion: The total of all sutural scores showed a uniform wide distribution and significant correlation with age as depicted in Figure 3. A regression line was plotted and a regression equation was formulated for the prediction of age. The R^2 value obtained was 0.376 which indicates that there is 37.65 predictability.

Age (y) = -27.49 + (0.75 X total of all scores)

(iv) Special sites: In the study of Meindl and Lovejoy, it was stated that fusion at the point Bregma and Lambda showed a satisfactory correlation with age and it can be used solely as an age predictor. According to his assumption, cranial suture fusion starts at the points Bregma and Lambda. Hence, these points were analysed separately.

(a) Bregma: It is the point of intersection of coronal sutures on both sides with sagittal suture in midline. Considering the endocranial and ectocranial subdivisions here, there were six subdivisions for analysis and 24 scores with wide permutations and combinations. On analysis, it had a good uniform distribution and hence was analysed for age prediction as depicted in Figure 4. Formula derived was: Age (y) = -20.13 + (4.29 X total of all scores at Bregma)

(b) Lambda: The point Lambda is formed by the inner thirds of right and left lambdoid along with the posterior one-fourth of Sagittal suture. Similar to Bregma there were 6 subdivisions under study and 4 gradations for each with 24 possible scores and multiple permutations and combinations. Regression ANOVA was done to do the age prediction and the results were as follows. Age (y) = -5.71 + (3.92 X total of all scores at Lambda)

D. Comparison of Age prediction from the various determinant scores: Various cumulative scores with a good prediction probability were analysed using Regression ANOVA for their significance/ p value and all were found significant enough with a p value <0.05. Their predictability percentage were compared using their respective R and R2 values as depicted in Table no:1. Of all predictors, cumulative scores of all endocranial sutures (48.7%) is the most dependable, followed by the total score (37.6%) and Bregma (36.8%). The least dependable one is the ectocranial score with a prediction of only 4.8%.

After deriving the regression equations, new age was calculated from the cumulative scores of the samples. It was then compared to the actual age and their deviations were analysed. Total of endocranial scores showed a minimum deviation of 0.05 years and maximum of 27 years (mean deviation was 2.38 years). Cumulative total of ectocranial scores showed the maximum variation with a minimum of 17 years and maximum of 70 years (mean deviation was 14.81). Total cumulative score showed a minimum deviation of 0.81 years and maximum of 29 years (mean deviation was 3.7 years). Total score around Bregma showed a deviation between 0.81 years and 29 years (mean deviation was 3.7 years). Total score around Lambda showed a deviation between 0.79 years and 21.91 years (mean deviation was 4.1 years). This deviation indicates that ectocranial is the least reliable.

Discussion:

In the previous studies with different methodologies, the results derived were of the mean age group of commencement and completion of fusion of cranial sutures.[4,5,9] On contrary to those studies, the present study showed that there is no such set pattern of fusion and it is difficult to predict such a mean age of commencement or closure. When comparing the present observations to the previous literatures, (a) there were a wide number of cases who showed non-fusion of sutures at expected ages of fusion (b) there was no definite pattern of suture fusion among sutures of the same individual (c) the pattern observed was different endocranially and ectocranially (d) the pattern was different endocranially and ectocranially in each suture.

Statistical analysis showed that it is difficult to guess a mean age of commencement and closure of fusion in any of the sutures under study. This is contrary to authors like Krogman,[2] Mukherjee[10] and Apurba Nandy[11] who mention a definite age of commencement and closure. Even though a lot of findings have been derived from the present study, the usual prediction of the mean age group of starting and completion of fusion of cranial sutures was merely impossible from the data of the present study.

Many of the previous literatures mentioned that their study population consisted mainly of skulls from museums which considered a mixture of races and limited data of description. Todd and Lyon,[9] Meindl and Lovejoy[8] and Acsadi- Nemeskeri[7] stated that the main disadvantage of such a study is the mixture of population and races.

It is possible to derive a regression formula for age estimation from cranial suture fusion only if there is more or less a uniform data and that too in equal proportions of age groups. Studies in same race and with equal distribution of sex in equal quadrant age groups were suggested to be the ideal study setting for deriving a regression equation.

Cumulative scores at the point Bregma and Lambda were calculated based on the study by Meindl and Lovejoy[8] who mentioned a hypothetical fact of a possible 'Y ascent' which suggested that sagittal and coronal sutures usually start fusing from the point Bregma, immediately after the closure of anterior fontanelle. He postulated regarding an 'Inverse Y descent' which held the same pattern but in the point Lambda. Out of all the five significant equations derived, the predictability was maximum (48%) for Sum of endocranial sutures. This indicates that endocranial sutures were more reliable than ectocranial sutures. The predictability from ectocranial sutures were as low as 4.39 %

According to the timing of fusion of sutures in the present study, endocranial fusion was much earlier than ectocranial fusion. But no specific time period could be predicted for the commencement of endocranial fusion. No set pattern (e.g. a definite age gap between the endocranial and ectocranial fusion) could be assessed from the data collected in the present study.

Todd and Lyon[9] however mentioned there was no tendency of early fusion endocranially. He added that ectocranial fusion was more variable and it was never complete. Lapsed union was common ectocranially. Acsadi and Nemeskeri[7] mentioned that within every decade, endocranial patterns vary, hence shows a significant score change which would reflect when calculating the age groups.

Patil T L et al.[12] were of the opinion that cranial suture fusion cannot be considered as a marker for estimation of age as the variation is too much. If at all it should be considered as a marker, endocranial fusion was more reliable than ectocranial fusion. On contrary to this, Nandy A[11] had mentioned that even though fusion occurs earlier at the ectocranial surface, the rate of fusion is much

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slower. Hence, to predict a young adult age group, endocranial scores would be more reliable. He spoke about the possibility of tempero-parietal suture having a lapsed union until death.

Ullas Shetty[13] described earlier fusion in endocranial side but he did not comment on the reliability between ectocranial and endocranial fusion. The only observation on that aspect was that ectocranial fusion did not follow a pattern at all and hence it cannot be considered as a predictor of age. In 2012, Kumar et al.[14] mentioned that endocranial fusion occurs much earlier than ectocranial fusion. All these observations from various literatures are in agreement with the present study.

Conclusion:

The most challenging task of every forensic pathologist is of establishing identity. Recent developments in science have brought forth alternatives like DNA fingerprinting that are efficient in establishing identity. But the real problem arises when biological material for DNA extraction is not available. In such scenarios, many a time anthropology comes into real play. Many dependable variables in anthropology like fusion of cranial sutures, has faced controversies. Many of the literatures relate these to the subjectivity of the methodology.

The present study adapted an objective methodology which will be more practical to be used in cases of unidentified bodies as well as skeletal remains. The regression formulae derived with very little mean deviations would be of ample help in arriving at more accurate conclusions.

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ORIGINAL ARTICLE

Impact of Lockdown on Unnatural Deaths at a Tertiary Care Hospital, Kolkata

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Abstract:

Unnatural deaths to a large extent are a curse to modern society. This research investigates trends of unnatural deaths reported to NRS Medical College Kolkata from November 2019 to January 2021. It was a retrospective descriptive study on 4403 postmortems carried out during the study period. The study period was categorized into pre-lockdown (November 2019-March2020), lockdown (April 2020-August 2020) and post-lockdown (September 2020-January 2021) phases with each phase for 5 months. Our findings have been presented with respect to age, gender, cause and manner of death. Out of 4403 autopsies, 2389 were unnatural deaths and the rest were due to natural causes. Besides, among 2389 unnatural deaths 874 were reported in the pre-lockdown phase, 484 in lockdown and 1031 in post-lockdown phases respectively. Railway incidents were most common in pre-lockdown (33.06%) and post-lockdown (27.8%) whereas hanging was the most common type of unnatural death in the lockdown phase (20.04%). Unnatural deaths that solely occur outdoors decreased during the lockdown while all other types increased during the lockdown phase. Hence, this study is determining the trends of all types of unnatural deaths reported at NRSMCH Kolkata during the study period and the improvement in public health can lower the unnatural death to a large exten.

Keywords: Unnatural deaths; Hanging; Poisoning; Accidents; Lockdown.

Introduction:

According to section 174 of the criminal procedures code (CrPC) any death such as suicide, homicide, accident, poisoning, or drug overdose is considered to be unnatural death.[1] It is also defined in a way where a lesion is found during autopsy which is incompatible with life.[2] Unnatural deaths can increase because of easy access to fatal substances like poisons including medicinal drugs and also due to operating machines.[3]

In December 2019, an outbreak of a new viral Coronavirus disease (COVID-19) belonging to the coronavirus family was reported in Wuhan (China).[4] MERS is a viral disease caused by Middle East respiratory syndrome coronavirus (MERS-CoV) that was first identified in Saudi Arabia in 2012.[5] COVID-19 created devastation across the globe as it was spreading rapidly and had no specific treatment and many nations across the world implemented lockdowns to restrict movement and social interaction in an effort to control the spread of the viral disease. However, the lockdowns can have a significant impact on socioeconomic life and some of the ways in which lockdowns can affect socioeconomic life include: (1) Economic disruption (2) Mental health (3) Education (4) Access to healthcare (5) Domestic violence.The first case of COVID-19 infection reported in India was on January 27, 2020 when a 20 year old female presented to the Emergency Department in General Hospital, Thrissur, Kerala, with a one-day history of dry cough and sore throat. There was no history of fever, rhinitis or shortness of breath. She gave history that she had returned to Kerala from Wuhan city, China, on January 23, 2020.[6] In this study, the effects of lockdown on trends of unnatural deaths reported to NRS Medical College Kolkata during the year 2020 were investigated. The data is in reference to age, sex, nationwide lockdown with the type of unnatural deaths (accidental, homicidal, suicidal and others like alcohol and drug intoxication, electric injury, and many more) Moreover, it was found that overall there was a decrease in unnatural deaths, particularly those occurring outdoors. However, the number of unnatural indoor deaths, such as hanging, homicides, and burns, remained unchanged or increased. Vikas Arya et al. have reported that suicide rates increased in India in 2020,[7] that was probably because of mental issues. Devassy S, et al. states[8] lockdowns can take a toll on mental health, leading to increased rates of anxiety, depression and other mental health disorders showever results of our study were different from that. During the lockdown, there was a decrease in all types of unnatural deaths which we studied and a significant decrease was seen in deaths caused by road traffic accidents, where a reduction of deaths in men was more than reduction of deaths women per month.[9] The aim of this retrospective study on the impact of lockdowns on unnatural deaths among could be useful for several reasons with some of the potential benefits such as: (1) Understanding the indirect impacts of lockdowns: While lockdowns are implemented to control the spread of a disease, they can impact other aspects of society, including the risk of unnatural deaths. (2) Improving public health responses: By examining the relationship between lockdowns and unnatural deaths, policymakers can develop strategies to reduce the risk of such deaths. Overall, a retrospective study on the impact of lockdowns on unnatural deaths could provide valuable insights that can inform decision-

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making and improve future responses to public health crises.

Materials and methods:

This study is a retrospective study of unnatural deaths in the Department of Forensic Medicine and Toxicology at NRSMCH in Kolkata, India. The study was done after approval from the institute ethical committee N.R.S Medical College with reference number-NRSMC/IEC/81/2023 dated 27.03.2023.The subjects of the present study consist of unnatural deaths among those brought to the mortuary of NRSMCH Kolkata during the study period (November 2019 to January 2021). The data was collected from autopsy reports, hospital Records, police inquests and medical certification of cause of death (MCCD). Deaths due to natural causes, such as Myocardial Infarction, non-traumatic intracranial hemorrhage, Sepsis, and COVID-19 were excluded from the study. The study period was divided into three phases based on the implementation of lockdowns in response to the COVID-19 pandemic: pre-lockdown (November 2019 to March 2020), lockdown phase (April 2020 to August 2020) and post-lockdown phase (September 2020 to January 2021) with each phase for a period of 5 months.

Results:

Fig. 1 (a): Comparison of the total number of postmortems in 2020, 2019, and 2021. A total of 2389 unnatural deaths were reported during the study period period, out of which 1031, 484 and 874 cases were in pre-lockdown, lockdown and post-lockdown phases respectively.

Fig. 1 (b): Trends of unnatural deaths during study period in different months, showing an abrupt fall in unnatural deaths at beginning of lockdown (April), a hike in lockdown and sharp increase in the post-lockdown (Aug).

Fig. 2 (a): Showing the incidences of cases of different unnatural deaths in different phases of the study period.

Fig. 2 (b): Showing fall in number of RTAs during lockdown period and increase in post-lockdown period. The difference in the incidence of RTA in pre-lockdown, post-lockdown and lockdown phases was found to be statistically significant at $p \leq .05$. (chi-square = 78.1516 and p-value is < 0.00001). As the Road traffic was also not allowed to move thus lead to fall in RTAs

Fig. 2 ©: Representing the trends of burn cases during 2020 with respect to lockdown. The incidence of burn cases decreased during the lock-down period but it was statistically not significant. (chi-square 3.0364. p-value 0.21911). As death due to burns is usually an indoor type of unnatural death at most of the times so the trend was not statically significant as the source of burn were available at homes also and access to burning objects remained unchanged.

Fig. 2 (d): Representing the incidence of hanging during pre-lockdown, lockdown and post-lockdown phase. During the lockdown phase the incidence of hanging was increased.The incidence of hanging among males showed a gradual increase from the pre-lockdown period to the post-lockdown stage. However, the overall increase in the cases was not statistically significant. (chi-square statistic 2.0995, p-value .350030). The

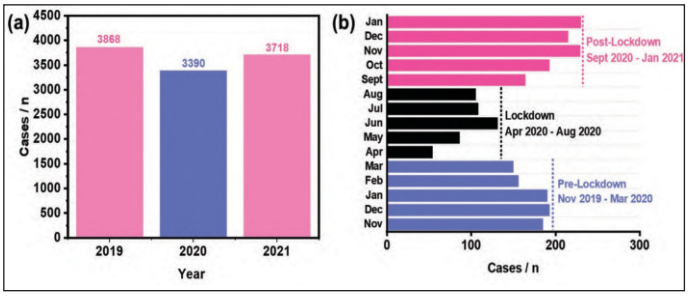

Figure 1.

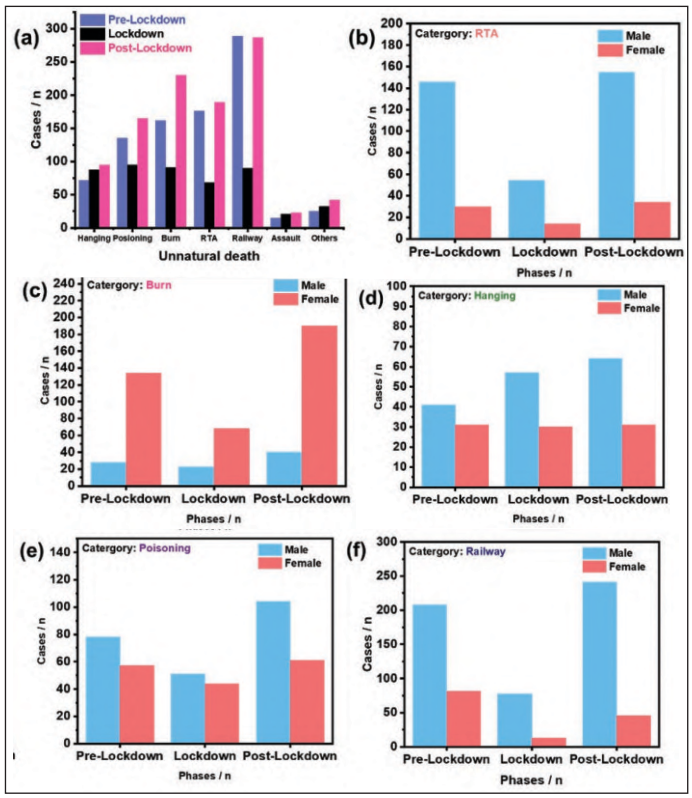

Figure 2.

trend remained almost same in every phase however a mild spike was observed in post-lockdown phase hence the results were not statically significant. As a lot of people came out from lock-down and found that they have lost their jobs, economical crisis that lead to emotional outbursts and trigger of anxiety.

Fig. 2 (e): Showing the trends of poisoning in different phases of study period. The maximum incidence of poison cases was observed in Post-lockdown phase and the incidence of poisoning cases decreased during the lockdown phase compared to the pre and post-lockdown phases but the difference was statistically not significant. (chi-square statistic 2.3008. p-value 0.316506). Although results were not statically significant but a noticeable decrease in number of poisoning cases was seen during lockdown phase most probably because people were restricted to their homes and shops were also closed so people had less access to the poisons and that led to fall in number of poisoning fatalities.

Fig. 2 (f) Representing the trends of railway accidents in different phases of lockdown and the railway accidents with respect to

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Table 1: Distribution of unnatural death cases with respect to gender in phases of lockdown (pre- lockdown, lockdown, post-lockdown).

Pre-lockdown	M	F	T	Lockdown	M	F	T	Post-lockdown	M	F	T
Hanging	41	31	72	Hanging	57	30	87	Hanging	64	31	95
Poisoning	78	57	135	Poisoning	51	44	95	Poisoning	104	61	165
Burn	28	134	162	Burn	23	68	91	Burn	40	190	230
RTA	146	30	176	RTA	54	14	68	RTA	155	34	189
Rail	208	81	289	Rail	78	13	90	Rail	241	46	287
Assault	13	2	15	Assault	15	6	21	Assault	19	4	23
others	21	4	25	others	26	5	32	others	38	4	32
Total	535	339	874	others	304	180	484	others	661	370	1031

M: Male; F: Female; T: Total

gender in different phases of lockdown. It can be clearly seen in the figure how there was a decrease in number of railway fatalities during lockdown period. The decrease in the Railway incidents during the lockdown phase compared to the other two phases was statistically found to be significant at $p \leq .05$. (chi-square 3.9252. p-value.047568). Because offices, schools and other works places were closed moreover restrictions were there on movement of people so the load on railways was less that also impacted the incidence of railway accidents.

Discussion:

The total number of postmortems studied during the year of 2020 at NRS Medical College Mortuary were 3390 which was less than that in 2019 (3860 cases) and 2021 (3718 cases), hence there was a decrease in count of unnatural reported to NRSMC mortuary in year 2020 as shown in Fig. 1 (a).In 2020, the number of autopsies decreased, with the steep decline at the onset of lockdown and there was an increase in number of cases towards the end of lockdown as shown in Fig. 1 (b). Moreover, our study found the number of deaths due to poisoning (95 cases) was the commonest cause of death during the lockdown phase followed by burns (91 cases) and railway incidents (90 cases), as shown in Table 1. Among the different types of unnatural deaths considered in the present study only hanging and homicidal deaths showed an increasing trend throughout the study period while in all other types the cases decreased during the lockdown period. Males comprised majority of the victims in all the types of deaths in our study except burns where females comprised 81.1% of the cases and the findings are similar to an article of World Health Organization (WHO) mentions that the women are more likely to die from burns than men, even though men generally have higher rates of injury.[10] This may be because women are more likely to be injured by open fires used for cooking or heating, which can cause clothing to catch fire. Besides, self-harm and violence are also risk factors for women, hence the trend was not impacted by lockdown. Moreover, the incidence of burns also showed variations during the lockdown and non-lockdown phases, as it was observed that there was a decrease in the number of cases of burns during the lockdown phase compared to the other two phases and females outnumbered the males throughout the period of study. In addition, the mean age of female victims was 39 years. In the study area the female is more prone to get injured with burn because women are exposed to flames in different circumstance like religious rituals, cooking on direct flame, wearing saree, etc. It is important to understand the underlying causes of these changes in order to develop appropriate interventions and preventative measures. Some potential factors that could influence the incidence of burns could include changes in daily routines, changes in access to cooking and heating sources, make the availability of safety measures, and initiation of safety awareness programs. It would be helpful to gather more data and information about the specific circumstances surrounding the burns in order to better understand the trends and identify potential solutions, Kruchevsky et al. reported a decreased incidence of burn during thephase of lockdown[11] which is consistent to our findings.

Rathore S, et al. have found in their study that there was a significant fall in incidence of RTAs.[12] In the present study we found statically that there was a significant decrease in the number of road traffic accidents (RTAs) during the lockdown period as shown in Fig. 2 (b) with a decrease of 77.9% was observed. During the pre-lockdown phase, there were 176 (39.7%) deaths from RTAs followed by 68 (15.7%) and 189 (43.6%) in the lockdown and post-lockdown phases respectively. Besides, majority of the victims of RTA were males with the mean age of 42 years. While it may not be possible to completely eliminate RTAs, their frequency can be reduced through strict enforcement of traffic rules and improvements of road infrastructure.[13]

Furthermore, there was no statistically significant changes in trends of deaths due to hanging as shown in Fig. 2 (d). Out of a total of 254 deaths reported due to hanging, 72 were reported during the pre-lockdown phase, 87 during lockdown, and 95 during the post-lockdown phase, the incidence of hanging in post lockdown increased because of job losses and hopelessness. According to the research conducted by Goceoglu UU and Balci Y, it was found that there were significant differences in socioeconomic and mental health factors between men and women in cases of hanging suicide. The number of males who committed suicide by hanging was higher than that of females.[14] Das and co-workers have also found that, there has been a sharp increase in hanging cases in the lockdown period.[15] In our study we also found that prevalence of males was more than females, but the trend of hanging was increasing during all phases. Aradhana Singh et al. reported in their study that the severe negative changes in behavior caused by the COVID-19 pandemic may have been worsened even further by full lockdowns, leading people to use the means of suicide that were easily accessible to them at home, such as hanging and common poisonings.[16]

The primary causes for this could be attributed to factors such as job loss, limited access to healthcare, social stigmatization, and a loss of hope leading people to severe depression. In contrast, the deaths due to poisoning, and railway accidents as shown in Fig.2 (e) and 2 (f) respectively, also decreased during the lockdown period in comparison to the other two phases. Although results were not statistically significant, but noticeable spikes were found in the deaths due to such incidents especially in case of poisoning in post-lockdown period, Behera A et al. stated that young males in the age group of 20-30 years, who are less educated and have lost their jobs due to the COVID-19 pandemic lockdown, may be at a higher risk for negative outcomes such as financial instability and mental health issues.[17]

Conclusion:

There was a decrease in the number of purely outdoor unnatural deaths, but other forms of unnatural deaths either remained constant or increased, particularly hanging which remained in increasing trend. In post-lockdown phase all types of unnatural deaths increased which was probably because of financial crises because of job losses, hopelessness, intolerance that developed because of isolation and social-stigmas of COVID-19. As the incidents of unnatural deaths are increasing every day and we found that the percentages of unnatural deaths decreased because of lockdown especially RTAs and railway fatalities so it is quite clear that the incidents of these unnatural deaths can be decreased. We have some recommendations to address the concern of the current era, that is the increasing trend of unnatural deaths: (1) Educate people about the importance of mental health, (2) Reassure the person (3) Reduce stigma towards mental health problems, (4) Arrange motivational programs, (5) Awareness programs about public safety measures.

Conflict of interest: None declared.

Funding: None

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ORIGINAL ARTICLE

Heart Disease Deaths in Jabalpur Region, an Autopsy based Retrospective Study

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Abstract:

To retrospectively find the different pathologies of heart disease in the cases examined at mortuary of NSCB Medical College, Jabalpur, M.P To find the incidence of heart disease in different age groups and different sex. To find the incidence of different pathologies of heart 2911 autopsies were performed during the time period of October 2021 to September 2022, out of that 83 cases of cardiac deaths were found. Deaths due to non-cardiac causes, such as trauma were excluded. Study Design – Cross sectional study, retrospective. Study Area – Jabalpur region Study Population – All autopsy cases which came to NSCB MC mortuary during the time period of October 2021 – September 2022. Out of total 2911 autopsies conducted, 83 cases of heart disease deaths were recorded. Among them 81.93% were due to coronary artery disease (CAD). 59.04% cases had cardiomegaly and heart weight was more (>420 grams) in 59.04 % cases. Among 83 cases of cardiac deaths 92 % victims were males and 8 % were females. The peak incidence of heart diseases was found to be in the age group of 40-49 years (27.71 %) followed by 50-59 years (26.51%). Least incidence were found in the age group below 19. Most of the heart disease deaths examined were due to coronary artery disease(CAD). Majority of victims were males. Hence this data shows us the quintessential requirement of intervention in the prevention of heart diseases.

Keywords: Heart disease; CAD; Cardiomegaly; Deaths.

Introduction:

Heart diseases comprise the most prevalent serious disorders in industrialized nations and are a rapidly growing problem in developing nations.[1] Heart disease is now the most common cause of death worldwide. Before 1900, infectious diseases and malnutrition were the most common causes, and heart disease was responsible for <10% of all deaths. In 2017, heart disease accounted for 17.8 million deaths worldwide (32%), with the same rate now occurring in high, low and middle-income countries.[1] India has one of the highest burdens of heart disease worldwide. The annual number of deaths from heart disease in India is projected to rise from 2.26 million (1990) to 4.77 million (2020).[2] Coronary artery disease(CAD) prevalence rates in India have been estimated over the past several decades and have ranged from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban populations.[3] Atherosclerosis is primarily a disease of aorta, carotid, iliac and coronary arteries. Recent advances in the field of modern medicine with the effective treatment life expectancy has been increased and an improvement in the quality of life but despite these achievements, the prevalence of coronary artery disease (CAD) still remains high.[4]

Aim and Objectives : Aim :- To retrospectively find the different pathologies of heart disease in the cases examined at Mortuary of NSCB Medical College, Jabalpur, M.P.

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Objectives :- (1)To find the incidence of heart disease in different age groups and different sex. (2)To find the incidence of different pathologies of heart

Materials and methods:

2911 autopsies were performed during the time period of October 2021 to September 2022, out of that 83 cases of cardiac deaths were found. Deaths due to non-cardiac causes, such as trauma were excluded.

Results:

2911 autopsies were performed during the time period of October 2021 to September 2022 out of that 83 cases of cardiac deaths were found. The cases in study were divided into different age groups according to the age and sex. 76 (92%) victims were males and 07 (8%)were females (table 1 & figure 1). Below 20 years and above 80 years 2 cases were found, who died from heart disease.

Most of the deceased from both sexes belonged to 40-49 years (27.71%) followed by 50-59 years (26.51%) and least incidence were found in the age group below 19 years and >80 years. (table 2 & fig 2). There were 49 cases with cardiomegaly . Any person with a heart in excess of 420gm is at risk of sudden death 5 (table 3,4 & fig.3 ,4). Maximum heart weight recorded in 1 case was 900gms among the all cases of heart disease deaths. 81.93% were due to coronary artery disease (CAD). Followed by cardiac tamponade 10.84% and 7.23% cases of other heart diseases such as myocardial bridging etc (table 5 & fig. 5).

Discussion:

There is considerable increase in the number of deaths due to coronary atherosclerosis in India and this number is probably expected to increase in the coming decades if not controlled.[6] The

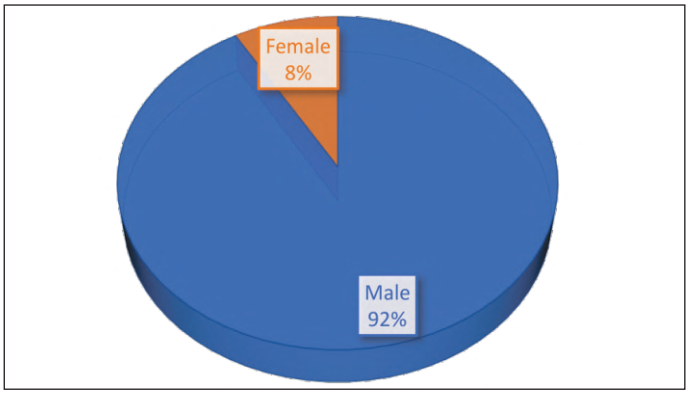

Figure 1. Percentage.

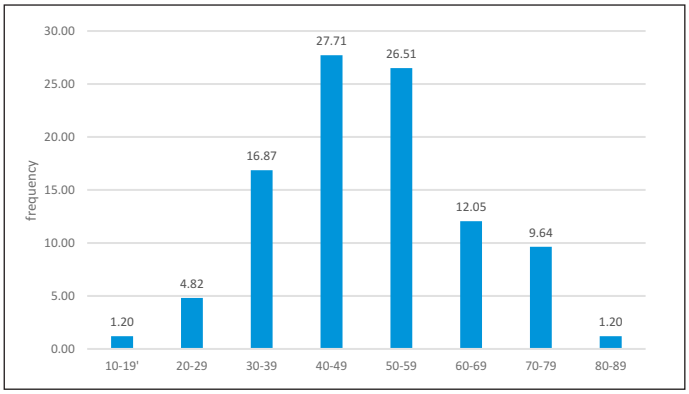

Figure 2. Age group.

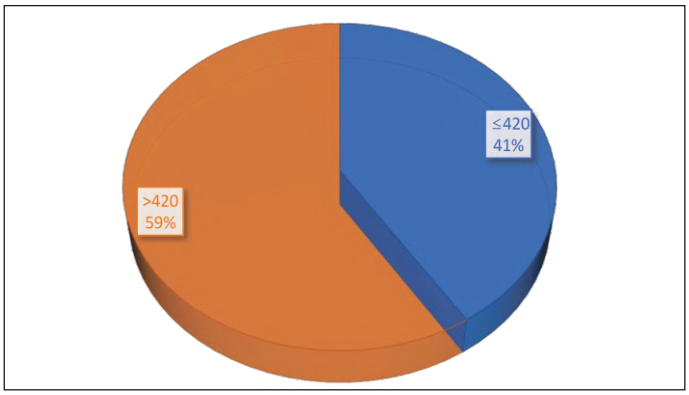

Figure 3. Heart weight.

Table 1. Gender – wise distribution of deaths due to heart disease.

Gender	Frequency	Percentage
Male	76	91.57
Female	7	8.43
Total	83	100.00

Table 2. Age group – wise distribution of deaths due to heart disease.

Age Group	Frequency	Percentage
10-19'	1	1.20
20-29	4	4.82
30-39	14	16.87
40-49	23	27.71
50-59	22	26.51
60-69	10	12.05
70-79	8	9.64
80-89	1	1.20
Total	83	100.00

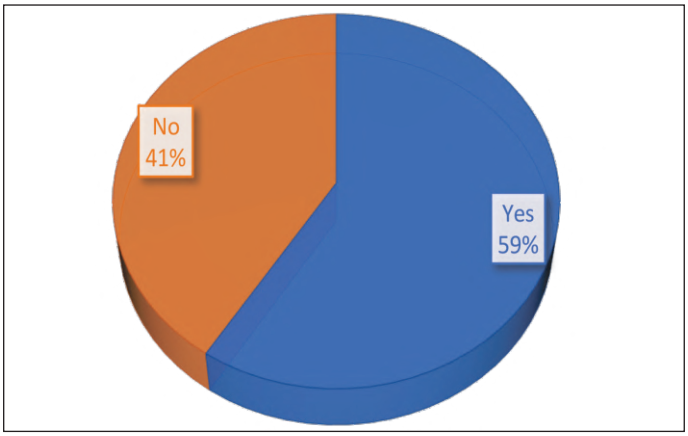

Figure 4. Cardiomegaly.

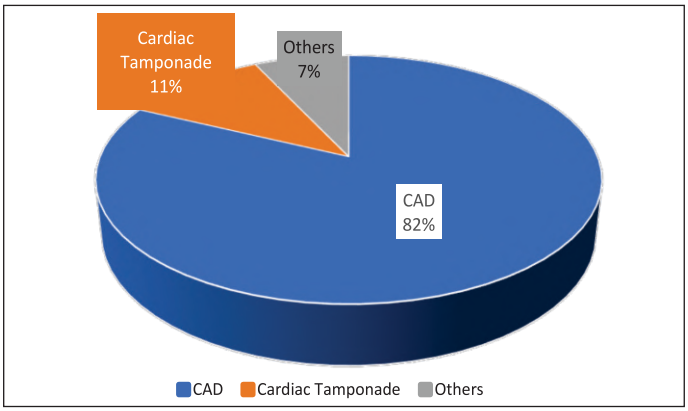

Figure 5. Types of pathology.

Table 3. Distribution of cases according to heart weight.

Heart weight	Frequency	Percentage
≤420	34	40.96
>420	49	59.04
Total	83	100.00

Table 4. Distribution of cases according to cardiomegaly.

Cardiomegaly	Frequency	Percentage
Yes	49	59.04
No	34	40.96
Total	83	100.00

Table 5. Distribution of heart disease deaths on the basis of types of pathology.

Types of pathology	Frequency	Percentage
CAD	68	81.93
Cardiac tamponade	9	10.84
Others	6	7.23
Total	83	100.00

Table 6. Comparison of sex distribution of heart disease in present study with previous studies.

Studies	Males (%)	Females (%)
Present study	92.0	8.0
Agravat et al.	73.7	26.3
Bhargava et al.	74.8	24.2
Murthy et al.	82.0	18.0
Padmavathi	66.5	33.5
Singh et al.	85.0	15.0
Tandon	66.5	35.5

most concern is the early age of CHD deaths in the developing countries as compared to the developed countries, which will definitely lame the major work force of our nation.[7] Comparison with previous studies Males are more affected than females (Table 6), In the studies of Sudha et al.,[8] Virmani et al.[9] and Stary. et al.[10] CAD develop quite early in life starting from age 20 years onwards. In our study incidence of CAD was found to be 81.93 % which was comparable with the frequency given by Dr. Sunil et al. (49.02%),[11] Yazdi et al. (40%)[12] and Golshahi et al. (28.9%).[13] Likely the acquisition of several risk factors such as tobacco consumption, lack of physical activity, stress, unhealthy diet, and obesity.

Conclusion:

Coronary artery disease was the major contributory cause of heart disease deaths and most numbers of deaths were reported in the age group 40-49 followed by 50-59 years with male to female ratio 10:1. Hence this data shows us the quintessential requirement of intervention in the prevention of heart diseases .

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ORIGINAL ARTICLE

Chromosomal Patterns in Convicted Homicide Criminals

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Abstract:

Crime is defined as doing of any act declared by stature or ordinance to be punishable in definite way, such as, by fine, imprisonment or death. The famous Danish 'Adoption studies' states that in addition to socio-economic factors, hereditary factors play an important role in the determination of criminality. Normally males have 46XY karyotype. The males with 47XYY karyotype may show a tendency towards behavioural problems like hyperactivity and distractibility and they are believed to be indulging in criminal activities. Studies of XYY males indicate that they are more prone to aggressive behaviour than the XY males. The present study was conducted at Karnataka Institute for DNA research, Dharwad by collecting blood sample from 53 prisoners who were convicted under S. 302 IPC to analyze the chromosomal pattern by doing karyotyping. All the 40 out of 53 subjects who were chromosomally analyzed showed the normal 46XY chromosome pattern. No abnormality was found in terms of number of chromosomes. Majority of the crimes have occurred against property issues (58.49%), followed by financial or money issues (15.09%), dowry issue (15.09%) and rest were due to other matters. Lower socio-economic status, poor education, personal habits might have played an important role in the causation of crimes.

Keywords: Chromosome; Karyotype; 47XYY; Criminals; S. 302 IPC; Aggression.

Introduction:

The subject of aggressive, antisocial, and criminal behaviour in man is as old as the history of man himself. Crime is defined as doing of any act declared by stature or ordinance to be punishable in definite way, such as, by fine, imprisonment or death. The famous Danish 'Adoption studies' states that in addition to socio-economic factors, hereditary factors play an important role in the determination of criminality. Scientific study of criminal behaviour is, however much more recent. All kinds of advanced scientific methods should be employed for detection of crime and to prove the guilt of criminal, so that innocent subjects are not victimized.

Normally males have 46XY karyotype. XYY syndrome is an aneuploidy of the sex chromosomes in which a human male has an extra Y-chromosome, giving a total of 47 chromosomes instead of 46 chromosomes. This produces a 47XYY karyotype. This condition usually affects 1 in 1000 male births.[1-3] The males with 47XYY karyotype may show a tendency towards behavioural problems like hyperactivity and distractibility and they are believed to be indulging in criminal activities. Studies of XYY males suggest that they are more prone to aggressive behaviour than the XY males.

Previous studies have shown that there is an association between the XYY karyotype males and the criminal behaviour.[4-6] We may hope that if a biological or physical basis for criminal behaviour is found, then one day we can find a cure for it, or if such individuals are detected in early part of their life, they can be given special attention and reformative education to prevent them from indulging in criminal activities in future.

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Materials and methods:

The present study was conducted for a period of 12 months at Karnataka Institute for DNA Research, Dharawad, Karnataka, by collecting blood sample from 53 prisoners who were convicted under S. 302 IPC, in Dharwad Central Jail of Karnataka state. The study was conducted with the aim to analyze the chromosomal pattern in homicide case convicts in prisons by doing karyotyping and to find out whether specific chromosomal abnormalities exist in them and if found whether it has any significant relation with the crime.

A) Inclusion criteria

1) Age above 18 years.
2) Male individuals.
3) Those who are convicted for homicidal act and sentenced by the law.
4) Those who are willing to give valid consent (voluntary consent).

B) Exclusion criteria:

1) Age below 18 years.
2) Those who are under trial.
3) Those who had recent blood transfusion (within last 6 months).

Method of collection of data and sampling procedure: After obtaining the consent from the legal and jail authorities and then informed written consent from the subjects, with aseptic

precautions about 3ml of venous blood was collected from the subject in Sodium heparin coated vacutainers and it was brought to the genetic laboratory at Karnataka Institute for DNA Research, Dharwad, within an hour for karyotyping analysis as per standard operating procedure.

Results:

Chromosomal analysis of 53 male prisoners who are convicted under S. 302 IPC from Central Jail, Dharwad, was done. Out of 53 samples, 13 samples could not be analyzed due to culture failure. So totally 40 samples were studied after karyotyping.

In the present study maximum number of subjects belong to the age group of 41-50 years i.e. 15 subjects (28.30%) and followed by 14 subjects (26.41%) of 31-40 years and least among ≥ 61 years i.e. 6 subjects (11.32%). In the present study 43 (81.13%) out of 53 subjects were married and rest 10 subjects (18.86%) were unmarried.

Above data shows that maximum number of subjects in the study group had literacy level of SSLC or below that is 33 subjects which accounts to 62.26% of total subjects, 7 (13.20%) subjects were illiterate, 7 (13.20%) subjects had studied PUC, 4 (7.54%) had pursued degree and 2 (3.77%) had done master degrees.

In present study, maximum number of subjects were from lower socio-economic status, that is 36 (67.92%) out of 53 subjects. This was followed by 15 (28.30%) subjects belonging to middle class, and the rest 2 (3.77%) belong to upper class.

In the present study majority of the crimes were committed by subjects in group that is 27 (50.94%) out of 53, and other 26 (49.05%) had committed the crime in single.

In the present study majority of subjects did murder of persons due to property issues i.e. 31 subjects out of 53 (58.49%), followed by finance or money related (8 subjects- 15.09%), dowry related issues (8 subjects- 15.09%), and the rest of the subjects were convicted for murder due to love affair related issues (2 subjects-3.77%), and illicit relationships (2 subjects-3.77%), dacoit followed by murder (1 subject-1.88%) and one subject was convicted for rape and murder (1 subject-1.88%).

Two out of 53 subjects studied, were suffering from psychosis disorder and were on treatment for it. Out of 53 subjects studied, 9 had the habit of only smoking, 5 subjects had the habit of only alcohol consumption and 24 had both alcohol and smoking habits. So, in total 29 (54.71%) subjects had the drinking habits.

Karyotyping results: All the 40 out of 53 subjects who were chromosomally analyzed showed the normal 46XY chromosome pattern. No abnormality was found in terms of number of chromosomes.

Discussion:

The present study was undertaken to analyze the chromosomal pattern in homicide case convicts in prison by doing karyotyping and to find out whether specific chromosomal abnormalities exist in them and, to find whether it has any significant relation with the crime or not. Previous studies on men with antisocial behaviour in prisons or institutions for hard to manage criminals have detected an additional Y chromosome in some percentage of men. Though the exact frequency of XYY men in the general population is not clearly known, chromosomal surveys among random samples suggest that it is lower than that found in the selected populations.

In present study no chromosomal abnormality was found among the 40 subjects karyotyped, and all men have showed the normal 46XY chromosome pattern that is no abnormality was found in terms of number of chromosomes. The present study is in conformity with the following studies;

A study was done by Welch JP et al.[7] of Johns Hopkins University School of Medicine, Baltimore, Maryland, on 464 inmates of Patuxent institution, who were classified as "defective delinquents". On the assumption that aggression is a significant feature of the syndrome, all senior, non-administrative, custodial officers were asked to answer a confidential questionnaire in which they were asked to list the twelve most aggressive, dangerous or violent inmates. All those twelve inmates were 72 inch or more tall and blood was obtained from ten (two refused). After karyotyping all these were found to be of 46XY chromosome complement.

Duffy JC et al. [8] analyzed two groups of young males; 18 patients from the Division of Child Psychiatry, University of Minnesota, and 28 juvenile delinquents from Lino Lakes Juvenile Detention Center. All patients were screened regarding stature and behaviour characteristics. None of the 46 cases analyzed showed any abnormality, either of autosomal or of sex chromosomes.

Where as many studies which have been conducted on prisoners who were of aggressive behaviour or who have done murder showed the presence of XYY chromosome complement in few percent of men.

In 1965, British cytogeneticist Patricia A Jacobs and colleagues[6] at Western General Hospital in Edinburgh, made a survey of chromosome in 197 male criminals. Out of which they found that twelve had chromosomal abnormality; seven had 47 chromosomes, and an XYY sex chromosome constitution, one had 48 chromosomes and XXYY sex chromosome constitution, and one was XY / XXY mosaic. The remaining three had structural abnormalities of the autosomes.

Casey and coworkers in their study among 100 mentally subnormal or mentally ill males detained for antisocial acts found 16 XYY's in England and all the XYY subjects were at least 6 feet tall.[9]

In a study done by Telfer MA et al on 129 tall men in four different institutions for the care of criminal males in Pennsylvania, found 5 with the XYY pattern as well as 7 with the Klinefelter syndrome (6 XXY's and 1 XXXY). All the aneuploidy subjects were mentally ill.[10]

Study done by Weiner et al in H.M. Prison Pentridge in Melbourne, Australia, found 3 XYY and 1 XYY / XYYY mosaic chromosome patterns among 34 tall (69-89.5 inch) male criminals.[11]

Gosavi SR and others made a study to find out if there is any definite association between the criminality and chromosomal aberrations. They selected individuals who were convicted by the Court of Law under S. 302 IPC as murderers in the Central Jail,

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Table 1. Age wise distribution of subjects.

Sl. No	Age group (years)	Number of subjects (Percentage)
1	18-30	11 (20.75%)
2	31-40	14 (26.41%)
3	41-50	15 (28.30%)
4	51-60	7 (13.20%)
5	≥ 61	6 (11.32%)

Table 2. Literacy level of subjects.

Illiterate	≤ S.S.L.C.	P.U.C.	Degree	Master degree
7 (13.20%)	33 (62.26%)	7 (13.20%)	4 (7.54%)	2 (3.77%)

Table 3. Socio-economic status of subjects.

Status	Number of subjects (Percentage)
Lower	36 (67.92%)
Middle	15 (28.30%)
Upper	2 (3.77%)

Nagpur and subjected them to cytogenetic study. By doing cytogenetic study of these criminals they found two cases of 47, XYY and two cases of 46, XYr (X). They stated that there is a definite association between the criminal behaviour and XYY chromosome.[4]

In this study, maximum number of subjects were from lower socio-economic status that is 36 (67.92%) out of 53 subjects. This is followed by 15 (28.30%) subjects belonging to middle class, and the rest 2 (3.77%) belonged to upper class. Criminological research generally demonstrates a disproportionate involvement of the lower socioeconomic classes in crime.[12]

In the present study majority of subjects had committed crime due to property issues followed by finance or money related, dowry related issues, and the rest of the subjects were convicted for murder due to love affair related issues and illicit relationships, dacoit followed by murder and one subject convicted for rape and murder.

Out of 53 subjects studied, 9 had the habit of only smoking, 5 had the habit of only alcohol consumption and 24 had both alcohol and smoking habits. So, in total 29 (54.71%) subjects had the drinking habits. This is in relation with the study done by Blumstein A et al who concluded after five studies that prisoners with drinking problems have higher assault rates than prisoners without drinking problems.[13]

Conclusion:

Karyogram of all the 40 criminals analyzed showed the normal 46XY chromosome pattern. Lower socio-economic status, poor education, personal habits might have played an important role in the causation of crimes. Majority of the crimes have occurred against property issues (58.49%), followed by financial or money issues (15.09%), dowry issue (15.09%) and rest were due to other matters. Rigorous proof of an association between chromosomal disorders and antisocial behaviour requires wide-scale chromosomal screening of the normal population with longitudinal study of all subjects manifesting sex chromosome errors is needed. If found, comparison of chromosomally abnormal criminal males with their chromosomally normal siblings and with their chromosomally normal criminal peers is needed. Possession of XYY does not by itself predispose one to criminal or violent behaviour as there are many underlying

Table 4. Crime committed by subjects single or in group.

Crime committed	Number of subjects (Percentage)
Single	26 (49.05%)
Group	27 (50.94%)

Table 5. Causes for conviction of subjects.

Cause	Number of subjects (Percentage)
Property issues	31 (58.49%)
Dowry related	8 (15.09%)
Finace/money	8 (15.07%)
Other matters	6 (11.32%)

Table 6. Height wise distribution of the subjects:.

Height in cm	Number of subjects (Percentage)
≤ 160	9 (16.98%)
161-170	34 (64.15%)
170-180	9 (16.98%)
≥ 181	1 (1.88%)

factors such as intellectual ability, socio-economic, familial, societal issues, some aggravating and intervening factors also contribute to the violent behaviour.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee.

Conflict of interest: None to declare.

Source of Funding: None to declare.

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ORIGINAL ARTICLE

Retrospective Study of Unidentified or Unclaimed bodies Brought for Autopsies at a Tertiary Care Hospital in Uttar Pradesh

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Abstract:

Identification is the process of determining a person's uniqueness. Practically in all autopsy centres throughout India, post-mortem examination of unidentified or unclaimed deceased remains a constant concern. There might be many causes for this. Although forensic specialists play a significant part in this identification procedure, investigating agencies are largely responsible for this. This is accomplished by working together using traditional and scientific methodologies. The aim was to study the profile of unidentified/unclaimed bodies in terms of age, sex, cause of death, seasonal variation, etc. The information was gathered from all unidentified/unclaimed deceased corpses submitted to the morgue for postmortem investigation at Teerthanker Mahaveer Medical Institution & Research Centre, a private medical college in Moradabad, Uttar Pradesh, between January 1st, 2018, and December 31st, 2022. From April 2020 to December 2021 autopsy was stopped at this institute because of covid pandemic. 125 corpses in all were taken to the department's morgue for postmortem assessment over the time frame of the research. Males were more in number as compared to females; males – 111 cases and females - 13 cases. The age range of 41–50 years had the highest proportion of cases, followed by that of 31–40 years. Most of the deceased belonged to the Hindu religion. Most of the cases occurred between the January to March period. Most of the cases died because of natural death. In natural deaths, the most common system involved was the lung followed by the heart.

Keywords: Identification; Unidentified body; Uttar Pradesh.

Introduction:

Identification is the process of determining a person's individuality.[1] Practically in all autopsy centres throughout India, post-mortem examination of unidentified or unclaimed deceased remains a constant concern. This might be because of many reasons. Unidentified and unclaimed though look same words but they have minute differences like unidentified means not identified and unclaimed means not claimed. In unidentified no data of the deceased is known whereas, in unclaimed body, partial details like the name and address of the deceased is known but there is no one to claim the body for last rites. Ritter[2] has described this as a "silent mass disaster". Because of modernization and easy transport facility, people travel easily to different cities for jobs or any other reason and if such a person dies in a different city, there is a high probability that he may be labeled as unknown if no identification data is available at the time of death. Although forensic specialists play a significant part in this identification procedure, investigating agencies are largely responsible for this. This is accomplished by working together using traditional and scientific methodologies.[3] After 72 hours of waiting period for relatives, police start the process of the last ritual of the deceased, usually as per the religion informed by the autopsy surgeon. The process of identification is an everyday occurrence in life, both in civil and criminal cases; be it joining a school/college/job, opening an account/getting a license, etc. In fact, almost every activity in our social life hovers around "identification".[4] In this present study, we tried to understand the profile of unidentified/unclaimed bodies in terms of the cause of death, age, gender, and pathological systems involved and to help police investigative agency to find the identity of the deceased brought for autopsy at Department of Forensic Medicine & Toxicology at Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh. The college has permission from State, to conduct autopsy of only unidentified/unclaimed bodies.

Aim and objectives - To study the profile of unidentified/ unclaimed bodies in terms of age, sex, cause of death, seasonal variation, etc. during a period from 1st January 2018 to 31st December 2022. From April 2020 to December 2021 autopsy was stopped at this institute because of covid19 pandemic.

Material and methods:

The information was gathered from all unidentified/unclaimed deceased corpses submitted to the morgue for postmortem investigation at Teerthanker Mahaveer Medical Institution & Research Centre, a private medical college in Moradabad, Uttar Pradesh, between January 1st, 2018, and December 31st, 2022. From April 2020 to December 2021 autopsy was stopped at this institute because of covid pandemic. Retrospective data compilation was done after a thorough analysis of all the

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Table 1. Showing year wise number of deceased as male and female.

Year	Male	Female	Fetus	Total
2018	48	03	00	51
2019	37	07	01	45
2020 (up to March)	06	02	00	8
2022	20	01	00	21
Total	111	13	1	125

Table 2. Shows the age group-wise number of deceased.

Age Group	Number of deceased
0-10	2
11-20	2
21-30	18
31-40	36
41-50	38
51-60	19
61-70	06
71-80	04
>80	00
Total	125

postmortem examination reports, inquest documents, case histories, during the time of the autopsy, and information gathered from the investigating police officers.

Inclusion Criteria - All cases brought for autopsy as unidentified/unclaimed bodies by the Police.

Exclusion Criteria - Skeletonized Body.

Observation and Results:

The number of autopsies conducted between the year 2018 to 2022 is mentioned in Table 1. In the year 2020 autopsies were conducted up to March only. From April 2020 to December 2021 no autopsy was conducted at this institute. Before covid era, a maximum number of autopsies was noted in the Year 2018 i.e. 51, followed by 2019 i.e. 45.

Table 2 shows the maximum number of deceased belonged to the age group 41-50 years, followed by 31-40 years. The youngest deceased was a fetus of 5 months and the eldest person of the age group was 80 years. The age of the deceased was calculated by anthropological data only and information provided by police.

Table 3 shows the religion-wise distribution of deceased, in which the maximum number belongs to Hindus followed by Muslims. In 5 bodies religion was not identifiable as one body is of 5 month fetus and 4 were of females without any tattoo or sign supporting religion. Religion identification is done by the presence of any feature like circumcision, tattoo names, etc.

Table 4 shows the seasonal variation of the number of deceased and the maximum number is from January to March followed by July to September, the reason being January to March is the period in which temperature falls to a minimum and in July to September temperature rises to maximum, means in both extremes of climate number of deceased were maximum, considering the fact in 2020, number of deceased were absent in hot climate also supports that peak in number of deceased will be in extremes of climate. In extreme winter, dense fog increases the chances of accidents leading to an increase in the number of unnatural deaths. The thermoregulation mechanism gets

Table 3 Shows the religion-wise number of deceased.

Religion	Hindu	Muslim	Unknown	Total
Number of deceased	86	34	5	125

Table 4. Showing season wise number of deceased.

Season wise	Number of deceased
January to March	43
April to June	21
July to September	35
October to December	26
Total	125

Table 5. Shows the number of deceased according to the manner of death.

Manner of death	Natural	Unnatural	Pending	Total
Number	74	34	17	125

Table 6. Shows the number of deceased according to the system involved in natural causes of death.

Primary System involved in natural cause of death	Number of deceased
Lung	29
Heart	26
Liver	2
CNS	4
Other	13
Total	74

hampered when unknown/beggars sleep in extreme climates leading to increased chances of death.

Table 5 shows the manner of death as unnatural or natural. Unnatural deaths again were not divided into accident, suicide, or homicide as there was no way for its confirmation. Maximum deaths were natural followed by unnatural. In 17 bodies, nothing evident was found hence opinion was reserved pending for accessory examination reports e.g. histopathological and chemical analysis.

Table 6 shows system involvement in natural deaths, of which the most common was respiratory just followed by cardiac. In 13 cases, generalized debility was noted.

In all autopsies, necessary samples were preserved. For DNA examination, bone pieces and tooth were preserved, and the viscera was preserved in suspected poisoning cases and sent to the Forensic Science Laboratory for chemical analysis. Histopathology samples whenever necessary were preserved in 10% formalin and sent to the pathology department for examination.

Discussion

Moradabad is one of the major cities in Uttar Pradesh. It is also called Brass City where brass-related and other factories are in large numbers. Many workers, unskilled & skilled laborers, orphans and beggars from neighboring villages migrate to the towns to earn a livelihood. Many times they are living alone, so when there is sudden death, the body is usually labeled as unidentified/unclaimed. Usually, bodies are kept in the morgue for 72 hours as a waiting period in the hope someone will come and identify or claim the deceased,[5] but this increases the cost of maintenance of the freezer. Any problem with the power supply may lead to the risk of decomposition of the body. The burden of unsolved crimes in society would be greatly reduced by identifying unclaimed dead bodies.[6] A sizeable collection of unidentified remains are brought in for postmortem assessment at

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any institution. Different procedures are used in accordance with protocol to determine the deceased person's identity. Police provide information on the dead, including images, physical characteristics, clothing details, etc., to the media and on social media. Fingerprints and DNA samples are kept for confirmation. An autopsy surgeon can provide comprehensive data obtained from a careful examination and body dissection. Based on his observations and the results of the lab, he must also provide an opinion on the manner, cause, and nature of death. In our study, most of the deceased were males. This is similar to a study done in Maharashtra.[7] Mostly being the earning member of the family, males stay away from home in search of jobs. The most common age-group in this research were 41 to 50 followed by 31 to 40 years mostly because this is the common earning age group working outside. In unnatural deaths, the most common cause was accidents, as the general age group involved in driving is 30 to 50 years and young ones have a tendency for rash driving & higher risk-taking capacity for adrenaline rush. Season wise most cases coincide in January to March followed by July to September as the temperature was extreme in these periods. Most of the people who died as unidentified/unclaimed had decreased immunity because of inadequate food and unhygienic conditions. Among these people, the beggars were staying by the side of the road and some laborers stay near the factory in an open environment. Extreme hot or cold climate poses a risk factor that fastens death. Sometimes, beggars/laborers who were living alone, when become unconscious or about to die, there is no one to point out the situation and due to this reason, many of the bodies were brought to the mortuary in early decomposition state. Among unnatural deaths, the most common cause was hemorrhagic shock due to multiple injuries, mostly because of accidents as the medical college lies on a national highway.

Conclusion:

125 bodies in all were taken to the department's morgue for postmortem assessment over the time frame of the research. Males were more in number as compared to females. Males – 111 cases & females - 13 cases. The age group 31–40 years had the 2nd -highest percentage of cases, followed by the 41–50 age group. Most of the deceased belonged to the Hindu religion. Most of the cases belonged to January to March period. Most of the cases died because of natural death. In natural deaths, the most common system involved was the lung followed by the heart. Necessary samples like viscera, and tissue bits for histopathology were reserved in cases where cause of death was pending. Bone pieces and teeth for DNA examination were preserved in all cases.

Suggestion: 89.2% of the Indian population has Aadhar data recorded. However, it is still difficult to identify a person when they pass away.[8] The early spread of information about unknown deceased is the crux of identification. The information utilizing photographs of the deceased, of clothes, tattoo marks, scars, deformities, etc. should be spread as early as possible by police officers on social media and in all possible ways. ZIPNET[9](Zonal Integrated Police Network) is a real-time platform for crime sharing and criminal information among its member states which includes Haryana, Delhi, Rajasthan, UP, Chandigarh, Punjab, Uttrakhand, and Himachal Pradesh, it would be far better if it includes all states and the information of unidentified/unclaimed should be available on it as early as possible. The Central Fingerprint Bureau (CFPB) exclusively maintains a criminal fingerprint database using Facts.[10] This powerful fingerprint identification technology is called (Fingerprint Analysis and Criminal Tracking System). The primary database/repository does not include the fingerprints of unclaimed remains (which may not be criminals), since this database only contains records of criminals.[6] There should be designated display boards in all cities for missing or found dead persons. “Missing Persons Registry” should be maintained uniformly in every major city. This information should be spread by a designated government office on a website so even a common person can also look for their loved ones, pan nation. If state or law permits, police should be allowed to use Aadhar-based STQC (Standardization Testing and Quality Certification) Certified fingerprint scanners for the deceased, by which fingerprints can be quickly used to check identity. The concept of a data bank can play a role if it is functioning in all states. In all facilities where an autopsy is conducted, an “Unknown case Register” with all concerned information should be maintained/stored. The pilot project UMID by AIIMS, New Delhi[10] should be expanded involving all autopsy stations across India and all centers where unidentified bodies are handled so identification by DNA will be done rapidly. The autopsy surgeon and the police officer should work as a team so that unknown and unclaimed will have a dignified last ritual after being identified by their loved ones.

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ORIGINAL ARTICLE

Profile of Burn Cases brought to a Tertiary Care Hospital of Tripura

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Abstract:

Burn injury has been a significant cause of morbidity & mortality worldwide resulting in major health crisis. The purpose of this study to provide an overview of the scenario of burn cases & their clinical parameters which will help the healthcare personnel to redirect their treatment modalities and thereby reducing their mortality and morbidity. A total of 300 cases were included in the study and the study was conducted in between 2021 to 2022. Majority of burn patients were between 21-30 years of age with female preponderance (68.70%), accidental burns were most common (52.7%) and none of the patients with 3rd degree burn survived beyond 5 days. Majority of the deaths occurred due to shock (48.6%). Result of the study shows that mortality was higher among reproductive women and majority occurred while working in kitchen. This study will provide information to raise awareness in order to prevent the victimization due to lethal burn injuries.

Keywords: Burn; Accidental burn; TBSA.

Introduction:

A burn is an injury which is caused by application of heat or chemical substances to the external or internal surfaces of the body, which causes destruction of tissue.[1] Burn injuries pose a significant public health concern worldwide, and their impact on individuals and communities cannot be overlooked.

According to the NCRB report, the incidence of burn injuries in India has been on the rise, with approximately 1,50,000 deaths reported annually. Burn injuries continue to be a leading cause of morbidity and mortality, particularly in developing countries. According to the National Crime Records Bureau (NCRB), the number of deaths by self-immolation decreased by 64% in 2021 compared to the year 2020, with a total of 4,196 cases. Additionally, there were 8,491 fire accident cases reported in 2021, which is 9% lower than in 2020.[2] The states with the highest percentage of "fire in residential or dwelling building" incidents during 2021 were Mizoram (100.0%), Assam (95.7%), Himachal Pradesh (88.2%), Karnataka (86.9%) and Tripura (86.4%).[3]

Furthermore, the WHO highlights that burns account for a significant proportion of disability-adjusted life years (DALYs) lost globally. An estimated 180000 deaths every year are caused by burns – the vast majority occur in low- and middle-income countries. In India, over 1000000 people are moderately or severely burnt every year.[4] Understanding the profile and characteristics of burn cases in a specific region is crucial for developing effective prevention strategies, improving treatment outcomes and allocating healthcare resources appropriately.

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In Tripura, a state in northeastern India, burn cases present a substantial burden on healthcare facilities. AGMC & GBP Hospital, as a leading tertiary care facility in Tripura, plays a pivotal role in managing burn cases in the region. This comprehensive study aims to provide insights into the demographics, etiology, severity and outcomes of burn injuries among patients admitted to the hospital. By analyzing a substantial number of burn cases, this study aims to contribute valuable data to the existing literature, aiding policymakers, healthcare providers and researchers in addressing the challenges associated with burn injuries.

Materials and methods:

This hospital and mortuary-based prospective study employed a descriptive design to investigate the profile of burn injury cases at Agartala Government Medical College and GBP Hospital in Tripura. A total of 300 cases were included in the study and the study was conducted in between 2021 to 2022.

Study Population: The study included two categories of patients: (1) Admitted and discharged burn injury cases and (2) Admitted and deceased burn injury cases.

Exclusion Criteria: Outpatient Department (OPD) patients with minor burns and cases brought dead to the hospital were excluded from the study.

Data Analysis: Descriptive statistics, such as frequencies, percentages, means and standard deviations, were used to summarize the demographic characteristics and profile of burn injury cases. The pattern of burn injuries based on severity and total body surface area involved was estimated. Epidemiological factors associated with burn injuries among the patients were analyzed.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee of Agartala Government Medical College and GBP Hospital. Confidentiality and privacy of patient information were ensured.

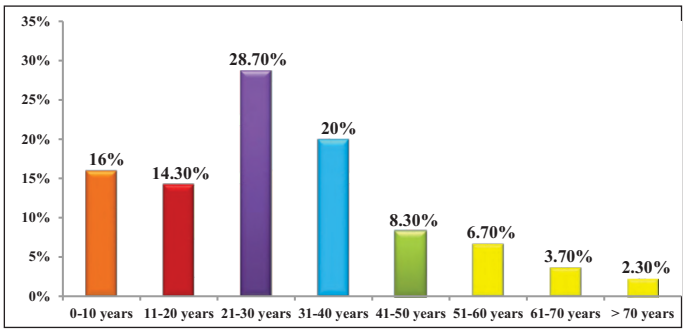

Figure 1. Distribution of burn cases by age group (N=300).

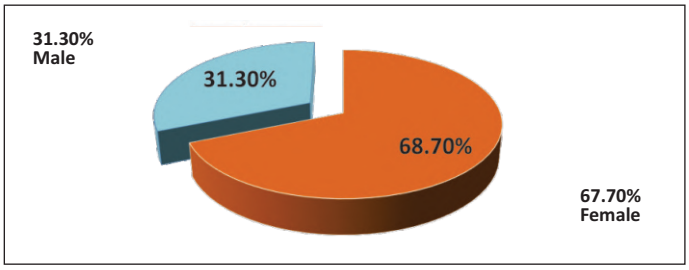

Figure 2. Distribution of the participants by Sex (N=300).

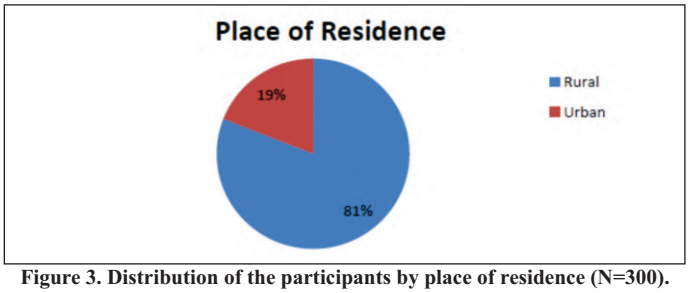

Figure 3. Distribution of the participants by place of residence (N=300).

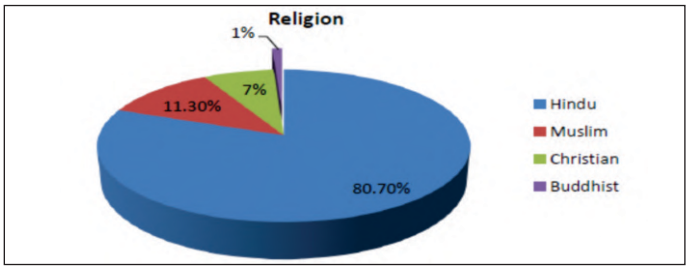

Figure 4. Distribution of the participants by their religion (N=300).

Results & observation:

Maximum burn patients were within the age group of 21-30 years (28.70 %). Female (68.70%) preponderance is more as compared to males (31.30%), with male: female ratio of 1:2. Most of the victims belonged to rural areas (81%) as compared to urban areas (19%). A huge percentage of cases were seen among Hindu religion (80.70%). Majority of victims were married (71.7%). Maximum percentage of victims had received education up to high school (29%). Majority of the burn incidents were seen among housewives (35%). Majority of them belonged to lower middle socio-economic status (36.7%). Maximum number of incidents occurred in the month of December (11.3%). Maximum number of incidents occurred in winter season (30.33%). Number of incidents peaked in between 05 AM To 10 AM- (29%) i.e in the morning. Majority number of burn incidents occurred indoors (84%). Most of the burn injuries were accidental burn (52.7%).

Table 1. Distribution of burn cases as per Marital Status (N=300).

Marital status	Frequency	Percentage (%)
Married	215	71.7
Unmarried	85	28.3
Total	300	100

Table 2. Distribution of burn cases as per educational qualification (N=300).

Educational Qualification	Frequency	Percentage (%)
High school	87	29.0
Primary	47	15.7
Higher secondary	46	15.4
Illiterate	43	14.3
Middle	34	11.3
Graduate	28	9.3
Pre-school	15	5.0
Total	300	100.00

Table 3. Distribution of burn cases according to their Occupation.

Occupation	Frequency	Percentage (%)
Housewife	105	35.0
Business	44	14.7
Student	43	14.3
Others	39	13.0
Employed	37	12.3
Labourer	32	10.7
Total	300	100.00

Table 4. Season wise distribution of burn cases(N=300).

Seasons	Frequency	Percentage (%)
Winter	91	30.33
Spring	36	12
Summer	61	20.33
Monsoon	83	28.66
Autumn	26	8.66
Total	300	100.00

Table 5. Distribution of the participants by manner of incident of burn (N=300).

Manner of Incident	Frequency	Percentage (%)
Accident	158	52.7
Suicide	118	39.3
Homicide	22	7.3
Not Commendable	2	0.7
Total	300	100.00

The leading cause of suicidal burn incident is dowry harassment which accounts for about 24 (20.4%) numbers of suicidal burn cases. Maximum of the victims had 21 % to 40 % of their total body surface area involved in burn (35.7%). Most of the burns were 2nd degree burn (58.40%). Out of 300 cases, 189 (63%) patients got successfully treated & discharged and 111 (37%) patients succumbed to death. The agent responsible for burn injury among 38.4 % study subjects was kerosene. The mean number of hospital stayed days among who survived & discharged was 4 days and 2.5 days among expired. Majority of the deaths occurred due to shock (48.6%). Females (46.1%) had more mortality than males (17%). Total body surface area involved in burn was 21 to 40% among 35.66% cases. Mortality starts rising when 41% to 60% of body surface area is involved in burn and the mortality is almost 100 % when the body surface area involved in burn is beyond 61% to 80%. The percentage of survivorship for more than 5 days in 2nd degree burn is more as compared to 3rd degree burn (17.1% > 0.0%) and there was no mortality among 1st degree as the degree of burn gets higher, the

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Table 6. Distribution of the participants by burn percent (N=300).

Burn Percentage (TBSA)	Frequency	Percentage (%)
21 to 40	107	35.7
81 to 100	61	20.3
41 to 60	47	15.7
61 to 80	45	15.0
0 to 20	40	13.3
Total	300	100.00

Table 7. Distribution of burn cases as per cause of death (N=111).

Cause of death	Frequency	Percentage (%)
Shock	54	48.6
Septicemia	47	42.4
Toxemia	4	3.6
Pneumonia	3	2.7
Septicemia with covid positive	3	2.7
Total	111	100.00

duration of hospital stay increases subsequently.

Discussion:

Age wise distribution of burns cases reveals that maximum number of cases belong to the age group of 21- 30 years (28.70%) and the incidence decrease in the age group of 31- 40 years (20%) followed by 0-10 years (16%) and 11-20 years (14.30%). In old age i.e after 70 years, incidence came down to 2.3%. Meera T et al.,[5] Halder A et al.,[6] Bandyopadhyay S et al.,[7] Debbarma S[8] and Shubhendu K et al.[9] revealed that burn incident is more common in the age group of 21-30 years, which is similar to my study. But Koller J et al.[10] in their study revealed that the age group with the highest number of burn patient was in children 0-3 years (21.1%), which is different from my study.

Among the burn victims, 68.70% are females and 31.30% are males. The male to female ratio is 1:2. Females outnumbered the males. Similar findings were observed in the studies conducted by Meera T et al.,[5] Halder A et al.,[6] Debbarma S[8] and Shubhendu K et al.[9] But Koller J et al.[10] in their study revealed male predominance (2.1:1) over female, which is different from my study.

In the studies conducted by Tripathi CB et al.,[11] Kumar A[12] and Nath A et al.[13] (2015) revealed that burns incidents were more common in the rural areas, which is similar to my study. In the studies conducted by Dasgupta SM, Tripathi Cb[14] (1984), Kumar A,[12] Nath A et al.[13] (2015) and Bandyopadhyay S et al.[15] (2019) revealed that burns incidents were more common among Hindus, which is similar to my study.

In the studies conducted by Meera T et al.[5] and Shubhendu K et al.[9] revealed that burn incident is more frequent among married people as compared to unmarried, which is similar to my study. Bandyopadhyay S et al.[15] revealed that maximum victims (61.47%) were educated up to 10th standard, which is similar to my study. In the study conducted by Dasgupta SM, Tripathi CB[14] (1984) reported that 59% of burnt wives were illiterate, 23% received only primary education and 16% were educated up to secondary standard and only 2% victims were graduate, which is not similar to my study.

In the studies conducted by Singh D[16] (1997) and Shubhendu K et al.[9] revealed that burns incidents were more common among housewives, which is similar to my study.

In the study conducted by Tejerina C et al.[17] revealed that burns incidents were more common during winter season, which is similar to my study. However the study conducted by Pandey SK, Chaurasia N[18] found that the peak incidence of burns occurred during summer season (43.6%) followed by winter (29.5%) and rainy (26.9%), which is different from my study.

In the study conducted by Mangal HM et al.[19] (2007) and Meera T et al.[5] found that the majority of burn cases were accidental followed by suicidal and homicidal, which is similar to my study findings.

In the study conducted by Nath A et al.[13] (2015) revealed that total body surface involved was greater than 80% category, which is not similar to my study. The study conducted by Mangal HM et al.[19] found that the total body surface area involved was more in 40-60% category.

Distribution of burn cases according to degree of burn reveals that, 58.40% patients had 2nd degree burn, 27.30% had 1st degree burn and 14.30% had 3rd degree burn. Shankar G et al.[20] (2014) found that the overall mortality was 37.50%, which is similar to my study.

In the study conducted by Tejerina C et al.[17](1992), Mangal HM et al.[19](2007), Nath A et al.[13] (2015) and Meera T et al.[5] found that most of the victims died from shock, which is similar to my study. In the study conducted by Singh D[16] (1997) and Tripathi CB et al.[11] observed that majority of the burn victims died due to septicemia, which is not similar to my study.

Conclusion:

This study on burn patients identified several important factors and epidemiological aspects related to burns. The majority of cases occurred in young adults aged 21-30 years, likely due to their higher exposure to hazardous situations. Housewives were the most commonly affected group, while unemployment, depression, and stressful situations were associated with burns among men. Women, on the other hand, faced burn risks related to young age at marriage, inability to cope with marital stress, harassment, and inadequate cooking precautions. Most burn incidents were accidental, with flame burns being most common due to various factors such as kerosene and open fires.

The study also highlighted that homes were the primary site of accidents. The involvement of a significant body surface area in burns, combined with delays in seeking medical help and higher mortality rates, indicated the severity of the cases and the need for improved resources and timely intervention. Shock was identified as the leading cause of mortality in nearly half of the cases.

Overall, understanding these risk factors and epidemiological aspects is crucial for designing effective preventive programs tailored to specific countries and regions.

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ORIGINAL ARTICLE

Assessment of Attitude and Knowledge of Law Students towards "Tele-evidence" Facility for Doctors

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Abstract:

A doctor's role not only includes patient care but also to provide evidence in the court as and when called upon to do so. Evidence giving in the court leads to an additional burden on the doctor with regards to the time and money spent on travelling, cancellation of the hearing after reaching the court, etc. An alternative for all these problems can be tele-evidence. This study aims to know the attitude and perception of final year undergraduate law students towards tele-evidence facilities for doctors. A cross sectional study was done using a questionnaire-based survey. The Likert scale questionnaire was used to assess the attitude, and the Cronbach alpha coefficient checked the Likert items' internal consistency. The analysis of the data was done using SPSS version 25. When summarised by median and mode for the individual Likert items, the results showed that the final year undergraduate law students have a positive outlook towards tele-evidence facilities for doctors but lack exposure to such advances. A study taking into account the opinion of practising lawyers and judges, especially those who have done court hearings using tele-evidence facilities for doctors, needs to be done.

Keywords: Doctors' roles; Burden on doctors; Tele-evidence; Court hearings.

Introduction:

Physicians' role includes patient care as well as going to courts of law to provide their testimony when called upon to do so according to the provisions of the Indian Evidence Act.[1] It leads to the absence of doctors from the hospitals, consumption of fuel for travelling, and loss of time. More than half of the doctors involved in a research have reported spending more than 1000 from their side for physical appearance in a court.[2] These expenses can lead to dissatisfaction among doctors.

The absence of a doctor from the hospital creates an undesirable effect on the doctor-patient ratio, especially if a substitute is not present, which is often observed in Primary health centres as well as Community Health Centres in India. The shortage of doctors that India is facing further compounds the problem.

"Tele-evidence" refers to using videoconferencing as a tool to produce evidence in front of the court. 130 doctors participated in a previous research conducted at a tertiary care hospital in India that has adopted "tele-evidence" as a pilot project.[2] Two thirds among them answered the summons by tele-evidence, and one third physically participated at court.[2] The disadvantages reported while attending the court were "time spent away from the hospital, cancellation/postponement of proceedings, absence of presiding judge/advocate, and no reimbursement of expenditure".[2] However, after introducing tele-evidence, "a 43% drop in monthly mileage of vehicles was observed, a 49% reduction in per month fuel cost, and 28% savings in terms of time consumed for court duties".[2] Satisfaction scores were higher with tele-evidence as compared to physical appearance at court.[2]

In the courtroom, lawyers play a significant role as they are the ones who debate about the validity of evidence in front of the judge. Hence knowing their view about tele-evidence facilities for doctors is essential. This research aimed to find the view of final year undergraduate law students on tele-evidence facilities for doctors. Final year undergraduate law students were selected because they visit court as a part of their curriculum in India and are the upcoming lawyers and the nation's youth, empowered with digital knowledge.

Materials and methods:

After obtaining clearance from the institutional ethics committee, and permission to conduct the research from the principal of the Law College, a "cross-sectional study" was done using a questionnaire-based survey to assess law students' attitudes and knowledge towards tele-evidence facilities for doctors.

Inclusion criteria: 1. Final year undergraduate law students from the Law College.

In this paper, "final year undergraduate law students" will be referred to as "law students" for ease of reading. The sampling method used was simple random sampling. A well-structured questionnaire in English was given to the mentioned participants to conduct the survey and written informed consent was obtained

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Table 1. Median and mode of questions in "section II".

	Question 1	Question 2	Question 3	Question 4	Question 5
Median	3.50	4.00	4.00	3.00	3.00
Mode	4	4	4	3	3

from each participant. Information obtained included Roll number, age, sex and answers to the questionnaire. The confidentiality of the participants is maintained.

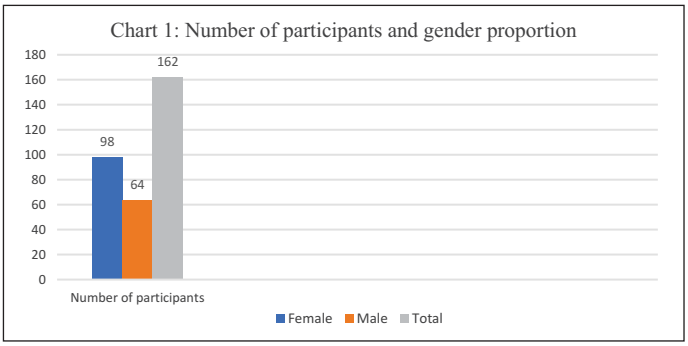
The questions in the survey were divided into two sections, the first section assessed the awareness of "tele-evidence" while the second section assessed the acceptance of "tele-evidence". The questionnaire used a "Likert scale" of 5 points from "Strongly agree" to "Strongly disagree" to assess law students' attitude towards tele-evidence facilities for doctors in "Section II" of the questionnaire which had five questions. "Section I" of questionnaire had one question on awareness of tele-evidence with a binary answer of Yes or No. Analysis of the data was done using SPSS version 25. The responses were coded and imported into SPSS.

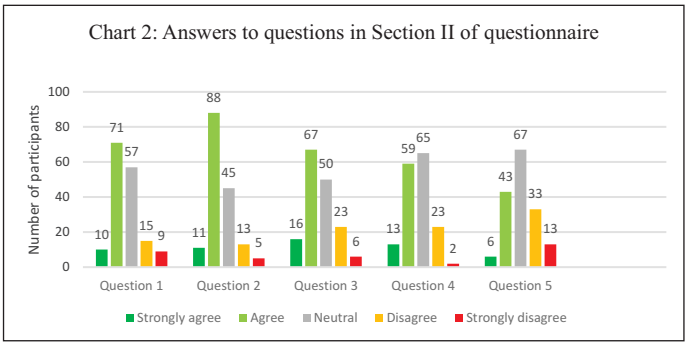
For the question about awareness of "tele-evidence" under Section I, the sample proportion was found for "Yes" and the population estimate's 95% confidence interval was calculated. For "Questions 1,2,3 and 5" under "Section II", the following values were used: "1=Strongly disagree", "2=Disagree", "3=Neutral", "4=Agree", "5=Strongly agree". For "Question 4" under "Section II", the following values were used: "5=Strongly disagree", "4=Disagree", "3=Neutral", "2=Agree", "1=Strongly agree". The reversal in scoring for Question 4 is because if it had not been done, a high score on Question 4 would suggest a negative attitude towards tele-evidence, while a high score on other questions in Section II suggests a positive attitude towards tele-evidence. The scoring was reversed to solve this discrepancy and make a high score on all questions in Section II imply a positive attitude.

It is recommended to use central tendency measures like median or mode for Likert data.[3] However, later advances suggest that Likert items (which are the individual question) are to be treated as ordinal data, but the amalgamation of several such items can be done into a "survey scale," and then a total score or mean score can be calculated for the scale items.[4,5] In this research, the above-stated practice has been used. The Likert items' internal consistency was checked by Cronbach alpha coefficient, which was found to be 0.710 using SPSS, which is acceptable as values over 0.7 are considered acceptable.[6] The more any respondent scores on the Likert items, the more they will be accepting of tele-evidence. For each respondent a mean acceptance score was created from their responses to Likert items of Section II. This individual mean acceptance score was further averaged for the whole sample and a sample mean acceptance score was deduced and a 95% confidence interval of the population estimate was calculated. The lowest possible value for the acceptance score is 1 and the highest value is 5 with 1 being least acceptance and 5 being highest acceptance.

Results:

The gender proportion of the respondents is shown in chart 1. For "Question 1" in "Section I" of questionnaire, 100 people out





of 162 responded "Yes". Hence the proportion of people in the sample having awareness of tele-evidence is 61.7%. The 95% confidence interval for the population estimate was found to be 53.8% to 69.2%.

The answers to the questions in Section II are summarized in the chart 2.

The table 1 shows the median and mode of all 5 Likert items in "Section II" of the questionnaire.

Mean acceptance score was calculated for each of 162 respondents, taking an average of individual responses to the questions in "Section II". The sample mean acceptance score was calculated to be 3.18 out of 5. The 95% confidence interval for the population estimate was calculated to be 3.08 to 3.27.

Discussion:

Interventions like tele-evidence are not alien to the Indian court system as they had been previously used. In the Nirbhaya case, the statement of Dr Paul Chui was recorded through video conferencing in the court.[7] Teaching hospitals in the states of Punjab and Haryana have adopted tele-evidence facility.[7] Tele-evidence does not pose any confidentiality threat as according to section 327 CrPC (Criminal Procedure Code) of the Indian constitution, "all courts are to be open courts to which the public may have access".[7] However, in some instances where the court is not open to public, like Protection of Child from Sexual Offenses Act (POSCO) cases, the doctor can come to the court.[7]

The present study aims to understand attitude of law students towards "tele-evidence" facilities for doctors. The analysis of the results shows that 61.7% of the sample population were aware of tele-evidence. Further, looking at the 95% confidence interval of the population estimate, it is 53.8% to 69.2%. Interventions like educational workshops about tele-evidence facilities for doctors

can make law students and lawyers aware of tele-evidence. Interventions like this can help the law students and the lawyers understand the need for tele-evidence facility for doctors, how it can contribute to society as a whole by saving time of the doctors, reducing vehicular emission, reducing fuel cost, and improving doctor satisfaction as had been proved by previous research.[2]

Most of the respondents agreed that tele-evidence could be used to substitute physical appearance in the case of doctors and also that it helps save doctors' time and other resources thus leading to improved patient care. This indicates a positive attitude towards tele-evidence facilities for doctors. Majority of the respondents agreed to support a law allowing doctors to give evidence through video conferencing. This further indicates the respondents' positive attitude towards tele-evidence facilities for doctors.

Most of our respondents had a neutral opinion when inquired about their view on whether tele-evidence can negatively impact the testimony given by the doctor in court, and whether tele-evidence could be better than appearing physically in the court to produce evidence in case of a doctor. A neutral opinion regarding those two statements may be because of the lack of experience of the respondents regarding tele-evidence. As of now, tele-evidence is not practised anywhere in South India, leading to a lack of exposure of law students towards practices like these.

One limitation of this research is that it does not consider the opinion of practising lawyers and judges. Future research considering the understanding of practising lawyers and judges, especially those who have conducted court hearings using tele-evidence facilities for doctors, could further enhance our understanding of the acceptance of tele-evidence facilities for doctors in the courtroom.

Conclusion:

Overall, it can be stated that the law students agree that tele-evidence can substitute physical appearance in case of doctors. They understand that it can benefit the doctor and patient care. They also agree to support a law allowing doctors to give evidence via tele-evidence facilities. However, the lack of exposure to such advances is seen. The law students have a positive outlook towards tele-evidence facilities for doctors but at the same time are not aware of how it can affect the quality of testimony given by the doctor in the court due to lack of exposure. The sample mean acceptance score of 3.18 out of 5 (95% CI, 3.08-3.27) calculated for the sample also reflects the analysis of individual Likert items done above.

The decision to introduce tele-evidence facility for doctors lies solely on the shoulders of the honourable courts of India. Having such a facility can prove beneficial not only to India's already burdened health care system but also to the environment in terms of less fuel consumption and emission.

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ORIGINAL ARTICLE

Traumatic Dental injuries and its Forensic Aspects: A Prospective study at a Tertiary care Teaching Hospital

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Abstract:

A traumatic dental injury is an impact injury to the teeth resulting from traffic accidents, falls, assaults, and sports. Traumatic dental injuries, by affecting a patient's speech and aesthetics, can lead to psychological and social problems, lowering the patient's quality of life. The role of the Forensic expert is to document and describe injuries and assess the quantum of disease and disability suffered. The study aims to analyse the pattern of traumatic dental injuries in a tertiary care teaching hospital and emphasise the medico-legal issues that arise from a Forensic perspective. 62 cases of traumatic dental injuries presenting to the emergency room or the department of Oral Medicine were studied prospectively over a one year period. There was a preponderance of male cases (61%) over female cases. A maximum number of cases were seen in the adult population (55%). Road traffic accidents (40.4%) were the most common mode of dental trauma. The commonest type of traumatic dental injury observed was uncomplicated crown fractures and maxillary central incisors were the most commonly traumatised teeth. In 12 cases injuries were reported as simple and in 50 cases, they were grievous in nature. To conclude, traumatic dental injuries are preventable, and their prevalence could be reduced when potential risk factors are identified. Meticulous examination and documentation of traumatic dental injuries should result in an accurate, complete and unbiased medico-legal report that will aid in the legal framing of criminal charges against the accused or suspect in question.

Keywords: Forensic aspects; Grievous hurt; Medico-legal report; Traumatic dental injury.

Introduction:

An injury inflicted on the dentoalveolar system is referred to as a traumatic dental injury. Since the oro-facial region is the most exposed part of the body, it is highly susceptible to traumatic injuries. A traumatic force applied to the teeth or periodontium can cause destruction in a variety of ways and to varying degrees of severity. These injuries occur as a result of traffic accidents, falls, assaults, and sports, and they may be present either solely or in conjunction with other regional injuries.

Traumatic dental injuries, by affecting patient's speech and aesthetics can lead to psychological and social problems, lowering the patient's quality of life. The role of the forensic expert is to document and describe injuries, assess the quantum of disease and disability suffered and draw conclusions to help with the legal framing of the criminal offences against the accused or suspect in question.

Several epidemiological studies[1-13] conducted throughout the globe have focused on the pattern of traumatic dental injuries in children and adults, and a few studies[14-19] have highlighted the forensic significance of such cases. However, there is still a paucity of literature with regard to the Forensic interpretation of such injuries, especially in an Indian scenario. With an intention to fill the dearth, the authors in the present study have attempted to analyse the pattern of traumatic dental injuries in a tertiary care teaching hospital and emphasise the medico legal issues that arise from a forensic perspective.

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Materials and methodology:

An approval from the Institutional Ethics Committee was obtained for the study. The present prospective study was conducted at a tertiary care teaching hospital on 62 cases of traumatic dental injuries presenting either to the emergency room directly or to the department of Oral Medicine during the period of 1 year, i.e., from January 2021 to December 2021.

The study included all such cases in the age range from 1 year to 80 years. Cases initially treated at an outside hospital and then referred to the teaching hospital were excluded from the study. All deceased cases were excluded from the study. Informed consent was taken from the patient or relatives after explaining to them in the vernacular language.

The patient details, history provided and dental findings were documented in a pre-structured proforma. The traumatic dental injuries sustained were categorised as per the classification and analysed.

Other authors have classified traumatic dental injuries according to the Ellis classification[2] or Andreasen's classification.[10] However, the authors in the present study classified traumatic dental injuries as per an unnamed classification used in studies

Table 1: Age wise distribution of cases.

Modes of traumatic injury	Children (<10 years)	Adolescents (10-18years)	Adults (>18 years)
Road traffic accidents	02	05	18
Falls	12	01	04
Sports	02	06	05
Assault	00	00	07
Total	16	12	34

Table 2: Types of traumatic dental injury.

Types of traumatic dental injury		Number of cases
Injury to hard dental tissue and pulp	Injury involving only enamel	16
	Injury involving dentin and enamel (uncomplicated crown fracture)	23
	Injury involving dentin, enamel and pulp (complicated crown fracture)	13
	Root fracture	07
Injuries to periodontal tissues	Concussion	02
	Luxation (Intrusion, Extrusion, Lateral)	05
	Avulsion	07
Injuries to supporting bone	Fracture of socket wall	07
	Fracture of alveolar process	06
	Fracture of maxilla/mandible	09
Injuries to gingival and oral mucosa	Abrasion, contusion and laceration	13

Table 3: Associated injuries.

Associated injuries	Number of cases and percentage
Head injuries	14(22.5%)
Facial injuries	21(33.8%)
Systemic injuries	05(8.06%)

conducted by Jung et al.[8] and Birgen et al.[16] which appeared more simple and appropriate for the present study. Traumatic dental injuries were classified into four categories: injuries to hard dental tissue and pulp; injuries to periodontal tissues; injuries to supporting bone; injuries to gingival and oral mucosa.

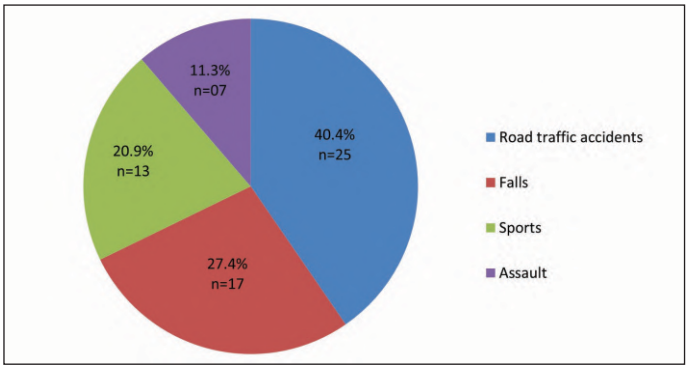
Results:

Overall, there was a preponderance of male cases (61%, n=38) over female cases (39%, n=24) A maximum number of cases were seen in the adult population (55%, n=34).The youngest patient presented at the age of one year while the oldest patient was seventy-five years old. The age-wise distribution of cases is depicted in Table 1. The most common mode of dental trauma is road traffic accidents [Graph 1]. Uncomplicated crown fractures were the commonest type of traumatic dental injury [Table 2] and maxillary central incisors were the most commonly traumatised teeth.

Discussion:

A traumatic dental injury is an impact injury to the teeth and the supporting hard and soft tissues within the vicinity of the oral cavity. It is usually sudden, circumstantial, unexpected, and accidental and often requires emergency attention.[13] The predisposing factors for traumatic dental injury include inadequate lip coverage, increased overjet, maxillary incisor protrusion, dental malposition, dental hypocalcification or hypercalcification, dental caries, and triggering seizures. The nature of the occurrence of accidental dental trauma usually varies according to age. In the first decade of life, primary dentition and hyperactive behaviour make children susceptible to

Graph 1: Modes of traumatic dental injury.



dental injury; rash and negligent behaviour and sports activities make them vulnerable in the adolescent age group. Traffic accidents, violent behaviour and assaults, and trivial falls make adults and the elderly susceptible to traumatic injury.

Consistent with the findings of the present study, various studies[1-10,12] have also reported an overall dominance of male cases compared to females. A higher prevalence in males could be attributed to their violent behaviour and active involvement in outdoor activities. Depending on the age, the cases in the present study were classified into children under ten years old, adolescents, and adults. A majority of traumatic dental injuries were seen among adults, followed by children and adolescents [Table 1]. Studies conducted by Shrestha et al.[3] and Mahmoodi et al.[4] also revealed a similar order of occurrence of injuries.

In the present study, considering all causations, the most common mode of traumatic dental injury was road traffic accidents (40.3%). The common mode of injury however varied according to age, and it was observed that falls were common in children under ten years old (75%), sports activity in adolescents (50%) and road traffic accidents in adults (53%). The above observations were similar to the findings observed in studies conducted by several authors.[1-3,7,9,12] Lack of parental supervision, lack of motor coordination and curious behaviour were the factors contributing to falls in children in the present study. Application of mouth guards is considered an effective preventive measure to prevent or reduce the severity of dental trauma in sports[4] but none of the cases of sports injuries in the present study were found wearing mouth guards. The study reported no cases of assaults among adolescents, which could be due to their reluctance to reveal the cause of injury, suggesting that the proportion due to assault may be underestimated. A study conducted by Nagrajappa et al.[2] also reported a similar finding. The reasons observed for higher incidences of road traffic accidents in adults in the present study were rash and negligent driving, lack of protective gear and alcohol intake.

Contrasting findings were observed in certain studies[4-6,10] which cited falls to be the most common mode of trauma probably because their studies reported higher incidences of trivial falls in the elderly due to poor balance and coordination, impaired vision and adverse effects of medications. However, the second most common injury in the above studies was attributed to road traffic accidents.

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Figure 1: Complicated crown fracture without displacement in relation to 11.

Figure 2: Accidental fall in children resulting in intrusion of 51 and 61.

Figure 3: Avulsion of teeth in relation to 31, 32 and 41 with gingival laceration and encrustation of lips (case of Road traffic accident).

The most commonly traumatised tooth was the maxillary central incisors, and the findings are in accordance with existing literature.[2-7] This is most likely due to the vulnerable position of these teeth, which frequently protrude and may have insufficient coverage by the lips. Another reason could be the non rigid connection of the mandible to the cranial base, which allows any impact force to dissipate.

Injuries to the hard dental tissues and pulp could include injuries involving only the enamel, or both dentin and enamel

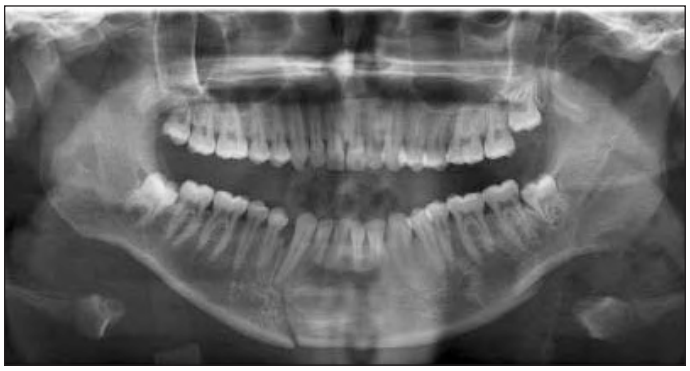

Figure 4: Orthopantogram revealing parasymphyseal fracture in mandibular anterior quadrant (case of assault).

Figure 5: Gingival laceration surrounded by oedema and haematoma (case of Road traffic accident).

(uncomplicated crown fracture), or those involving dentin, enamel and pulp (complicated crown fracture). Crown fractures are usually seen in road traffic accidents and falls and they occur due to an impact from a small object moving at a relatively high velocity and making contact from a lateral direction. In the present study, uncomplicated crown fractures (n=23) outnumber complicated crown fractures(n=13) and the findings are consistent to the findings of various studies[2-7,10,12] and contrary to the findings of Shubham et al.[1] root fractures usually occur as a result of an assault.

Injuries to periodontal tissues include concussion, luxation and avulsion. Concussion can be appreciated by eliciting tenderness on percussion in the absence of tooth displacement or loosening. Tooth luxation is the dislocation and loosening of tooth. Radiographically, there are three types of luxation. Tooth intrusion is the luxation of tooth inward into the alveolar socket. In extrusive luxation, the tooth is displaced from the socket in an occlusal direction and there is a large definite increase in width of the space in apical area. In lateral luxation, there is a marked widening of periodontal space apically on either side of the tooth depending on direction of impact.[16] Eighty percent of luxation injuries in the present study were appreciated in children, consistent with the findings of Shrestha et al.[3] and Toprak et al.[9] This could be due to the higher bone elasticity in children that has the ability to absorb more energy of impact favouring luxation injuries. Another reason could be the smaller crown and roots that favour luxation rather than a fracture. Permanent teeth are embedded more firmly in the alveolar bone and are more likely to

fracture. Tooth avulsion refers to the tooth being out of the alveolar socket completely. Injuries to the supporting bone are seen as fracture of socket wall, fractures of alveolar process and fractures of maxilla and mandible. Injuries to gingival or oral mucosa usually take the form of abrasion, contusion or laceration.

Forensic aspects: The role of the Forensic expert lies in documenting and evaluating dental injuries. It is always important to document injuries and photographs as they serve as key Forensic evidence in the Courts of law. Assessing the gravity of trauma and the traumatic mechanisms involved allows establishment of causation between the nature and extent of permanent impairment and injury which aids in the legal framing of criminal offences. The question of dental trauma affecting mastication, speech, and aesthetics arises in civil and criminal cases. Among civil cases, those most commonly seen are those related to compensation and insurance claims. Among criminal cases are assaults, accidental trauma, or cases of negligence against a doctor as a result of iatrogenic trauma. The quantum of punishment is fixed by the courts based on the opinion of the doctor regarding the loss of function.

Dental trauma and Section 320 Indian Penal Code (IPC) : The clauses of grievous injury that are applicable to dental trauma are defined in Section 320IPC.

Seventh clause-Fracture or dislocation of bone or tooth: fracture of orbital walls.

Dislocation of a tooth, whether deciduous or permanent, is a grievous injury. It is no defence that since the teeth are deciduous and will eventually be replaced by the successional permanent teeth, they do not attract the clause. Similarly, tooth luxation, whether intrusion, extrusion, or lateral, is a grievous injury. Fractures of the supporting bone, such as fractures of the socket wall, alveolar process, maxilla, and mandible, are grievous injuries.

Eight clause-Any hurt which endangers life or which causes the sufferer to be during the space of twenty days in severe body pain or unable to follow his daily routine.

Traumatic dental injuries indirectly attract this clause on numerous occasions. It is observed that traumatic dental injuries may be associated with life threatening head injuries, facial injuries, and systemic injuries. The present study also reported such a finding [Table 3]. In comparison to such injuries, the dental injuries sustained may be miniscule. As a result, in such scenarios, the final opinion may not be relevant to dental injury at all. However, dental pain, on the other hand, is a subjective phenomenon in which the forensic expert should be able to assess the severity of the traumatic dental injury suffered and whether such injuries are capable of causing pain for a period of twenty days and affect his routine activities like brushing teeth and chewing food. Out of the 62 cases of traumatic dental injuries examined in the present study, the authors reported 12 cases as simple and 50 cases as grievous in nature.

Dental trauma and professional negligence: An act of omission or commission refers to professional negligence. In traumatic dental injuries, it is essential to provide prompt care in order to savage the pulp, thereby preventing further complications like pulp necrosis, ankylotic and inflammatory root resorption, and pulp canal obliteration. Failure to do so will result in medical negligence. An act of commission, i.e., iatrogenic traumatic injury, includes slippage of instruments (clippers, elevators), dislocation of neighbouring teeth through inadequate support, or tracheal intubation.

The Doctrine of Res Ipsa Loquitur constitutes gross negligence like extraction of the wrong tooth, or severing the lingual nerve or inferior alveolar nerve, resulting in numbness and taste disorders.

A new intervening negligent act by the doctor following a traumatic injury is referred to as a Novus actus interveniens. The elements of negligence may include causing damage to nerves while attempting to repair them or introducing infections as a result of using unsterile equipment.

Informed consent is considered a cornerstone of ethical medical practice. Informed consent should be obtained after explaining the procedure to the patient and giving him autonomy to decide. However, informed consent is not a defence in suits of criminal negligence.

Depending on the quantum of damage resulting from negligence, doctors may be punished under Section 336, Section 337, Section 338, or Section 304A of Indian Penal Code.

The number of days of medical care required, time taken for adequate healing should all be taken into consideration while evaluating dental injuries. However, no cases of negligence or iatrogenic trauma were reported in the present study.

Dental trauma and Road traffic accidents: Road traffic accidents being the commonest mode of dental trauma in adults in the present study was due to high incidences of drunken driving (48%, n=12) or lack of protective gear like helmets (28%, n=7), or a fatal combination of both (40%, n=10). Road traffic accidents usually involve monetary compensation and insurance claims and hence require a meticulous examination and an accurate opinion. Primary preventive approach through safe riding and driving practices and strict implementation of traffic rules like speed monitoring, compulsory helmets and testing for alcohol levels should be enforced.[20]

Conclusion:

The present prospective study gives an insight into the pattern and magnitude of traumatic dental injuries. Their prevalence could be reduced if potential risk factors are identified, since in most cases reported, they were observed to be preventable. Preventive strategies include parental awareness and supervision so as to prevent injuries among children and adolescents, and awareness and outreach programmes highlighting the importance of protective gear and the dangers of drunken driving among adults.

From the Forensic purview, meticulous examination and documentation of traumatic dental injuries should result in an accurate, complete, and unbiased medicolegal report. The quantum of punishment is fixed by the courts based on the opinion of the doctor. On certain occasions, the presence of associated life threatening injuries may mask the nonfatal traumatic dental injuries, leaving less scope to address the latter. To conclude, it is imperative for future prospective studies to stress upon many more preventive strategies to reduce traumatic

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dental injuries and emphasise a few more forensic aspects that may have been overlooked.

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ORIGINAL ARTICLE

Review of Estimation of Age from Eruption of Teeth in the Age-group 6-11 years

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Abstract:

Estimation of age is a valuable tool to assist in administration of justice in civil and criminal cases. Children with undocumented birth date are vulnerable to violation of various child rights. Dental techniques for estimation of age are currently considered the best in assessing true chronological age as dental development is less affected than skeletal development by malnutrition and hormonal disorders. Estimation of age by eruption of teeth is the best choice as it is non-invasive and more economical. To study the age of eruption of permanent teeth of children in the age-group 6-11 years of both sexes of Kolkata. To compare the findings with the time of eruption determined from previous studies and note any variations in age of eruption of teeth in relation to sex, socio-economic status, food habits. An observational, cross sectional, institution based, descriptive study on 144 school-going children of age group 6 years to 11 years randomly from various schools in Kolkata was done for the eruption of permanent teeth. Number of teeth erupted was observed and noted as per FDI chart. Data collected during the study was tabulated and verified using standard statistical tools. Out of a total 144 children 72(50%) were male children and 72(50%) were female children in the age group of 6-11 years. Eruption times of permanent teeth were noted in various age groups. According to the present study there has been no significant change in the age of eruption of permanent teeth over the years. The earliest tooth to erupt is the first mandibular molar. Permanent teeth erupted few months earlier in females as compared to males. Permanent teeth appeared earlier in the lower jaw than in upper jaw except first premolar on the left side. Majority of the teeth erupted earlier in the left quadrant as compared to the right quadrant.

Keywords: Age estimation; Tooth eruption; Child rights.

Introduction:

Estimation of age is a valuable tool to assist in administration of justice in civil and criminal cases. It is required in identification, consent, criminal responsibility, kidnapping, attainment of majority, judicial punishment, rape, criminal abortion, prostitution.[1] Age limits are important for admission in schools, for participating in various competitive sports like swimming and talent search contests.

In a developing country like India, due to illiteracy there is unawareness regarding importance of registration of births and often maintenance of records is improper. Children with undocumented birth date are vulnerable to violation of various child rights eg. child labour. Article 24 states that no child below the age 14 years shall be employed in work in any factory or mine or engaged in any other hazardous employment.[2-4] Due to globalization in most of the industrialized nations there is an influx of immigrants , for whom often a clear documentation of age is not available. Hence scientific determination of age is very important. Tooth formation is considered best in assessing chronological age as variations are less as compared to other developmental factors.[5,6] Dental development is less affected than skeletal development by malnutrition and hormonal disorders. In ancient times, age estimations of living adolescents were considered important. In ancient Rome, adolescents were judged to be fit for service, as soon as the second molars had erupted completely.[7] 170 years ago tooth eruption was first used for age estimation in connection with child labor. Assessment of tooth development to estimate the age of living subjects was used in 19th century industrial revolution in England.[8,9] Dental age assessment can be done radiographically and clinical visualization of eruption of teeth. The times of eruption of teeth are fairly constant. Estimation of age by eruption of teeth is the best choice as it does not require any special equipment, expertise, is non-invasive and more economical. Variation exists in the eruption times of permanent teeth due to racial, geographical, nutritional, genetic, hormonal, nutritional, socio-economic factors.[10-12]

Earlier charts and tables were used for the assessment of age based on formation, eruption and calcification of teeth. Table of Krenfild and Logan, later modified by Kronfild and Schour (1939) is commonly used and accepted for many years. These were reviewed by Mcdonald and Avery (1998). These data when reviewed by Lund and Law, established earlier ages than the previously accepted value. The last study was done in West Bengal in 1992 by Banerjee P. and Banerjee A.R. Over the years there has been change in climate, lifestyle and food habits. My hypothesis is that these factors will affect the pattern of eruption

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of permanent teeth. The purpose of this study is to note the age of eruption of permanent teeth at present in children of Kolkata in the age-group 6-11 years in both sexes and observe if there is any variation from the available data in standard textbooks, and the relationship of eruption of permanent teeth with sex, socio-economic status and food habit.

AIM: To study the age of eruption of permanent teeth of children in the age-group 6-11 years of both sexes of Kolkata.

Objectives: To compare the findings with the time of eruption determined from previous studies and note any variations in age of eruption of teeth in relation to sex, socio-economic status, food habits.

Materials and methods:

This is an observational, cross sectional, institution based, descriptive, study done in schools in Kolkata and its suburbs (3 boys' and 3 girls' schools were selected each from different socio-economic strata) from 1st April 2016 - 31st March 2017. 144 school-going children of age group 6 years to 11 years were studied randomly from various schools in Kolkata for the eruption of permanent teeth and their relation with age, sex, socio-economic status, food habit. The ethical clearance was obtained from the institutional Ethical Committee Review Board. Prior to the procedure, permission was obtained from the Principal of the school. Informed written consent was obtained from the parents on behalf of the children and assent was also obtained from the study children in accordance with Helsinki Declaration.[13]

Inclusion criteria: Children of age group 6-11 years with documented record of date of birth.

Table 1. Mean age of eruption and standard deviation of each tooth of the subjects.

Teeth	Age of eruption (in years) (mean ± s.d)
Upper central incisor (Rt)	7.60±1.49
Upper central incisor (Lt)	7.46±1.22
Lower central incisor (Rt)	7.42±1.48
Lower central incisor (Lt)	7.22±1.32
Upper Lateral Incisor (Rt)	8.23±1.37
Upper Lateral Incisor (Lt)	8.22±1.39
Lower Lateral Incisor (Rt)	8.09±1.42
Lower Lateral Incisor (Lt)	8.05±1.43
Upper Canine (Rt)	11.50±1.08
Upper Canine (Lt)	11.66±0.89
Lower Canine (Rt)	11.69±0.70
Lower Canine (Lt)	11.52±0.79
Upper 1st Premolar (Rt)	9.99±1.11
Upper 1st Premolar (Lt)	9.78±1.22
Lower 1st Premolar (Rt)	10.09±0.96
Lower 1st Premolar (Lt)	9.97±0.97
Upper 2nd Premolar (Rt)	10.60±0.96
Upper 2nd Premolar (Lt)	10.52±0.97
Lower 2nd Premolar (Rt)	10.58±0.73
Lower 2nd Premolar (Lt)	10.60±0.72
Upper 1st Permanent Molar (Rt)	6.94±1.49
Upper 1st Permanent Molar (Lt)	6.83±1.55
Lower 1st Permanent Molar (Rt)	6.85±1.54
Lower 1st Permanent Molar (Lt)	6.68±1.65

Table 2. Mean age of eruption and standard deviation of each group of teeth.

Teeth	Mean	S.D
Central Incisor	7.4	1.31
Lateral Incisor	8.1	1.4
Canine	11.6	0.9
First Premolar	9.9	1.1
Second Premolar	10.6	0.8
First Permanent Molar	6.8	1.5

Table 3. Comparison of mean age of eruption of teeth of male and female subjects.

Teeth	Female	Male	p-value
	Age of eruption (in years) (mean ± s.d)	Age of eruption (in years) (mean ± s.d)	
Upper central incisor (Rt)	7.57±1.44	7.72±1.49	>0.05 NS
Upper central incisor (Lt)	7.27±1.23	7.56±1.22	>0.05 NS
Lower central incisor (Rt)	7.38±1.37	7.66±1.48	>0.05 NS
Lower central incisor (Lt)	7.14±1.27	7.42±1.32	>0.05 NS
Upper Lateral Incisor (Rt)	8.11±1.14	8.54±1.37	>0.05 NS
Upper Lateral Incisor (Lt)	8.17±1.34	8.28±1.39	>0.05 NS
Lower Lateral Incisor (Rt)	8.02±1.39	8.18±1.42	>0.05 NS
Lower Lateral Incisor (Lt)	8.04±1.22	8.22±1.43	>0.05 NS
Upper Canine (Rt)	11.34±1.14	11.58±1.06	>0.05 NS
Upper Canine (Lt)	11.24±0.87	11.82±0.83	>0.05 NS
Lower Canine (Rt)	11.46±0.72	11.73±0.71	>0.05 NS
Lower Canine (Lt)	11.32±0.67	11.63±0.77	>0.05 NS
Upper 1st Premolar (Rt)	9.27±1.17	9.85±1.13	>0.05 NS
Upper 1st Premolar (Lt)	9.66±1.30	9.83±1.27	>0.05 NS
Lower 1st Premolar (Rt)	9.89±1.06	10.24±0.93	>0.05 NS
Lower 1st Premolar (Lt)	9.77±0.84	9.89±0.92	>0.05 NS
Upper 2nd Premolar (Rt)	10.34±0.81	10.62±0.68	>0.05 NS
Upper 2nd Premolar (Lt)	10.28±0.82	10.56±0.97	>0.05 NS
Lower 2nd Premolar (Rt)	10.33±0.71	10.60±0.63	>0.05 NS
Lower 2nd Premolar (Lt)	10.42±0.63	10.57±0.66	>0.05 NS
Upper 1st Permanent Molar (Rt)	6.77±1.32	6.84±1.32	>0.05 NS
Upper 1st Permanent Molar (Lt)	6.63±1.44	6.93±1.45	>0.05 NS
Lower 1st Permanent Molar (Rt)	6.70±1.52	6.92±1.44	>0.05 NS
Lower 1st Permanent Molar (Lt)	6.46±1.41	6.77±1.42	>0.05 NS

Though most of the teeth of the females erupted a few months earlier than that of males t-test showed that there was no significant difference in mean age of eruption of males and females (p>0.05).

Exclusion criteria: Children with disease affecting dentition (rickets, malnutrition, hypothyroidism). Children having any surgical procedure in teeth and gums. Congenital disorders involving maxillofacial region e.g. Cleft palate. Children who had medications which can alter dental eruption. Those children whose parents did not give consent. Age (from standard record of date of birth), sex, weight, height, time of eruption of teeth were noted. The basic information about the children was recorded from the school record. A questionnaire was provided to each child regarding their food habit. Only those children were selected who had documented record of date of birth. The weights of the children were noted. The height of the children was measured from the child's head with the help of measuring scale.

Their teeth were examined visually for eruption. The recently erupted permanent teeth were identified on right and left quadrants in both upper and lower jaw. A tooth was considered erupted, if it has pierced through gums and un-erupted if not present in oral cavity. After examination of teeth, statistical tables

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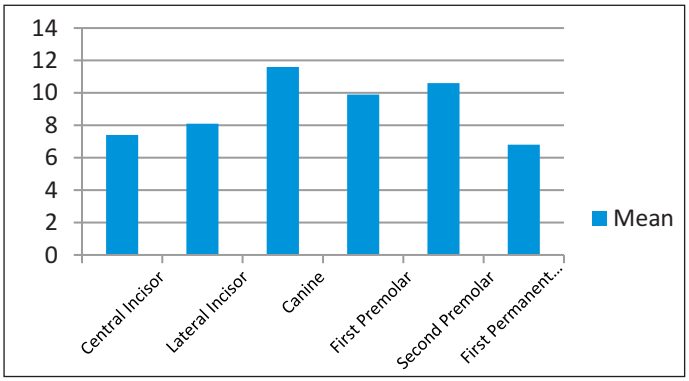

Figure 1. Mean age of eruption of each group of teeth.

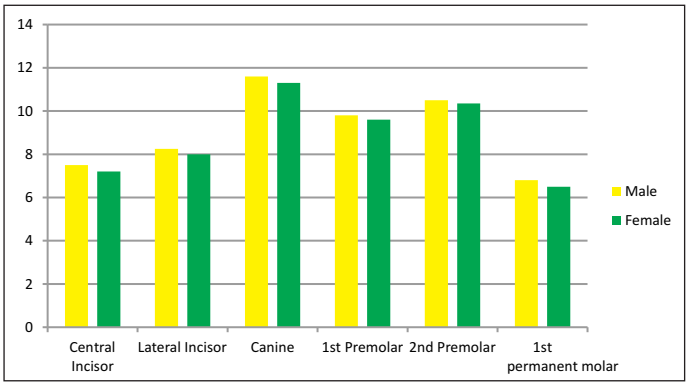

Figure 2. Difference in age of eruption between male and female.

were prepared for mean age, range and Standard deviation for eruption of each tooth in the upper and lower jaw and also for right and left quadrants of the same jaw and a comparison was done and the data was then statistically analysed. (tables 1,2,3,4,5 and figures 1,2,3,4)

Result & Discussion:

The present study was conducted from April 2016 to March 2017. 144 school-going children were examined randomly from various schools under the jurisdiction of Kolkata corporation. Out of a total 144 children 72(50%) were male children and 72(50%) were female children in the age group of 6-11 years. In this study the earliest tooth to erupt is the first mandibular molar of the left quadrant at the age of 6.68 years followed by first mandibular molar of the right quadrant (5.90 years); the earliest tooth to emerge in the maxilla is first molar of the left quadrant (6.00 years). Central incisors erupted between 7.22 to7.60 years in both right and left halves of upper and lower jaws. The mean age of eruption was 7.15 +/- 1.25 years in the lower jaw and 7.6 +/- 1.42 years in the upper jaw. Lateral incisors erupted between 8.05 to 8.23 years in both halves of upper and lower jaws. The mean age of eruption was 8.14 +/- 1.30 years in the lower jaw and 8.40+/- 1.39 years in the upper jaw. First premolars erupted at the age of 9.78 to 10.09 years in both halves of upper and lower jaws with the mean age of eruption 9.74 ± 0.97 years for the lower jaw and 10.01 ± 0.77 years for the upper jaw. Second premolars erupted between 10.52 to 10.60 years in both halves of upper and lower jaws. The mean age of eruption was 10.35 +/- 0.75 years for the lower jaw and 10.53 =/- 0.55 years for the upper jaw. Canines erupted at the age between 11.50 to 11.69 years for both halves of

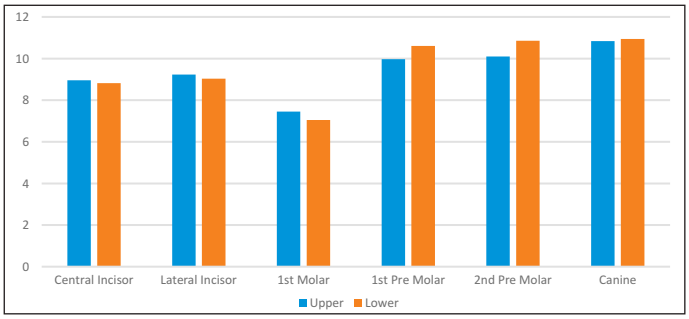

Figure 3. Difference in age of eruption between upper and lower jaw.

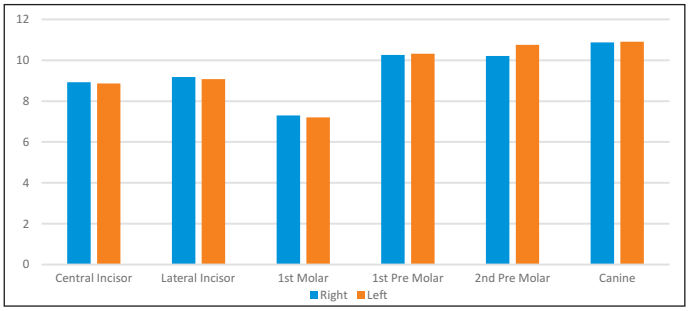

Figure 4. Difference in age of eruption between right and left jaw.

Table 4. Comparison of mean age of eruption of teeth of upper jaw and lower jaw of the subjects.

Teeth	Lower Jaw	Upper Jaw	p-value
	Age of eruption (in years) (mean±s.d)	Age of eruption (in years) (mean±s.d)	
Central incisor (Lt)	7.08±1.19	7.37±1.38	>0.05 NS
Central incisor (Rt)	7.24±1.32	7.91±1.46	>0.05 NS
Lateral Incisor (Lt)	8.16±1.29	8.64±1.41	>0.05 NS
Lateral Incisor (Rt)	8.12±1.30	8.19±1.37	>0.05 NS
Canine (Lt)	11.22±0.54	11.44±0.47	>0.05 NS
Canine (Rt)	11.16±0.68	11.59±0.66	>0.05 NS
1st Premolar (Lt)	10.47±0.78	9.71±0.90	<0.05 S
1st Premolar (Rt)	10.61±1.17	9.98±0.56	<0.05 S
2nd Premolar (Lt)	10.74±0.58	10.10±0.49	<0.05 S
2nd Premolar (Rt)	10.86±0.87	10.15±0.62	<0.05 S
1st Permanent Molar (Lt)	6.24±1.43	6.68±1.42	>0.05 NS
1st Permanent Molar (Rt)	6.62±1.58	6.88±1.44	>0.05 NS

Most of the teeth of the lower jaw erupted a few months earlier than that of upper jaw except 1st and 2nd premolar which erupted significantly earlier in the upper jaw. t-test showed that there was no significant difference in mean age of eruption of the other teeth in the upper and lower jaw (p>0.05).

the upper and lower jaws with the mean age of eruption 11.19± 0.61 years for the lower jaw and 11.50 ± 0.57years for the upper jaw (table 1 and table 2).

The findings of my study regarding age of eruption of permanent teeth in the age-group 6-11 years is consistent with the available data in standard textbooks. There has been no significant change in the age of eruption of permanent teeth over the years. The present study confirms the previous reports among several Indian populations that the earliest tooth to erupt is the first mandibular molar. Several studies have also reported that the mandibular teeth erupt earlier than their maxillary counterparts.[3,5,7,10,15,16] The results were similar to the findings of the study conducted by Chaurasia in 2004. He found that the permanent teeth eruption starts in the form of first permanent molar at 6 years, C.I.- 7 years,

Table 5. Comparison of mean age of eruption of teeth of left side of jaw and right side of jaw of the subjects.

Teeth	Left	Right	p-value
	Age of eruption (in years) (mean±s.d)	Age of eruption (in years) (mean±s.d)	
Upper central incisor	7.47±1.44	7.82±1.33	>0.05 NS
Lower central incisor	7.18±1.37	7.78±1.26	>0.05 NS
Upper Lateral Incisor	8.07±1.14	8.42±1.23	>0.05 NS
Lower Lateral Incisor	8.09±1.39	8.24±1.40	>0.05 NS
Upper Canine	11.17±1.14	11.46±1.18	>0.05 NS
Lower Canine	11.16±0.72	11.34±0.66	>0.05 NS
Upper 1st Premolar	9.19±1.17	9.66±1.14	>0.05 NS
Lower 1st Premolar	9.78±1.06	10.17±0.87	>0.05 NS
Upper 2nd Premolar	10.68±0.81	10.18±0.64	<0.05 S
Lower 2nd Premolar	10.75±0.71	10.27±0.59	<0.05 NS
Upper 1st Permanent Molar	6.62±1.32	6.76±1.27	>0.05 NS
Lower 1st Permanent Molar	6.38±1.52	6.42±1.41	>0.05 NS

*Statistically Significant, NS- Statistically Not Significant

Most of the teeth of the left side of jaw erupted a few months earlier than that of right of jaw except 2nd premolar which erupted significantly earlier in the right jaw. t-test showed that there was no significant difference in mean age of eruption of the other teeth in the left side and right side (p>0.05).

L.I. – 8 years, first premolar- 9 years, second premolar – 10 years, permanent canine- 11 years. It was observed that permanent teeth erupted few months earlier in females as compared to males. Permanent teeth appeared earlier in the lower jaw than in the upper jaw except first premolar on the left side. Permanent teeth appeared few months earlier in the left quadrant compared to the right quadrant. These findings were consistent with the findings of Sharma and Mittal (2001) who studied Gujjar children between 6 to 13 years of age. They found that eruption is earlier in females and that mandibular teeth except premolars tend to emerge earlier than their maxillary counterparts. The findings of this study were consistent with those of Subramanyam in 2001. He found that permanent teeth appear few months earlier in girls than in boys and peranent teeth appear earlier in the lower jaw.[17]

Conclusion:

First permanent teeth to erupt were the first permanent molars at the age between 6.68 to 6.94 years in both halves of upper and lower jaws. Permanent central incisors erupted between the age of 7.22 to 7.60 years for both halves of upper as well as lower jaw. Permanent lateral incisors erupted between the age of 8.05 to 8.23 years in both halves of upper and lower jaws. First premolars erupted between the age of 9.78 to 10.09 years for both halves of upper and lower jaw Second premolars erupted between 10.52 to 10.60 years for both halves of upper and lower jaw. Canines erupted between 11.50 to 11.69 years for both halves of upper and lower jaw. Eruption of permanent teeth were earlier in the lower jaw than that of the upper jaw except 1st premolar (left) which showed earlier eruption in the upper jaw as compared with the lower jaw. Co-relation of eruption of permanent teeth with sex showed earlier eruption times of all the permanent teeth in females as compared with males.

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ORIGINAL ARTICLE

Pattern Predominance in Cheiloscopy, Dactyloscopy and its Correlation with Blood group: An Observational Study

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Abstract:

To observe the association of lip prints and fingerprint patterns with gender and pattern predominance in the group of subjects with blood groups contrasting ABO and Rh. The study included 470 participants. Lip prints and fingerprints were recorded using lipstick and ink (stamp pad), respectively, on white bond paper. Cellophane tape was employed to transfer the lip print from the lips to bond paper. Determination of blood group was done by ABO typing using anti-A & anti-B sera. A statistically notable association was seen between gender and blood group type (p-value <.05). Type I lip print design, whorl pattern of fingerprints and B+ blood group were most commonly observed in males and females. Type I lip print pattern was most commonly found in the A+ blood group and all A- blood groups. The arch pattern was seen predominantly with type IV, whorl with type I and loop with type III. Loop pattern was more common in A+(37.3%), B-(66.7%) & O+(42.7%) while whorl pattern was common in A-(50%), B+(50.5%), AB+(53.2%) & O-(66.7%) (p value<.05). Definite association was observed between fingerprint, blood group and sex of an individual. These can be used as essential adjuncts in forensic science and mass catastrophes. And where fingerprint evaluation is impossible, then lip print and blood group can be used as a second identification line.

Keywords: Observational study; Forensic science; Lip prints; Fingerprints; Blood group and Gender determination.

Introduction:

Dental surgeons are mostly confined to examination, diagnosis, treatment and prevention of oral & maxillofacial lesions. But another undetected spectrum of their work front may be beneficial in the legal matters concerning forensic sciences.[1] Individual recognition is a crucial and critical task in forensic science and forensic analysis,[1] and it plays a vital role in inclusion or exclusion in case of a missing person, suspecting a criminal offence or in a mass disaster.[3] Locard's Exchange Rule conveys, when any two articles fall into reach, evidence is always exchanged from one to the alternative. Traces from the site may be taken anywhere by an individual and, simultaneously, may be left behind at the location.[2] "Identity" is a set of physical characteristics, normal or pathological, functional or psychic, that define an individual.[4] Personal identification is of utmost importance in forensics. Still, all means, like DNA analysis, are not feasible for every case as it is a costly, sensitive technique[5] and unavailable in rural areas.[6]

Cheiloscopy and Dactyloscopy have equal value to other types of forensic evidence for personal identification and sex determination. The word Cheiloscopy gets it's derivation from the Greek words "cheilos" which means "lips", and "e skopein" meaning "to see".[17] The grooves and furrows on the red part of the cardinal border of the human lips are considered and perceived as lip print or Cheiloscopy.[2] France's most incredible criminologist Edmond Locard in 1932 was the first to suggest of lip prints. 'Fingerprints' or 'Dermatoglyphics' can be explained as the scientific investigation of epidermal ridges and their configuration on the volar aspect of the plantar and palmar regions,[18] and they are determined genotypically.[8-10]

Karl Landsteiner discovered the blood group system in 1901.[11] ABO is classified into A, B, O & AB blood groups based on the presence of antigens in plasma. Rh positive & Rh negative are differentiated based on the existence of D antigen in plasma, known as the Rhesus technique.[2] Partial identification using any method leads to determining some facts. However, others may remain unidentified. Hence, the successful approach uses a combination of methods.[12] Therefore, these three parameters, lip prints, fingerprints and blood groups are evidence which can be used for forensic identification as they are easily identified.[5] They are unaltered, constant throughout life and unique characteristic of an individual; hence, they are lifelong markers in one's identity.[13] However, the lip prints differ in monozygotic twins,[14] and fingerprints can be altered by injuries like cuts, burns and bruises, but usually after healing, the pattern is restored.[15]

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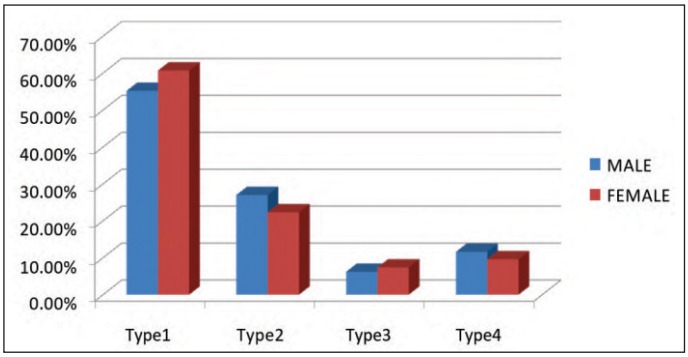
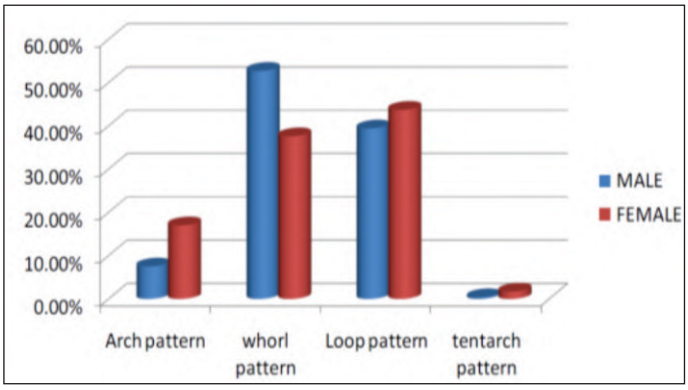


Graph 1. Pattern predominance of lip prints about sex.



Graph 2. Pattern predominance of finger prints about sex.

Evidence expresses that rather than using fingerprints & lip prints only, correlating lip prints & fingerprints with blood groups may be of essence in forensic science for more accurate identification of an individual. It is hypothesized that there is a significant correlation between lip prints, fingerprints, blood group and the sex of an individual.

The present study thus was aimed to observe the association between lip prints and fingerprints pattern in sex determination and pattern predominance among different blood groups.

Materials and methods:

This study was undertaken in the Department of Oral Pathology, Sri Aurobindo College of Dentistry, Indore (M.P), India. It was carried over two months after approval from the Institutional Ethics Committee. The study included patients visiting the OPD of the department and students of BDS 2nd and 3rd year. Very particular exclusions were made for the study to make it a feasible one. Subjects with permanent scars on their fingers, lips, or thumb with any hand deformities due to injury, birth defect or disease, those with worn fingerprints, and extra webbed or bandaged fingers were excluded from the study. Written informed consent was obtained from the participants of the study. Lip prints and fingerprints were recorded using lipstick and ink (stamp pad). The lip and fingerprints were recorded on white bond paper. Cellophane tape was employed to transfer the lip print from the lips to bond paper. [Figure 1 & Figure 2 shows Materials required for lip print and fingerprint] To record lip prints, lipstick was thoroughly applied in a single direction, cellophane tape was pressed over the lips for a few seconds and then carefully lifted and pasted on paper to create a permanent

Figure 1. Materials required for lip print and fingerprint.

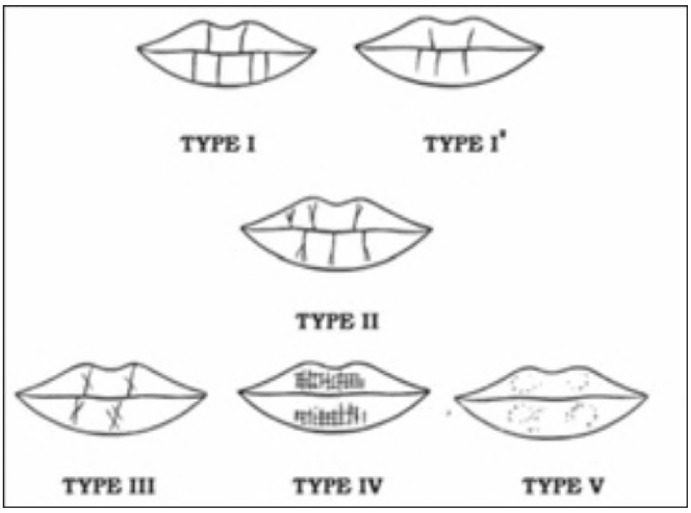


Figure 2. Classification of Lip Prints given by Tsuchihashis & Suzuki (1971)16. Type I: Vertical, comprising complete longitudinal fissures/ patterns; Type I': Incomplete longitudinal fissures; Type II: Branching Y-shaped pattern; Type III: Criss-cross pattern; Type IV: Reticular, typical chequered pattern, fence like.

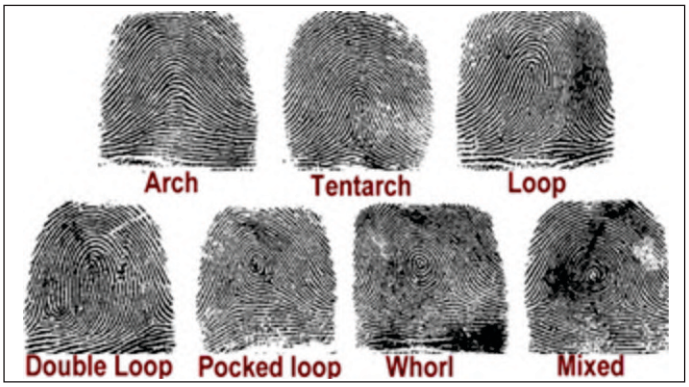


Figure 3. Classification of fingerprint by Henry's16.

record. The lip prints were classified according to criteria given by Tsuchihashis & Suzuki (1971).[16] [Figure 3 shows the Classification of Lip Prints given by Tsuchihashis & Suzuki (1971)[16]]

Type I: Vertical, comprising complete longitudinal fissures/ patterns.

Type I': Incomplete longitudinal fissures. Type II: Branching Y-

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shaped pattern Type III: Criss-cross pattern.

Type IV: Reticular, fence typical chequered pattern.

In pursuance of fingerprints, the subjects were asked to press their fingers on the ink pad and then on the bond paper. Finger prints of both right and left hands were studied. Henry's classification (1897) was used to classify fingerprints.[16] [Figure 4 shows the Classification of fingerprints by Henry's]. Determination of blood group was done by ABO typing using anti-A & anti-B sera. A blood specimen was missed with the antisera on a microscopic plate. A derivation of blood group A was done by a positive reaction (agglutination) of the blood with anti-A sera. Reaction with anti-B sera was suggestive of blood group B. No agglutination was suggestive of blood group O, and agglutination with both antisera conveyed blood group AB. The data was analysed using SPSS (Statistical Package for Social Sciences) 20.0 version, IBM, Chicago.

Results:

The study included 470 participants aged 20-50, comprising 241 males and 229 females. Results of the study revealed a statistically significant association between gender and the blood group type (p-value <.05). [Table 1 indicates Pattern predominance of Blood group among male & female] The type of blood group and pattern of lip print and fingerprint were also found to be significantly associated with each other (p value<.05). [Table 2 indicates association of blood group with different patterns of fingerprints in the study population] Type I lip print design, whorl pattern of fingerprints and B+ blood group were most commonly observed in both males and females. [Graph 1 shows the pattern predominance of lip prints about sex and Graph 2 shows the pattern predominance of fingerprints about sex]. A- blood group was found in 4 individuals; all were type I lip print patterns, while in others A+ blood group was predominantly associated with lip print type I. The arch pattern was seen predominantly with type IV, whorl with type I and loop with type III. Loop pattern was more common in A+ (37.3%), B- (66.7%) & O+ (42.7%), while whorl pattern was typical in A- (50%), B+ (50.5%), AB+ (53.2%) & O- (66.7%). [Table 2 indicates the association of blood groups with different patterns of fingerprints in the study population]

Table 1. Pattern predominance of Blood group among male & female.

Blood Group type	Male N (%)	Female N (%)	p value Ω
A+(A Positive)	34 (14.1%)	41 (17.9%)	<0.001*
A- (A Negative)	0 (0.0%)	4 (1.7%)	
B+ (B Positive)	123 (51.0%)	79 (34.5%)	
B- (B Negative)	0 (0.0%)	6 (2.6%)	
AB+ (AB Positive)	26 (10.8%)	21 (9.2%)	
AB- (AB Negative)	0 (0.0%)	2 (0.9%)	
O+ (O Positive)	56 (23.2%)	75 (32.8%)	
O- (O Negative)	2 (0.8%)	1 (0.4%)	
Total	241 (100.0%)	229 (100.0%)	

Ω Chi-squaretest. *p value<0.05 was considered statistically significant.

Table 2. Association of blood groups with different patterns of fingerprints in the study population.

Blood group types	Fingerprint pattern				
	Arch pattern	Whorl pattern	Loop pattern	Tentarch pattern	p valueΩ
A+ (A Positive)	16 (21.30%)	27 (36.00%)	28 (37.30%)	4 (5.30%)	<.05*
A- (A Negative)	1 (25.00%)	2 (50.00%)	1 (25.00%)	0 (0.0%)	
B+ (B Positive)	13 (6.40%)	102 (50.50%)	86 (42.60%)	1 (0.50%)	
B- (B Negative)	0 (0.0%)	2 (33.30%)	4 (66.70%)	0 (0.0%)	
AB+ (AB Positive)	4 (8.50%)	25 (53.20%)	18 (38.30%)	0 (0.0%)	
AB- (AB Negative)	1 (50.00%)	0 (0.0%)	1 (50.00%)	0 (0.0%)	
O+ (O Positive)	22 (16.80%)	53 (40.50%)	56 (42.70%)	0 (0.0%)	
O- (O Negative)	0 (0.0%)	2 (66.70%)	1 (33.30%)	0 (0.0%)	
Total	57 (12.10%)	213 (45.30%)	195 (41.50%)	5 (1.10%)	

ΩChi-squaretest* p value<0.05 wasconsidered statistically significant.

Discussion:

Human identification is one of the most challenging and tiring jobs now, where people face difficulties.[17] Personal identification of any individual is because of their specific traits, which become a marker in forensic cases. They vary from macroscopic structures to molecular DNA typing, which are permanent and persistent from birth to death.[5]

Fingerprints and lip prints are essential in forensic investigation and personal identification.[14] Blood falls into the same category as essential and the most common evidence for identifying and verifying one's identity.[17]

Recently, a lipstick has been developed that does not leave any visible trace after contact with surfaces such as glass, clothing, cutlery or cigarette butts. However invisible, these prints can be lifted using magnetic and aluminium powder. There was the development of "latent" prints similar to latent fingerprints due to secretions of oil and moisture from the edges of the lips containing sebaceous glands with sweat glands.[14]

In our study, we found a definite association between fingerprint, blood group and sex of an individual. Srilekha N et al.[18] conducted a study in which they found no significant correlation between lip print, fingerprint and blood group. Karim B et al.,[3] Verghese AJ et al.[19] and Murkey PN et al.[20] conducted studies that found no correlation between lip print pattern and blood group.

In the present study, whorl was found to be the most predominantly observed fingerprint pattern in males, while the loop pattern was more common in females, and the type I lip print pattern was most common in males (55.2%) and females (60.7%). Bansal N et al.[16] conducted a study in which they found whorls were of a high frequency in males and females presented with a high frequency of loops similar to our study. But in contrast, they found that type I lip print pattern was most predominant in females while type III was predominant in males.

In the given study, the type I lip print pattern was most common in males and females. Contrary to our study, Sultana Q et al.[21] found that the type III lip print pattern was most common among males and type I was among females. Khanapure SC et al.[14] found that the commonly observed lip print pattern among males was type IV and among females was type II. Sharma P et al.[1] & Dongarwar GR et al.[4] conducted a study where they reported that the type I pattern was most commonly seen in females, whereas the type IV pattern was commonly seen in males. Gupta S et al.[7] found that type III was most commonly seen in females and type II in males. Lip print patterns are unique to different populations, and therefore, the variation can be explained by the ethnic, racial and

geographical differences in the study population. In the present study, the subjects were in different parts of India. Some other reasons for discrepancy can be the employment of different classification systems of lip print patterns or the employment of different methods for lip print analysis in these studies.[5]

We found a significant correlation between fingerprint and blood group. In our study, Sangam MR et al.[22] also found a significant association between fingerprint patterns and blood groups. The present study revealed that the whorl pattern of fingerprints was most commonly seen in males & loop pattern in females. In contrast to our study, Ekanem AU et al.[11] found the highest number of males with loop patterns and females with arch patterns. In our study, the whorl pattern occurred more frequently in males ans loops in females, and the loop pattern was predominantly seen in persons with B- blood group followed by those having O+ blood group and the whorl pattern was more commonly seen in people with O- blood group followed by those with AB+ blood group. Raloti SK et al.[8] found results similar to our study on fingerprint patterns in gender determination. Still, in contrast, they found the loop pattern to be predominant in persons with blood group B+ and whorl pattern was predominant in persons with O+ blood group.

In our study, we found that loop patterns were common in females and whorls were common in males, and Loop patterns were more common in people with A+ (37.3%), B- (66.7%) and O- (42.7%) blood group types and whorl pattern was commoner in people with in A-(50%), B+(50.5%), AB+ (53.2%) & O- (66.7%) blood group types. Rastogi P et al.[10] and Bhavana D et al.[9] conducted a study in which a loop pattern was found in a more significant number of females and a whorl pattern in a more significant number of males, which is by our study. They also concluded that loop pattern dominated in all Rh+ & Rh- blood groups but whorls in the O- blood group. Bharadwaja A et al.[23] in their study found that more people with blood group A showed a loop pattern (Rh+ 54.2% & Rh- 60%) while more subjects with blood group AB had a whorl pattern(Rh+ 43.3% & Rh- 60%). As its clinical relevance, fingerprint and blood group are unique, and they do not change, but the amount of weightage received by fingerprints was more than the blood group. Further, the scope of the study is that it should be conducted on a larger sample size and in a particular state for determining specificities about rare blood groups, i.e. A-.

Conclusion:

A definite association was observed of fingerprint, blood group & sex of an individual. These can be used as essential adjuncts in forensic science and mass catastrophe. In case where fingerprint evaluation is impossible, then lip print and blood group can be used as a second identification line.

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ORIGINAL ARTICLE

An Analysis of Demographics and Attributing events in Sexual Offence cases reported at One stop Centre – A Retrospective study

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Abstract:

This retrospective study aims to analyze the demographic characteristics and event attributes of sexual assault survivors who sought assistance at One-Stop Center (OSC) in Visakhapatnam, India, between 2021 and 2022. The OSC, known as Sakhi, provides comprehensive medical, legal, and psychological support to women affected by sexual assault. The study collected relevant data from entry register including information on age, literacy, socioeconomic status, residence, relationship to the perpetrator, consent, time of reporting, and the sections under which the cases were registered. A total of 288 cases were analyzed, revealing significant findings regarding the demographics and characteristics of sexual assault survivors. The study found that the majority of survivors were above 25 years old, followed by those between 19 and 24 years old. The cases primarily involved literate individuals from low socio economic background with a higher prevalence of cases in urban areas. Intimate partners were identified as the primary perpetrators in most cases, while force or coercion was reported in 20% of incidents. The study provides valuable insights into the characteristics and patterns of sexual assault cases and emphasizes the need for targeted interventions to prevent sexual assault and support survivors based on their specific needs. These findings contribute to a better understanding of sexual assault dynamics and development of nationwide prevention strategies and support services for survivors.

Keywords: One stop centre; Sakhi; Sexual assault survivor; POCSO.

Introduction:

In India, the one-stop center for sexual offences is commonly known as Sakhi. Sakhi stands for "Support, Advocacy, and Knowledge for Health Initiatives". It is a government-run initiative launched under the Nirbhaya Fund in 2015 to provide medical, legal, and psychological assistance to women who are survivors of sexual assault or domestic violence. These centers are also known as "Sakhi One Stop Centres" and are in various districts across the country. They aim to provide a safe and private space for survivors to receive all necessary support and assistance in one place.

A one-stop center (OSC) aims to provide integrated support and assistance to women affected by violence, including domestic violence, sexual assault, and other forms of gender-based violence. These centers are intended to be a single point of contact for survivors of violence seeking support and assistance. They provide medical, legal, and psychological aid, as well as temporary shelter, counseling, and rehabilitation services. The centers are staffed by a team of trained professionals, including doctors, lawyers, counselors, and social workers. The goal of the one-stop center is to provide a safe and supportive environment for women to access the services they need to heal and recover from the trauma of sexual violence. They also aim to facilitate the reporting and investigation of cases of violence against women, and to help survivors navigate the legal system. Demographic analysis of sexual assault survivors can provide valuable insights into the prevalence and nature of sexual assault, as well as the characteristics of survivors who are most at risk. Some key demographic factors that may be examined in such an analysis include:

1. Gender: Sexual assault can affect people of all genders, but women and girls are disproportionately affected. In India, for example, the National Crime Records Bureau (NCRB) reported that over 86% of reported cases of rape in 2019 were against women.

2. Age: Sexual assault can occur at any age, but some age groups may be more vulnerable than others. For example, children and young adults may be at higher risk of sexual assault than older adults. In India, the NCRB reported that nearly 34% of reported cases of rape in 2019 were against victims under the age of 18.

3. Socioeconomic status: Socioeconomic factors, such as income, education, and social status, can influence the risk of sexual assault. Research suggests that people from lower-income households may be at higher risk of sexual assault than those from higher-income households. In addition, survivors from marginalized communities, such as Dalits, Adivasis, and other minority groups, may also be at higher risk of sexual assault.

4. Marital Status: Even though there is no law against marital rape in India, the statistics would give a better perspective if at all, any decision should be made in this regard by the law makers.

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5. Geographic location: The prevalence of sexual assault can vary by geographic location, with some areas experiencing higher rates than others. For example, previous studies has shown that rural areas in India may have higher rates of sexual assault than urban areas.

6. Relationship to perpetrator: Sexual assault can occur in a variety of contexts, including intimate partner relationships, familial relationships, and stranger assaults. The relationship between the survivor and perpetrator can be an important factor in understanding the nature and prevalence of sexual assault. In India, for example, the NCRB reported that in 2019, over 94% of reported cases of sexual assault were committed by someone known to the victim.

Analyzing event attributes in sexual assault cases can provide important information about the nature and context of the assault. Some key event attributes that may be analysed in such cases include:

1. Perpetrator characteristics: The characteristics of the perpetrator, such as their relationship to the survivor, age, gender, and level of familiarity with the survivor, can provide important insights into the nature of the assault and potential risk factors for sexual assault.

2. Use of force or coercion: The use of force, threats, or coercion in the assault can provide insights into the nature of the assault and the level of violence involved.

3. Reporting and response: The survivor's decision to report the assault and the response of law enforcement and healthcare providers can provide insights into the barriers survivors may face in seeking justice and receiving support.

4. IPC Section: These cases are reported under POCSO, 376 and 354. It will provide the information about the case load and required medal and legal resources. Commonly, by the word sexual offence, we usually understand the offence of rape though it also includes various other types of offences. The Criminal Law (Amendment) Act, 2013 (Act. 13 of 2013) re-defined rape and also made the punishments more stringent. There is also another act which came in 2012 as The Prevention of Children from Sexual Offences Act, 2012 (No. 32 of 2012) by which the term 'Penetrative Sexual Assault' is inducted. In addition to the legislation on sexual offences, sexual harassment is also taken into consideration.

Aims and objectives:

1.To help policymakers and advocates better understand the needs of sexual assault survivors and develop targeted interventions to prevent sexual assault and provide support to survivors.

2. To identify patterns and risk factors associated with different types of assaults, as well as inform prevention efforts and interventions to support survivors.

Materials and methods:

Our study was done retrospectively. There is only one OSC in the district of Visakhapatnam. It is located in King George Hospital. All the medicolegal legal cases of the district are referred here for comprehensive care. We have collected the data from entry registers after obtaining the permission from the concerned authorities. Strict confidentiality was maintained while collecting the data. A detailed history is recorded in the registers by the on duty OSC staff. We have collected the information regarding age, literacy, socio economic status, residence (rural/urban), relation to the perpetrator, consent, time of reporting after the incident and section under which the case was registered. The results thus obtained were analyzed.

Inclusion criteria: All the medico legal cases related to sexual offences brought to OSC, Visakhapatnam in 2021 and 2022.

Exclusion criteria: Non-Medico-legal cases like domestic violence and kidnapping.

Results:

In the study period, a total of 288 cases were reported, with varying demographics and characteristics. Among the reported cases, 5% (15) involved girls below 12 years old, 12% (35) involved girls between 12 and 15 years old, 24% (68) involved girls between 16 and 18 years old, 29% (84) involved girls between 19 and 24 years old, and 30% (86) involved girls above 25 years old. Out of the 288 individuals involved, 86% (250) were literate, while 14% (38) were illiterate. Socioeconomically, 85% (246) belonged to a low-income group, 15% (42) to a middle-income group, and none were classified as high-income. Regarding marital status, 77% (223) of the individuals were unmarried, while 23% (65) were married. In terms of geographical distribution, 43% (124) resided in rural areas, while 57% (164) lived in urban areas. The perpetrators in the cases were primarily intimate partners (lovers/boyfriends) in 71% (204) of the incidents, followed by relatives in 2% (6) of the cases, close family members in 3% (8) of the cases, known persons/neighbors in 22% (64) of the cases, and unknown individuals in 2% (6) of the cases. Force or coercion was reported in 20% (57) of the incidents, while the remaining 80% (231) were reported as consensual by the survivor. None of the cases were reported within 24 hours of the incident, 9% (26) were reported within 24 to 72 hours, and 91% (262) were reported after 72 hours. Out of the 288 cases, 38% (108) were registered under the Protection of Children from Sexual Offences (POCSO) Act and IPC 376, 57% (165) were exclusively registered under IPC 376, and 5% (15) were registered under IPC 354.

Discussion:

According to the National Crime Records Bureau of India, the reported instances of crimes against women witnessed a 15.3% increase in 2021 compared to 2020.[1] In 2011, there were over 228,650 reported cases of crimes against women, whereas in 2021, the number reached 428,278, indicating an 87% surge.[1]

Among the female population residing in India in the year 2012, 7.5% live in West Bengal, where 12.7% of the reported crimes against women took place.[2] Andhra Pradesh is home to 7.3% of India's female population and accounts for 11.5% of the total reported crimes against women.[2] Obtaining precise statistics regarding the actual occurrence of cases is extremely challenging since a significant number of incidents go unreported. This is primarily due to the fear of being ridiculed or shamed of potential reporters, as well as the immense pressure to avoid bringing

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Table 1. Victim demographics.

Age of the Victim	
< 12	15 (5%)
12 to 15	35 (12%)
16 to 18	68 (24%)
19 to 24	84 (29%)
> 25	86 (30%)
Total	288
Education status of the victim	
literates	250 (86%)
Illiterates	38 (14%)
Total	288
Socio Economic Status of the victim	
High	0
Middle	42 (15%)
Low	246 (85%)
Total	288
Marital Status of Victim	
Married	65 (23%)
Unmarried	223 (77%)
Total	288
Location of the victims residence	
Rural	124 (43%)
Urban	164 (57%)
Total	288
Willingness of the Victim	
Invalid Consensual	231 (80%)
Unwilling/Force or coercion	57 (20%)
Total	288

dishonor to their families.[3,4] Likewise, law enforcement officials are often more reluctant to register the case and favor the families of the accused. In some cases the victim has to fear severe consequences, such as honor killings.[3]

In terms of age groups, the highest number of reported cases to the OSC came from individuals above 25 years, closely followed by the age groups of 19 to 24 and 16 to 18 years. If we combine the age groups of 12 to 15, 16 to 18, and girls of 11years and 19 to 20 years, this combined group would have the highest number of cases. Similar findings were reported by Tamuli,[5] Kumar Pal et al.,[6] Sarkar et al.,[7] Mariam,[8] Praveen et al.,[9] and Santhosh et al.,[10] where the age group considered was 11 to 20 years. Most of the girls in the age range of 12 to 15 and 16 to 18 were involved in consensual sexual relationships and participated willingly, even though their consent is not legally valid. It was their parents who indulged in the complaints and made the girls hostile.

Analyzing the judgments of cases handled under the POCSO (Protection of Children from Sexual Offenses) Act by the Mumbai Sessions Court at Greater Mumbai in 2019, as found on its website, out of a total of 59 concluded trials, 33 cases were related to "romantic relationships" (56%). In Greater Mumbai, out of 44 cases, 24 cases (54.5%)were involving similar relationships. In all these 24 cases prosecuted in Greater Mumbai, where romantic relationships were involved, the accused were acquitted. In none of theseof cases in Greater Mumbai did the "victims" support the prosecution's case. This data suggests that it was not the "victims" who initiated the criminal action, but rather their family members who approached the police. The fact that the informants were mostly the parents of the "victims" indicates

Table 2.

Time of reporting since the incident	
< 24 hours	0
24 to 72 hours	26 (9%)
>72 hours	262 (91%)
Total	288

Table 3.

Perpetrator relationship with victim	
Intimate partner	204 (71%)
Relative	6 (2%)
Close family member	8 (3%)
Known person/neighbor	64(22%)
Unknown person	6 (2%)
Total	288

Table 4.

IPC Section	No of Cases
POCSO & 376	108 (38%)
376	165 (57%)
354	15 (5%)
Total	288

that the girls themselves had no grievances against the accused. Furthermore, the high rate of the girls turning "hostile" towards the prosecution's allegations of penetrative sexual assault suggests that these girls were involved in romantic relationships. Similar data can be found across the country, raising questions about lowering the age of consent.

In the study, 86% of the survivors were literate. Additionally, most girls below the age of 25 were students attending educational institutions, which aligns with the findings of studies conducted by Tamuli,[5] Kumar Pal et al.,[6] Sarkar et al.,[7] Santhosh et al.,[10] and Ambika Prasad et al.[11]

The majority of the survivors who reported the incidents belonged to lower socioeconomic status, which is consistent with the findings of studies by Tamuli,[5] Sarkar et al.,[7] Mariam,[8] and Swetha et al.[12] However, Ambika Prasad et al.[11] reported that 55% of the cases were from above the poverty line, which contradicts our study. Although the number of cases reported from higher socioeconomic status background is very low, it may be attributed to feelings of embarrassment and the fear of blame within the social strata of society leading to under reporting. Such incidents are devastating for the honor of the entire family, making it a difficult decision to report to the police and undergo the complex procedures to seek justice.

During the study period, 77% of the survivors, respectively, were unmarried. This corresponds to the findings of studies conducted by Tamuli,[5] Kumar et al.,[6] Mariam,[8] Praveen,[9] Santhosh et al.,[10] and Ambika Prasad et al.[11] As most individuals in this age group are not yet married and may be involved in various types of relationships, it is evident that the reported cases are higher among unmarried individuals. Moreover, married women face additional challenges within the family structure, making it more difficult to report such incidents, especially in a familial system in a country like India.

Since Visakhapatnam is an urban area, the reported cases predominantly originate from urban regions. Santhosh et al.[10] conducted a study in western Maharashtra, where more cases

were reported from urban areas compared to rural areas, whereas Ambika Prasad et al.[11] conducted their study in Berhampur, Odisha, and found a higher number of reported cases from rural areas than urban areas.

In our study, the perpetrator was an intimate partner in the majority of the cases, similar to studies conducted by Tamuli[5] and Ambika Prasad et al.[11] Known individuals were the most common perpetrators in studies conducted by Sarkar et al.,[7] Mariam,[8] Parveen,[9] Santhosh et al.,[10] and Swetha et al.[12] However, this contrasts with the study by Parveen,[9] where unknown individuals were the most common perpetrators. An intimate partner could be a boyfriend, lover, classmate, coluege, relative or a friend known to the victim. These types of relationships often involve romantic associations. In most cases, the accused have been acquitted by the Special Courts, especially in cases involving romantic relationships. Based on the reviewed judgments, the acquittals were often based on grounds such as the "victim" being intentionally concealing her age at the time of sexual intercourse, a valid marriage having taken place with no evidence of intercourse prior to the age of eighteen, the prosecution failing to prove forcible sexual intercourse, the "victim" not identifying the accused, or the "victim" being found to be above eighteen years old when the sexual intercourse occurred.

In our study, force or coercion in 20% of the cases during the years 2021 and 2022. In the remaining cases, the victim's willingness was present, similar to the findings of Kumar pal et al.,[6] where 59.8% of the cases involved invalid consensual rape. Force was used in 68.56% of those cases, which contrasts with the studies conducted by Ambika Prasad et al.,[11] where force was used in 46% of the cases, and Riggs N et al.,[13] where force was used in 80% of the cases. These cases were registered under aggravated penetrative sexual assault.

Regarding the time of reporting since the incident, no cases were reported within the initial 24 hours. During the 24 to 72 hours period, 9% of the cases were reported, while 91% were reported after 72 hours during the years 2021 and 2022. Tamuli[5] found that most cases were reported between 3 to 7 days, Kumar pal et al.[6] reported that most cases were reported on the 2nd day, Mariam[8] noted that most cases were reported between 24 to 72 hours, and Ambika Prasad et al.[11] found that most cases were reported after 72 hours. Sarkar et al.[7] reported that the majority of cases were reported between the 5th to 7th day, while Parveen[9] observed that most cases were reported within two weeks. This variation in the time of reporting can be attributed to various factors, including fear, embarrassment, primary intervention by local leaders to settle the case, delay on the part of legal authorities to register the case, and, in some cases, false allegations with ulterior motives.

In the study period, a total of 288 cases were reported, out of which 108 cases were registered under POCSO and 376 IPC, 165 under 376 IPC, and 15 under 354 IPC. Although the percentage of cases reported under POCSO is high, as discussed earlier, one of the major reasons is the increase in the age of consent. This has resulted in cases of "romantic relationship" burdening the criminal justice system. At the all-India level, 52% of the cases under the POCSO Act involved victims between sixteen and eighteen years old, while in Maharashtra, 51% of such cases fell within this age group. The exact number of cases related to "romantic relationships" is not indicated, but the judgments reviewed in Mumbai for 2019 show that more than 50% of the cases were related to such relationships, and the majority of the "victims" were between sixteen and eighteen years old.

Data compiled by the Bangalore Police Commissioner reveals that the number of complaints under Section 354 of the Indian Penal Code increased from 150 in 2006 to 776 in 2016. This could be attributed to an increase in the number of incidents as well as a greater willingness on the part of women to register complaints. However, the conviction rate during those ten years was only 0.37%, which is very low. In cities like Visakhapatnam, women may still fear and feel embarrassed to register a complaint, but this can be overcome through increased awareness and safety measures.

Summary and suggestions: The study highlights the need for targeted interventions and prevention efforts to address sexual assault and support survivors. It suggests several areas for further research and action, including:

Prevention efforts: As the high percentage of cases were involving intimate partners, there is a need for awareness campaigns and programs addressing healthy relationships, consent, and gender equality.

Education and literacy: The majority of survivors were literate, emphasizing the importance of education in empowering individuals and reducing vulnerability to sexual assault. However, further research is needed to understand the relationship between education and risk factors.

Socioeconomic factors: The study found a higher prevalence of sexual assault among individuals from low-income groups. Efforts should focus on addressing the underlying socioeconomic inequalities that contribute to increased risk.

Urban-rural divide: The study found a significant proportion of cases from both rural and urban areas. Tailored interventions should consider the unique challenges faced by survivors in different settings.

Reporting barriers: The study showed that the majority of cases were reported after 72 hours, indicating potential barriers to timely reporting. Identifying and addressing these barriers, such as social stigma and fear, is crucial to ensuring survivors' access to justice and support.

Age-related interventions: The study highlighted the vulnerability of young girls, particularly those aged 12-18, who were involved in romantic relationships. Comprehensive sex education and awareness programs can help address misconceptions about consent and healthy relationships.

Legal reforms: The study identified the need to reevaluate the age of consent by the relevant authorities and the prosecution of cases involving romantic relationships. Policy discussions and legal reforms may be necessary to ensure justice for survivors while considering the complexities of such cases.

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ORIGINAL ARTICLE

Implementation of Quick Response (QR) Code as a Teaching-Learning Tool-An Interventional Study

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Abstract:

The potential enhancement of teaching and learning through Quick Response (QR) codes and mobile devices offers students customized, relevant, and real-world learning experiences. As students control their education more, institutions must ensure convenient access to online content. This study's plan involves implementing QR codes in the departmental museum to provide students with supplementary information and interactive content. We plan to use QR codes in our departmental museum to enhance the learning experience. QR codes will allow students to access additional information and interactive content related to the exhibits. Settings and Design: An interventional study conducted in a Forensic Medicine museum setting. Created Quick Response codes (QR codes) linked to study materials for each museum specimen. Divided students into two groups: one scanned QR codes during museum visits for instant access to study material, while the other used traditional catalogs. A Multiple-Choice Question (MCQ) test assessed the effectiveness of QR codes as a teaching tool. The collected data underwent a thorough error-checking process, followed by data entry in MS Excel. Subsequently, the data was analyzed using the latest SPSS 11.0 software. The response indicates that students generally agree that QR codes are helpful in improving their comprehension, analysis, and exploration of subjects linked to museum exhibits and medicolegal work. QR codes can completely transform education and give students access to interactive, adaptable and lifetime learning opportunities.

Keywords: Museum visit; Quick response code; Self-directed learning.

Key Messages: QR codes possess transformative educational potential, providing students with interactive, adaptable and lifelong learning opportunities. Teachers adapting to the evolving needs of today's students must embrace tools like QR codes as technology advances.

Introduction:

A museum is "an organization that collects, preserves, and presents for public viewing a collection of artifacts and other objects of scientific, artistic, or historical significance through either temporary or permanent exhibits."[1] A significant and easily accessible resource for individual and group study, medical school museums are valuable resources for developing professional communication skills and self-directed learning, essential aspects of the competency-based medical education (CBME) curriculum."[2,3] These museums have historically been the primary source for teaching anatomy, pathology, and forensic medicine. They are regarded as superior to most other educational resources because of their exceptional capacity to support individual inquiry and group learning.[4,5] Strong communication skills were developed in this interactive setting, an important goal still at the heart of medical education today.[6]

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Self-directed learning (SDL) is crucial for medical students. It helps them develop skills like increased responsibility, assertiveness, and accountability, essential for their future careers as medical professionals. Similarly, medical educators hope to incorporate SDL into the curriculum to develop students who can independently oversee their further education and will never give up on their quest for knowledge via critical thinking. Self-directed learning improves memory and helps students make better decisions based on the information they retain. An excellent location for supporting SDL activities with undergraduate students is the Forensic Medicine Museum.[7] There is a lot of promise for improving teaching and learning experiences with modern technology like QR codes and mobile devices. This is so that students can interact socially and with content in various circumstances and obtain knowledge, resulting in customized, pertinent, and real-world learning experiences.[8,9] As students take charge of their education in higher education, the onus shifts to the institution to give them quick, easy, adaptable, and user-friendly access to online content and resources.[10] We plan to use QR codes in our departmental museum to enhance the learning experience. QR codes will allow students to access additional information and interactive content related to the exhibits.

Figure 1. Snake specimen in museum.

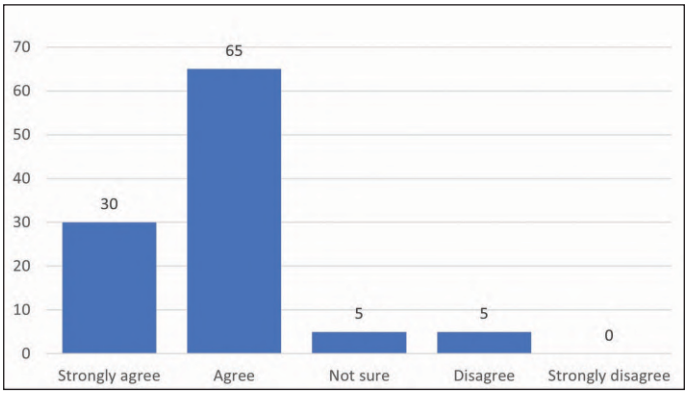

Chart 1. I was able to have a better understanding of specimen.

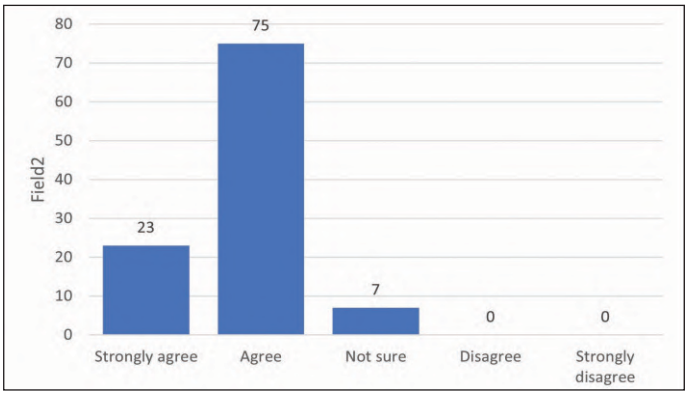

Chart 2. I was able to differentiate between various specimens and could analyze better.

Objective-1. To develop a quick response code as a teaching and learning tool.

2. To assess the effectiveness (performance of students and perception) of the quick response code as a teaching-learning tool.

Methodology:

Our technological team produced software called 'QR Code Generator,' making creating study materials with embedded QR codes easy. The QR code graphics are then printed, laminated, and attached to the appropriate museum artifacts by tying or sticking. Students in our medical college's MBBS Phase II, Semester IV, participated in this study. The students were split into groups A and B for the practical classes. As the control group,

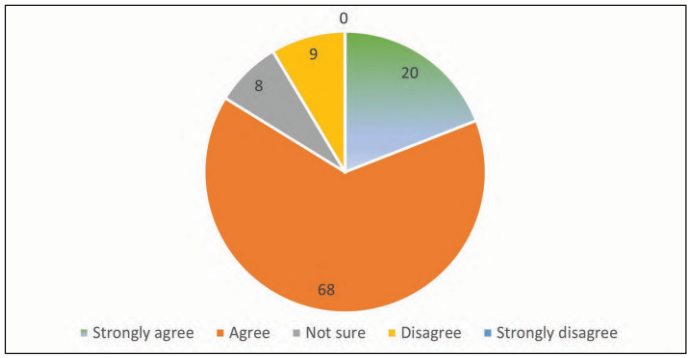

Chart 3. I was able to explore further opportunities for additional information about the specimen related to the given topic.

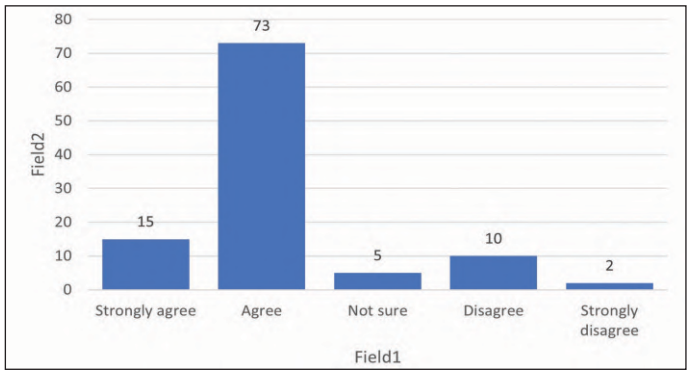

Chart 4. I was able to do quick revision for topics.

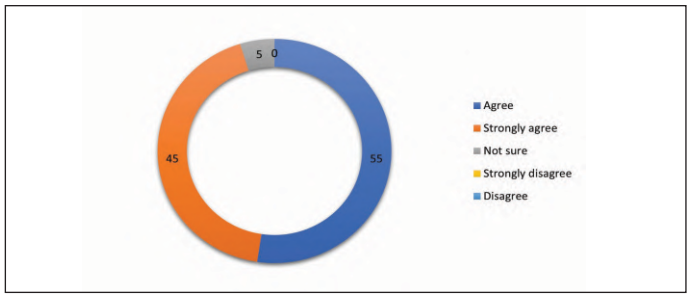

Chart 5. I will be able to identify various weapons & injury produced by it during medicolegal work better.

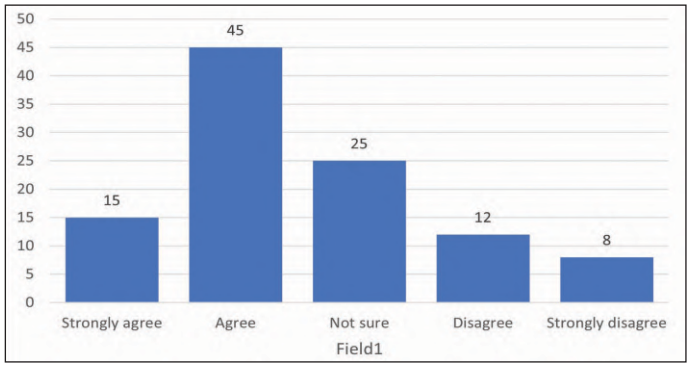

Chart 6. I will be able to identify the clinical features of poisons during case of poisoning better.

Group A went through standard museum-style tutorials where they looked through a hard copy booklet that listed every specimen in the Forensic Medicine Museum. The experimental group B was given "upgraded museum settings," which included cutting-edge educational tools like smartphone-based QR code

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Figure 2. Study material for the weapon (lathi) specimen in the museum.

Figure 3. Study material for wet specimen (SAH) in the museum.

Figure 4. Demonstration of bedside test of poison (Celphos).

scanning. Students could correlate facts while standing in front of the exhibits, thanks to the method providing comprehensive information on each specimen. Students can now scan those QR codes to get all pertinent study information in front of the museum specimen [Fig. 1, Fig 2, Fig 3, Fig. 4]. Users had to download and install Google Lens from the Google Play Store if their smartphone did not have an inbuilt QR code scanner. Users must log in to their Gmail account through their smartphone before scanning the QR Code.

Type of Study: Interventional study.

Teaching Phase: Group B students were exposed to QR codes covering the same topics. In contrast, Group A students were given paper copies of the museum catalog as study material about wet specimens, weapons, and poisons. The purpose of an evaluation consisting of multiple-choice questions (MCQs) was to gauge how well students understood the presented content. Using Google Forms, the MCQ assessment was given to both groups after the museum visiting session that same day. After completing the multiple-choice question test, Groups A and B switched exposures in a crossover procedure. Group A was exposed to QR codes, while Group B was given traditional museum catalog study materials. Finally, a feedback form was given to the students to ascertain their opinions and preferences about using the hard copy museum catalog or QR Code as a teaching-learning instrument. This feedback collection technique aimed to gather insightful information from the students to provide a thorough grasp of their preferences and experiences in the classroom. The feedback questionnaire asked questions about the overall learning experience, engagement, information accessibility, and ease of comprehension. Pre-testing was used to validate this feedback form. A total of 105 students participated in the study; out of 105 students, Group A comprised 49 students, and 56 belonged to Group B.

Table 1.

Method	Total number of students (N)	Mean	Std. Deviation	P Value
Traditional Method	49	55.45	10.04	P value (0.01) significant
QR Code	56	60.03	9.56	

Ethical Considerations/Consent: Participants' anonymity and confidentiality will be ensured throughout the study. The study was conducted after getting clearance from the Institutional Ethics Committee. (IEC NO- IEC/BU/2023/Ex. 83/3222023)

Statistical Analysis: The collected data underwent a thorough error-checking process, followed by data entry in MS Excel. Subsequently, the data was analyzed using the latest SPSS 21 software. The analysis focused on the MCQ test results for both the control and experimental groups and the mean value of the test result of both the methods measured.

Results:

Table 1 revealed that the mean value of the QR Code teaching-learning method is higher than the traditional teaching-learning method with a significant P value. The feedback survey shows that students favor using QR codes to comprehend and evaluate museum exhibits. A sizable majority of students said they agreed with the statement, "I was able to better understand museum specimens by using QR codes"; 65 students (61.9%) agreed, and 30 students (28.6%) strongly agreed. Just five students (4.8%) disagreed, while five students (4.8%) were unsure (Chart 1). Similarly, when questioned about their ability to distinguish between different specimens and analyze them more thoroughly using QR codes, most students gave good answers. Of the pupils, 75 (71.4%) agreed, and 23 (21.9%) strongly agreed. Seven (6.7%) students were unsure (chart 2). A significant portion of students considered this feature helpful when using QR codes to explore more information about specimens associated with a particular topic. Sixty-eight students (64.8%) agreed, compared to 20 (19%) who strongly agreed. Nine students (8.6%) disagreed, while eight students (7.6%) were unsure (chart 3). Many pupils attested to the efficiency of employing QR codes to revise various subjects quickly. Of the pupils, 73 (69.5%) agreed, and 15 (14.3%) strongly agreed. Ten students (9.5%) disagreed, two students (1.9%) strongly disagreed, and five students (4.8%) were unsure (chart 4). Lastly, most students gave favorable answers when asked how QR codes may be used to identify weapons and injuries sustained during medicolegal work. Forty-five students (42.9%) strongly agreed, and fifty-five (52.4%) agreed. Of the students, five (4.8%) had no idea (chart 5). The feedback from students regarding the use of QR codes in identifying the clinical features of poison during cases of poisoning reveals a varied response. A notable 57.2% of students (combining those who strongly agreed and agreed) found the QR codes helpful, emphasizing their perceived utility in understanding the clinical aspects of poison-related cases. However, 23.8% of students expressed uncertainty, indicating a lack of consensus or mixed opinions among the respondents. Additionally, 18.8% of students (combining those who disagreed and strongly disagreed) did not find the QR codes effective for identifying clinical features of poison. These results suggest a

need for further exploration of how QR codes can be optimized to cater to different learning preferences and address any specific challenges students may encounter in comprehending clinical features related to poisoning cases.

Overall, the response indicates that students generally agree that QR codes help improve their comprehension, analysis, and exploration of subjects linked to museum exhibits and medicolegal work.

Discussion:

Traditional techniques did not significantly affect the motivation of second-year MBBS students to learn pathology, according to the study by Kumar VVSR and Kumar M. On the other hand, the students in the experimental group who were shown QR codes in the pathology museum environment showed notably higher levels of motivation.[11] In educational applications, QR codes are versatile. According to Lee et al. (2011), these codes let teachers create customized field study guides for each student, increasing student learning efficacy by supplying only relevant material. It has been observed that incorporating field trips with QR code activities helps to engage students and seamlessly blend online learning with real-world applications. Essentially, QR codes facilitate a variety of instructional approaches.[12] QR codes enhance student motivation and passion and support learner-centered learning when used with learner-centered instruction. Rikala and Kankaanranta report that pupils are curious about this novel method and find QR codes engaging.[13] Some colleges use QR codes to improve mobile phone efficiency, allowing students to access information and services swiftly.[14] Studies reveal that students actively seek instructional resources that provide more convenience and flexibility to fit their busy schedules. Students' responses to numerous studies investigating mobile learning, or m-learning, in the classroom have been overwhelmingly positive. Most students concur that using mobile devices makes studying flexible, portable, and convenient.[15-17] The significant qualities of QR Codes as instructional aids, such as their independence from time and place and ability to hold relevant content, highlight the strong arguments for using them in the classroom. While time independence expands the learning experience beyond traditional classroom hours, location independence permits learning outside a prescribed context. Video and photo footage must be included for complete coverage to be considered meaningful. Using QR codes containing course material enhances the mobile learning platform's functionality even further in an educational setting.[18] According to the Law and So study, students reported that QR codes provided the required variance in the classroom and made it easier to learn specific module themes. The information was well-structured and articulated and the sample exam items helped students grasp challenging ideas more deeply. QR codes in mobile learning have the potential to be highly beneficial since they keep students interested, involved, and connected- all of which will improve the learning process and promote lifetime learning. Additionally, it has been discovered that QR codes are valuable instruments for engagement and motivation that promote solo and group learning.[19] Building on these findings, the present study aligns with the observed benefits of QR codes in education. When employed alongside learner-centered instruction, QR codes have been found to amplify student motivation and enthusiasm, fostering learner-centered learning. Students in the present study recognized QR codes as valuable tools that introduce variety in the classroom and enhance understanding of challenging module themes. The well-structured information and sample exam items provided clarity on complex concepts. Overall, QR codes in mobile learning are highly beneficial, keeping students interested, involved, and connected- enhancing the learning experience and promoting lifelong learning.

Conclusion:

The study emphasizes how effective QR codes are as game-changing tools in the classroom, especially for mobile learning. The findings align with earlier research by Kumar VVSR and Kumar M[11] that highlights the shortcomings of conventional instruction compared to the increased motivation that students who encounter QR codes experience. Regarding education, QR codes are helpful since they provide customized field study guides and boost participation through creative methods like field excursions. According to Rikala and Kankaanranta,[13] the current study confirms the beneficial effects of learner-centered training, where QR codes encourage students' enthusiasm and interest. Moreover, the result aligns with broader patterns in educational research, suggesting that students are looking for more adaptable and convenient learning materials and that mobile learning is their preferred method.[15-17] The distinct qualities of QR codes, which provide time and location independence, support their use in educational settings. The integration of multimedia information and the capacity to extend learning outside regular hours and venues improve the overall learning experience.[18] The current study supports the conclusions made by Law and So, highlighting that QR codes, add diversity to the classroom and help students comprehend complex subjects more deeply.[19] Simply put, the study adds to the increasing amount of data showing QR codes as great learning tools that can be used in solo and group situations. The research's conclusions highlight how QR codes can completely transform education and give students access to interactive, adaptable, and lifetime learning opportunities. Teachers who want to meet the changing requirements of today's students must use tools like QR codes as technology advances.

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ORIGINAL ARTICLE

Morphological and Morphometric Study of Cerebellum in Human Foetuses

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Abstract:

The cerebellum is a region of the brain which plays an important role in motor control though it does not initiate movement. It contributes for coordination, precision and accurate timing of movement. The cerebellum stands as great modulator of neurologic function and new horizons of cerebellar action were included in neurology and psychiatry. The awareness of cerebellar anatomy has a great neurosurgical importance. A total of 44 apparently normal dead aborted embryos and fetuses of both sexes and of 13 weeks to 36 weeks gestational age were utilized for observing and measuring certain morphological and morphometric parameters of external body and external surface of cerebellum and gestational age related developmental histology of cerebellum. When the results were analyzed it was observed that there is increase in fetal weight with increase in gestational age. Biparietal diameter increased from 13-16 weeks to 29-32 weeks; thereafter it decreased in 33-36 weeks. Head circumference increased with gestational age. Morphological observations of cerebellum are discussed in results. The knowledge of foetal cerebellar anatomy has a tremendous neurosurgical importance and also in the field of forensic medicine.

Keywords: Cerebellum; Morphometry; Vermis; Gestation.

Introduction:

The cerebellum is situated in posterior cranial fossa and it is the major part of hindbrain. Formation of cerebellar hemisphere and vermis are noticed in 12th week and folds of it develop at fourth month.[1] The fetal cerebellum is developing from metencephalon which is the rostral slant of the embryonic hindbrain.[2] Cerebellum has two hemispheres connected by the vermis and it consists of three lobes and two transverse fissures, one horizontal fissure. The primary fissure could be recognized at week 21, and the vermis lobe was visible at week 24.[3]

Cerebellum is one of the first structures in the brain that begins to differentiate but last to mature since its development is spread over a longer period and shows age related changes.[4] Fetal cerebellum measurement is key factors to know the abnormal fetal growth related to central nervous system anomalies, Reece EA.[5] Present study aim is to find out the best parameter suited for estimation of gestational age and quantitative assessment of growth of various parameters in normal fetuses Correlation with the growth cerebellar parameters.

Materials and methods:

The present study on human foetal cerebellum was conducted at department of Anatomy, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India by dissection method for observing and recording morphological and morphometric parameters of foetal cerebellum. A total of forty four dead and spontaneously aborted fetuses of both sexes along with relevant obstetric history were collected from the Dept. of Obstetrics and Gynecology after taking consent from the relatives by following the guidelines and permission given by the ethical committee of S.V. Medical College, Tirupati. The Crown-rump and Crown-heel length (Fig. 1) were taken with the foetus stretched to avoid errors in measurements due to the curved position of the foetus.

Preservation of specimen: Subsequently the fetuses were preserved in 10% formalin solution that was injected into the pleura, peritoneum and orbital cavity. The extremities were preserved by multiple injection.

Dissection procedure done for collection of cerebellum: The layers of scalp are removed by making an incision in the midline then the bones of skull cap are removed using the curved scissors for younger fetuses and using saw for removing skull cap of older fetuses. The folds of dura, the falx cerebri and tentorium cerebelli were removed. The attachment of cranial nerves to the base of brain was served close to the foramen from which they exit. The junction of brainstem with spinal cord was separated at the level of foramen magnum. Now, the brain with its coverings was removed from the cranial cavity. Then the cerebellum was lift out from posterior cranial fossa.

Gestational age-wise distribution of aborted fetuses:

A. This group includes study of 44 aborted fetuses, ranging from 13-36 weeks gestational age, in which males fetuse were 18 and female fetuses were 26. All the fetuses included in this group were normal.

B. Total number of fetuses was categorized into 6 gestational age groups according to age wise and sex- wise distribution. 13-16, 17-20, 21-24, 25-28, 29-32 and 33-36 weeks for understanding the morphometry and morphological at close intervals of 4 weeks.

Fetal external morphological and morphometric parameters: gestational age, gender, external appearance, fetal weight, Bi-

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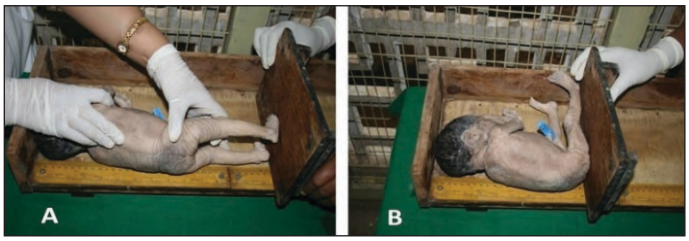

Figure 1. Shows A. Measuring crown-heel length, B. Measuring crown-rump length.

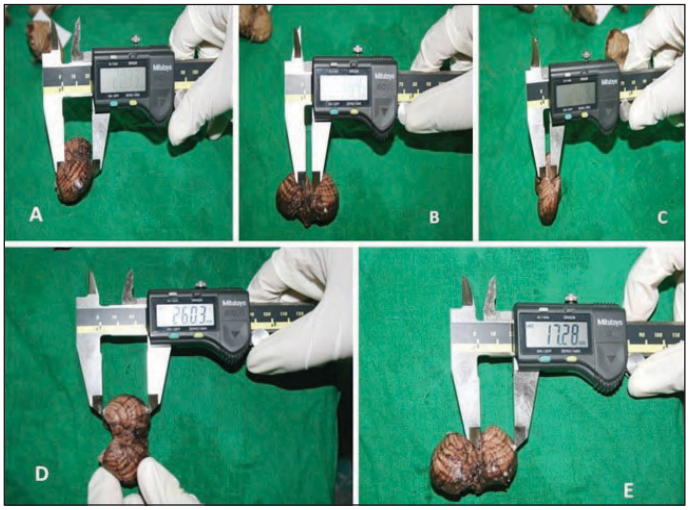

Figure 2. Shows a. Measuring the length of vermis, b. Measuring the width of vermis, c.Measuring the thickness of cerebellum, d. Measuring length of cerebellum, e. Measuring the width of cerebellum.

parietal diameter (B. P. D), head circumference (H.C.), crown-rump length (C.R.L.), crown- heel length (C.H.L.).

Fetal cerebellar external morphological parameters: Morphology of lobes, appearance of primary fissure, postero-lateral fissure and horizontal fissure on the superior and inferior surfaces of both cerebellar hemispheres were observed and recorded in the data sheets according to gestational ages.

Measurements of various cerebellar parameters: The measurements for the both right and left cerebellar hemispheres were taken individually by using paquimeter (Absolute digital verniar calipers) (fig.2).

a). Length of vermis (mm) (fig. 2) - It is measured by paquimeter, placing it along the vermis from anterior cerebellar notch to posterior cerebellar notch.

b). Width of vermis (mm) (fig. 2) - It is measured by keeping the instrument along the width of vermis which was a point located in between the widest part of cerebellar hemispheres.

c). Thickness of vermis (mm) (fig 2) - It is measured by placing the instrument on the vermis at the anterior cerebellar notch.

1. Right lobe - Length (mm) (fig 2) - It is measured at a point where the longest distance was seen for each right cerebellar hemisphere. Width (mm) (fig2) - It is measured at point where the widest width was present. 2. Left lobe - Length (mm) - It is measured at a point where the longest distance was seen for each right cerebellar hemisphere. Width (mm) - It is measured at point where the widest width was present.

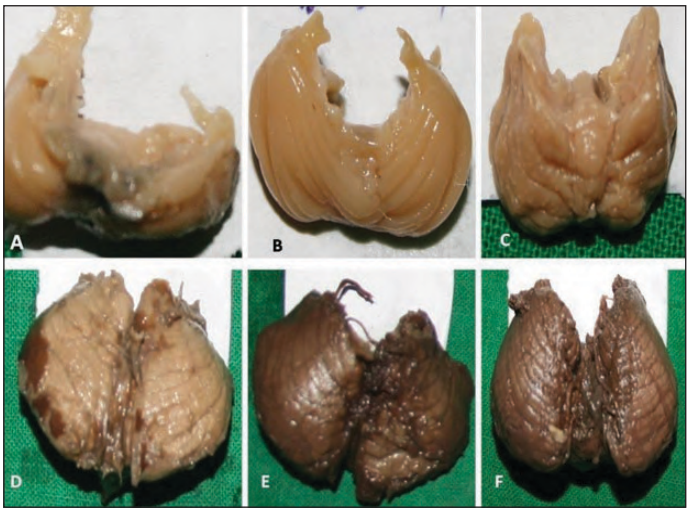

Figure 3. Shows A. 17 weeks, Female- superior surface, B. 13 Weeks, Male- superior surface, C:26 weeks Female inferior surface, C: 22 weeks Male superior surface. D: 30 weeks Male inferior surface E: 36 weeks Male inferior surface.

Statistical analysis: Statistical method has been carried out by using IBM SPSS 20.0 one way ANOVA and correlation analysis of variance technique applied at 5 % level of significance.

Results:

A total of 44 apparently normal dead and aborted embryos and fetuses of both sexes and of 13 weeks to 36 weeks gestational age were utilized for observing and measuring certain morphological and morphometric parameters of external body and external surface of cerebellum and also histological features of cerebellum. The results of the present study were described in the following order.

External foetal morphology: All the fetuses observed in this group were apparently normal.

External foetal parameters/morphometry: The external body parameters of foetal weight (FW), crown- rump length (CRL), crown- heel length (CHL), head circumference (HC) and Bi-parietal diameter (BPD) were statistically analyzed by calculating independent mean, standard deviation and sample t test for each gender and represented in table 5.2. The foetal weight was measured in grams. Other morphometric parameters were measured in centimeters.

Table 1 Showing the one way ANOVA for various external body parameters in the sample studied in 4 week- wise gestational age groups of aborted fetuses. This table reveals that by carrying out ANOVA, Foetal weight increased significantly in all groups. CRL increased with significant values. CHL decreased in 17-20 and 21-24 weeks and increased in 13-16, 25-28, 29-32 and 33-36 weeks groups with significant values. BPD decreased in 17-20 weeks and 33-36 weeks of gestational age, it is increased with significant value in remaining age groups. HC increased significantly in all age groups. Table 2 is showing the one way ANOVA by age for various external parameters of cerebellum in the sample studied in week-wise gestational age groups of aborted fetuses. This table reveals that by carrying out ANOVA, vermis length decreased in 25-28 weeks and remaining

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Table 1. Showing, mean, standard error, one way anova and significance levels for external body parameters in aborted fetuses of different gestational age groups.

Para-meters	13-16 weeks		17-20 weeks		21-24 weeks		25-28 weeks		29-32 weeks		33-36 weeks		F-value	Sig.
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E		
Weight	105.00	45.00	473.33	93.23	685.56	73.41	871.82	127.37	1521.50	191.11	2125.00	186.53	17.165	0.000*
C RL	11.75	1.75	15.75	0.51	21.14	0.52	23.67	0.77	28.14	0.61	33.88	0.45	87.092	0.000*
C HL	32.75	11.25	23.50	0.85	32.37	1.30	36.89	1.43	43.14	0.98	51.27	2.49	41.439	0.000*
BPD	8.10	0.10	6.78	0.33	8.23	0.62	8.90	0.62	10.60	0.66	9.65	1.06	3.984	0.009*
HC	12.50	1.50	15.08	0.78	22.63	0.95	24.28	0.94	27.01	2.08	32.87	0.61	16.679	0.000*

Table 2. Showing, mean, standard error, one way anova and significance levels for cerebellar parameters in different gestational age groups.

Parameters	13-16 weeks		17-20 weeks		21-24 weeks		25-28 weeks		29-32 weeks		33-36 weeks		F-value	Sig.
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E		
Vermis length	4.14	0.50	5.63	0.74	10.14	1.43	9.97	1.08	12.62	1.01	17.11	0.76	10.169	0.000*
Vermis width	2.71	0.87	3.40	0.50	4.37	0.22	3.74	0.37	5.29	0.45	4.26	0.29	3.566	0.015*
Vermis thickness	1.48	0.38	3.30	0.31	3.66	0.28	2.93	0.41	3.92	0.33	3.42	0.39	1.280	0.295NS
RL length	6.66	1.18	7.98	0.89	13.21	1.16	15.45	1.45	18.98	1.63	26.60	1.31	17.549	0.000*
RL width	5.08	0.82	6.03	0.56	11.30	1.34	12.16	1.32	15.57	1.46	19.91	0.46	11.866	0.000*
LL length	6.66	1.18	7.52	0.74	12.74	1.26	15.29	1.57	18.64	1.53	26.19	1.04	17.543	0.000*
LL width	5.42	0.49	6.25	0.49	10.85	1.04	22.00	10.20	14.90	1.46	20.04	0.62	1.024	0.408NS
Cerebellum weight	0.35	0.15	0.58	0.15	2.40	0.52	4.76	1.28	7.44	1.15	14.53	1.93	16.461	0.000*

Table 3. Showing, correlation analysis between foetal cerebellar morphometry and external foetal morphometry.

Correlation values between Foetal and Cerebellar Parameters		Foetal Parameters			
		C R	C H	BPD	HC
Cerebellar Parameters	Vermis length	0.779	0.652	0.392	0.627
	Vermis width	0.394	0.181	0.497	0.292
	Vermis thickness	0.250	0.026	0.357	0.177
	RL length	0.858	0.707	0.460	0.655
	RL width	0.820	0.710	0.375	0.658
	LL length	0.860	0.713	0.446	0.660
	LL width	0.279	0.217	0.170	0.277
	cerebellum weight	0.803	0.749	0.249	0.613

gestational age groups it increased with significant value. Vermis width decreased in 25-28, 33-36 weeks and remaining age groups increased significantly. Vermis thickness is decreased in 25-28, 33-36 groups, and increases in remaining age groups but it is statistically not significant. Right lobe length and width, left lobe length increased significantly in all gestational age groups. Left lobe width decreased in 29-32 group and in remaining age groups width is increased but it is statistically not significant. Cerebellum weight is increased significantly in all gestational age groups.

Table 3 shows the correlation values between the foetal and cerebellar parameters. The bold values represent significant correlations which were tested at 5% level of significance. All the parameters are positively correlated and the parameters vermis length is highly correlated with CR, CH and HC. Similarly, the parameters RL length, RL width, LL length and cerebellum weight are highly correlated with CR, CH and HC. The rest of the parameters are not significantly correlated.

Morphological observations of cerebellum: Observations in group-a (13-16 wks): External surface of cerebellum is smooth. Vermis and lobes of cerebellum could not be clearly demarcated **(**Fig.3). The right and left lobes are symmetrical, and fissures are lightly demarcated.

Observations in group-b (17-20 wks): Beginning of formation of folia were observed. Early stage of demarcation of Vermis and lobes of cerebellum observed **(**Fig.3). The right and left lobes are symmetrical, and fissure on hemispheres are clearly seen.

Observations in group-c (21-24 wks): Folia could be demarcated. Vermis and lobes of cerebellum clearly demarcated than previous gestation age group **(**Fig.3). The right and left lobes are symmetrical, and fissure on hemispheres are clearly demarcated.

Observations in group-d (25-28 wks): Folia could be clearly demarcated. Vermis and lobes of cerebellum well demarcated **(**Fig.3). The right and left lobes are symmetrical, and fissures on hemispheres well demarcated.

Observations in group-e (29-32 wks): Folia could be well demarcated. Vermis and lobes of cerebellum well demarcated. The right and left lobes are symmetrical, and fissures on hemispheres are well demarcated **(**Fig.3).

Observations in group-f (33-36 wks): Folia could be clearly demarcated. Vermis and lobes of cerebellum well demarcated. The right and left lobes are symmetrical, and fissures on hemispheres are well demarcated than other previous age groups **(**Fig.3).

Discussion:

When the results were analyzed it was observed that there is increase in fetal weight with increase in gestational age. Biparietal diameter increased from 13-16 weeks to 29-32 weeks; thereafter it decreased in 33-36 weeks. Head circumference increased with gestational age.

The formation of folia was gradually increased from 20-30 weeks of gestational age.[6-8] but it was not mentioned in the literature when it will start forming. According to Parisi et al., [9] by 4 months gestation, the vermis becomes fully foliated. In the present study the earliest age of the specimen is that of 13 weeks in which folia were not observed and in 17 weeks specimen the folia were observed. Based on the observations in the present study it can be concluded that they start appearing between 13 and 17 weeks.

According to Liu F et al.,[10] primary fissure was the first to be visualized and was detectable as early as 14th week. In the present study it appeared at 13 weeks and is earlier than reported in literature by Fei Liu et al. and delayed by one week when compared with the report, it appears sometimes during 12th

week.[11] According to Sir Arthur Keith[12] at the end of the 4th month four fissures are seen in human cerebellum. The posterolateral fissure could be recognized at 17th week as stated in the literature by Fei Liu et al. but in the present study it appeared as early as 13 weeks.

Based on MRI studies[13] and based on ultrasonographic studies[14] reported that at around 11 to 12 weeks, the cerebellum and early vermis can be noticed along the cranial aspect of the fourth ventricle. By 13 to 14 weeks, the early fastigial point can be seen developing as a crease along the ventral surface of the cerebellar plate. In the present study at 13 weeks vermis and cerebellar hemispheres could be identified but they cannot be demarcated clearly. At 17 weeks the vermis and lobes could be clearly demarcated. The size of the cerebellum (or) transverse cerebellar diameter (TCD) is useful biometric parameter to estimate gestational age in the second trimester.[15] The ratio between TCD and vermis length and between TCD and vermis width decreases with gestational age. These results show trajectory development in MRI. These parameters increase our understanding of normal cerebellar development in fetus, and facilitate the diagnosis of pathological intrauterine changes. All the parameters of vermis presented significance with gestational age group except thickness of vermis. The length of both lobes and width of Right lobe were significant with gestational age groups. Cerebellum weight is increased significantly in all gestational age groups.

All the foetal and cerebellar parameters are positively correlated and vermis length is highly correlated with CRL, CHL and HC. Similarly, the parameters RL length, RL Width, LL Length and cerebellum weight are highly correlated with CRL, CHL and HC. The rest of the parameters are not significantly correlated. Occlusion: All the external foetal morphometric parameters are significant with increased gestational age. In the present study all the fissures appeared earlier than that reported in the literature. The external parameters of cerebellum and foetal external parameters are positively correlated. All the parameters of cerebellum except thickness of vermis and left lobe width presented significance with gestational age.

The information of cerebellar anatomy has got incredible importance in neurosurgical practice. Future studies might engage assessment of the cerebellum at other gestational ages of foetuses. The purpose of this study is to use the results to estimate the cerebellum in fetuses with malformations of the CNS also. While present method is difficult to be used in vivo evaluation, it can contribute an anatomical foundation for the diagnosis of foetal neuro abnormalities. The normal parameters and dimensions of the vermis in different gestational periods are tremendously important in evaluating the posterior cranial fossa abnormalities because vermian defect are the main features of occurrence of neural defects and malformations.

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ORIGINAL ARTICLE

Clinical Profile of Poisoning in Children and it's short-term Outcomes

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Abstract:

Poisoning in children is a neglected health problem. Curiosity and tendency of exploration in children drives them to consume poisons accidentally. It can cause significant morbidity and mortality. To describe the epidemiology and clinical profile of children brought to hospital with history of poisoning and to determine the short-term outcomes at discharge. Hospital records of children, age 1 month to 15 years, admitted with history of acute poisoning in Paediatric ICU over an 8-year period were reviewed retrospectively. Institutional ethics committee approval was taken. Relevant information was collected in proforma and analysed statistically. Of the 200 children, majority were boys aged less than 5 years, consumed poisons accidentally at home. Most commonly found poisons were chemicals especially kerosene, mosquito repellents followed by medicines used by family members. Among medicines, paracetamol was most common. Intentional poisoning was seen in adolescents. The poisons were typically kept in unsafe and handy locations. Majority of the children were asymptomatic; while others presented with vomiting, drowsiness, pain abdomen and cough. Most of the children survived, with 14.5% being discharged against medical advice. There were 2 deaths among the 200 children. The children were usually hospitalised for less than 7 days. Majority of poisoning were accidental in small children. Kerosene was the most commonly used followed by mosquito repellents and medications. Paracetamol was the most common medication noted. All poisoning in adolescents were with the intent of self-harm. Chemicals kept in soft drink bottles contributed to poisoning in children.

Keywords: Poisoning; Accidental consumption; Poison.

Introduction:

Poisoning in children is a serious health problem which is often neglected and underestimated. Exposure to toxins is slowly becoming a major health problem contributing to acute illness in children. It can cause significant morbidity and mortality. By definition poisoning is a state of medical emergency as a result of ingestion of an exogenous chemical in a level that is harmful to the individual.[1] Curiosity and the tendency of exploration in children drives them to consume poisons accidentally.[2] This inadvertently occurs in their homes, thus making it a preventable cause of mortality and morbidity.[3] Hospital statistics reported periodically from different parts of India indicate an incidence varying from 0.33 - 7.64 % of total admissions.[4] Approximately 3,45,814 individuals of various ages died worldwide as a result of poisoning, according to the WHO Global Burden of Disease research. Although adults made up the bulk of those who ingested poison, 13% of those cases involved children under the age of 20.[5]

Paediatric poisonings account for 0.23-3.3% of the total poisoning in India.[6] The chemical consumed by younger children is typically identifiable but estimating the dosage might be challenging. Accidental poisoning occurs often in the age group of 1-5 years, although less than 1 percent of poisoning in children is serious. The intent of this study was to determine the epidemiology, pattern and outcome in children with poisoning admitted to a tertiary care hospital.

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Materials and method:

The case files of all paediatric patients admitted with history of poisoning between January 2014 and September 2022, a period of 8 years, were reviewed for this retrospective observational analysis. Institutional ethical committee approval was taken. This study included all patients with a history of acute poisoning who were younger than 15 years old. Chronic poisoning such as lead poisoning and food poisoning were among the exclusion criteria. Age, gender, poison type, amount consumed, mode of poisoning (ingestion, inhalation, and skin contact), time between exposure or consumption and presentation, home first-aid treatment, clinical characteristics, therapeutic intervention, and outcome were all noted in a proforma for the patients who were included. The collected data was statistically analysed.

Results:

A total of 200 children were enrolled in the study, from 1 month to 18 years, of which 122 were males as depicted in fig 1. Majority of patients were in 1–5 years age group (n=153, 76.5%) followed by 10-15 years (n=26, 14.5%), as depicted in fig 2. Amongst the 200 children, 65% were from rural areas. Most of the poisoning were accidental and at home which were identified early by the caretakers. About 69.5% of poisoning were witnessed since it was accidental and immediate measures were initiated. 90% of children were brought to the hospital within 5 hours of consumption. Up to 83.5% of poisoning were consumed accidentally and 13.5 % were taken intentionally by children. All intentional poisoning were by adolescents. Majority of poisoning occurred at home. Household chemicals including kerosene,

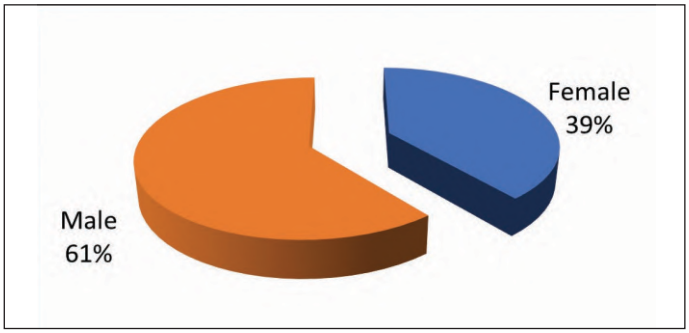

Figure 1: Gender.

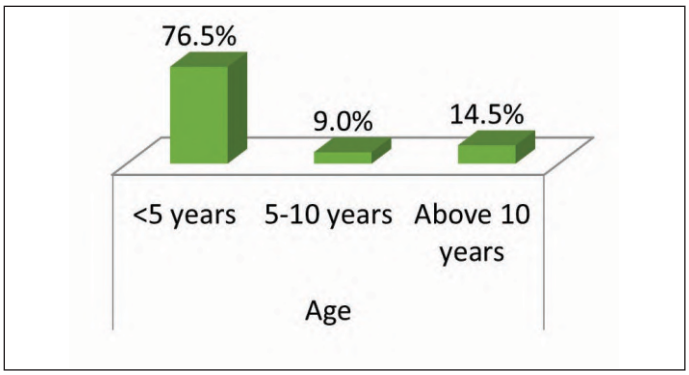

Figure 2: Age distribution.

Table 1: Clinical features.

Symptoms	Number	Percentage
Asymptomatic	86	43%
Vomiting	60	30%
Cough	24	12%
drowsiness	10	5%
Pain abdomen	8	4 %
Breathlessness	8	4 %
Convulsion	2	1%
Fever	4	2%
Loose stools	1	0.5%
Rashes	1	0.5 %

insecticides and pesticides including mosquito repellents, potassium permanganate, ratol and phenol were most frequently used. Other chemicals include carbofuran, DDT, Dettol, diesel, glass cleaner, sewing machine oil, ant powder and carbamate. It was noted that most of the poisons such as kerosene, turpentine oil etc were kept in alternate bottles, which was possibly within the reach of children leading the child to accidentally consume the item. Mosquito repellents were in their original containers but due to their bright colours and odour would instigate the curiosity of children especially toddlers. Medications such as paracetamol, thyroxine, antipsychiatry medications etc taken for treatment by the family members of the child were frequently encountered in accidental poisoning. Paracetamol is the most common medication leading to poisoning in this study. Toxic plants included datura fruit. Other poisons included gingelly oil and vinegar. All poisons were taken orally

Most of the children were asymptomatic (n=86, 43%). Vomiting (30%) was the most common presenting symptom followed by cough, drowsiness, pain abdomen and breathlessness., as

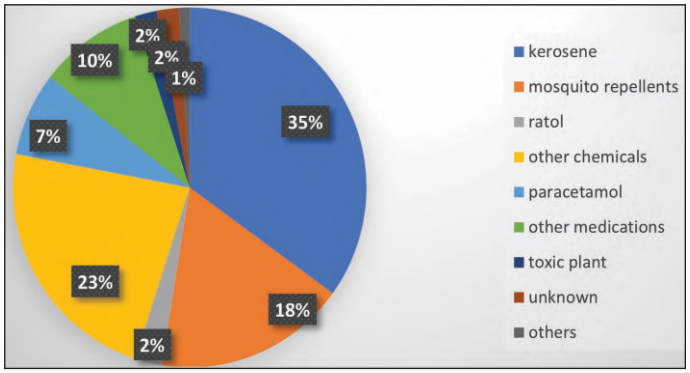

Figure 3: Type of poison.

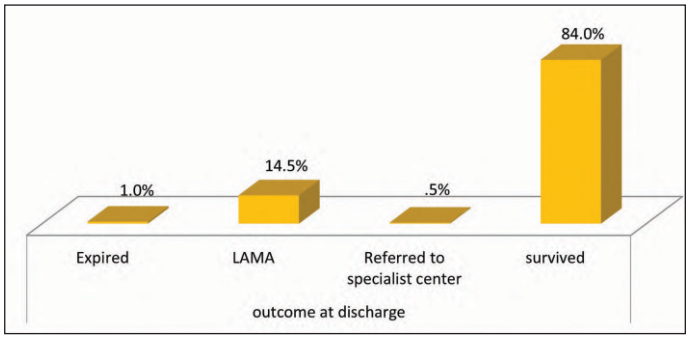

Figure 3: Outcome at discharge.

depicted in table 1. Most of the children maintained stable vitals, 15 children required oxygen support and 4 required ventilatory support. Induced vomiting was done at home in case of 8 children, others were directly taken to the hospital. About 17 children were given specific antidote, gastric lavage was given for 2 children. Others required only supportive care. Almost 98% children were discharged within 7 days. Majority of children survived, out of which 29 patients went leaving against medical advice, one patient was referred to specialist centre. 2 children expired as depicted in fig 3.

Discussion:

Poisoning in children is a critical health problem and a leading factor in serious mortality and morbidity. It is observed that males are more common in childhood poisoning, according to a few studies. In this study we had a similar observation. Males were more common; this may be because they tend to be more hyperactive, have more freedom or are more likely to be biased for hospital admission than females. In accordance with earlier studies, the majority of our patients were in the 1 to 5 year age group.[7,8,9] The majority of our patients were from adjacent urban regions. In the current study, the average duration between poisoning and presentation to emergency was 2 to 5 hours. Majority of poisoning occurred at home (98%). Various household chemicals such as toilet cleaner, detergents, mosquito repellents were commonly encountered in childhood poisoning. In a study done by R Khadgawat and others it was noted that ingestion of kerosene oil accounted for 48.9% of all occurrences of unintentional poisoning in children.[10] The most frequent agent encountered in our study was kerosene and children commonly had access to these chemicals as they were routinely kept in empty soft drink bottles in their reach.

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Drug toxicity by accidental ingestion of medications that is taken by the family members is common (n:171, 75.5%), mainly due to the lack of awareness of child-proof storage and packaging and careless storage by family members. In addition to that iatrogenic intoxication is also common. Most common medicines encountered in poisoning were – paracetamol, antipsychiatry medications, thyroxine. The most common drug identified in our study was paracetamol (n-15, 7.5%).

Majority of the poisoning in children were accidental while 14.5 % were with intention of self-harm. It was noted that all adolescent poisonings were intentional. Commonly used agents were ratol, phenol, kerosene , medications such as paracetamol and antipsychiatry medications and pesticides like carbofuran. In 2 children with intentional poisoning, the type of poison was unknown.

The majority of our patients had no symptoms at presentation or only experienced minor, non-specific symptoms like nausea, coughing, and pain in the abdomen. About 2% children developed serious symptoms and signs and required ventilatory support**.** These children had consumed the poison with the intent of self-harm, quantity of poison consumed was more and also had delayed presentation to the hospital. Two children expired in our study during the course of hospital stay. Majority of the paediatric poisoning was accidental with a very small amount consumed and required only supportive care. The transfer of hazardous drugs from their original containers or those left within children's reach was observed. These accidental poisonings are also caused by inadequate storage facilities. Our study had few limitations. The assessment of all risk factors could not be determined with the available data. But it is crucial to be aware regarding the morbidity that could be prevented in accidental poisoning and adequate interventions to be taken immediately. Assessment of socioeconomic circumstances, psychological state of the child and of the caretakers is necessary.

Conclusion:

In our study, we found that kerosene is the most common causative agent, followed by mosquito repellents and paracetamol. Majority of the poisoning were accidental. Home safety education for safe storage of medicines, household and cleaning products is necessary. All poisoning in adolescents were intentional with a suicidal intent. To stop the surge in incidents of self-poisoning, it is important to start the proper mental health awareness and interventions in children.

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CASE REPORT

Multiple Intussusceptions as the Cause of Death in Asymptomatic neonate: A rare case report

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Abstract:

Intussusception, a major cause of intestinal obstruction in childhood. The most common type is ileocolic, followed by ileo-ileal. Intussusception has a peak incidence between three to nine months (Pollack and Pender, 1991) and has a male predominance. Autopsy proof of both intussusception and peritonitis is needed for pronouncement of death from aggravated intussusception. Frequent vomiting, secondary to ileus, may lead to aspiration and suffocation when it may be impossible to demonstrate peritonitis, even with confirmed intussusception. If no pathological lead point, intussusception is likely to represent a primary rather than secondary phenomenon. The cause of intussusception is not known in most of the cases. Several association and possible causative factors have been identified like large peyer's patches, polyps, Meckel diverticula, cystic fibrosis, lymphoma, viral etiology particularly adenovirus, recent history of upper respiratory illness and heredity. It is important to clearly distinguish agonal intussusception from antemortem intussusception. Agonal intussusceptions are believed to occur terminally are an incidental finding, not a cause of death although designation of the intussusception as 'agonal' cannot be justified by some authors. We report a case of a 7 days old male child with history of not accepting feed for 1 day who was brought dead. Five ileo-ileal intussusceptions were evident grossly at autopsy and histopathological examination was diagnostic of cause of death. Multiple antemortem intussusception as cause of death is fairly uncommon and no ample literature was available for reference and hence reporting the interesting case.

Keywords: Sudden death; Infant; Intussusception.

Introduction:

Intussusception is the most common cause of intestinal obstruction in children younger than 2 years of age.[1,2] Although intussusception in childhood is usually a relatively benign entity, which is transient and resolve spontaneously, it may rarely be associated with unexpected death.[3] The most common type is ileocolic, followed by ileo-ileal. The cause of intussusception is idiopathic in most of the cases. Several association and possible causative factors as large Peyer patches, polyps, Meckel diverticula, cystic fibrosis, lymphoma, rotavirus vaccination, antibiotic use, recent history of upper respiratory tract illness, viral aetiology particularly adenovirus and heredity are identified.[1] Unexpected death may occur at any age, with intussusception at any level with no pathological lead point. It has been estimated that 13–20% of children with intussusception have so called 'painless intussusception' with no discomfort or colic.[4] Autopsy findings in sudden deaths in which no other gross abnormality other than intussusception are evident, it was difficult to ascertain if death is due to sequelae of intussusception alone or it is a postmortem agonal artefact.[2]

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The Case:

A 7-day old infant was found gasping during the morning hours and was declared brought dead in Trauma and Emergency in a tertiary level hospital of Central India with alleged history of lethargy and not taking breastfeeding in the night-time. Previous history of fever of two-day duration following vaccination was also present. The antenatal and postnatal period of the mother was uneventful. Since the death was out of the healthcare institution and was not correlating to any obvious pathology or injury a medicolegal autopsy was conducted to ascertain the cause of death. The weight of the neonate to be 2.1kg and length of 48cm. There were no external injuries to the neonate. All orifices were intact and devoid of any injury or pathology.

The remnants of the umbilical cord had fallen off with a healing umbilical area. No pus or pathology were evident at the umbilical area. On internal examination, the brain was 381gm in weight and was oedematous and congested on cut. All vital organs including both lungs, heart, liver and both kidneys were showing normal gross findings. Stomach contained 5 ml greenish brown mucoid fluid with no peculiar smell or congestion. On further exploration of intestinal loops, five ileo-ileal intussusceptions were evident grossly (Photo 1 and 2). At the level of intussusception, the proximal bowel segments were dilated, edematous & distal were dark reddish to dusky and collapsed, not easily reducible. There were no other gross significant findings in other organ systems. The affected portion was preserved in formalin for histopathological examination.

Photo 1. Multiple intussusceptions on gross.

Photo 2. Single Intussusception site .

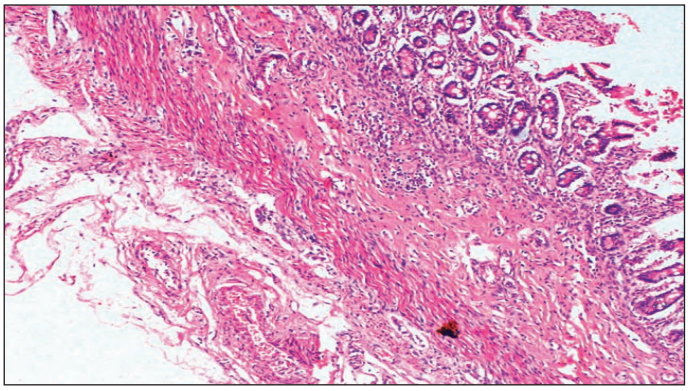

Photo 3. Inflammatory infiltrate in all layers, H&E, 10X.

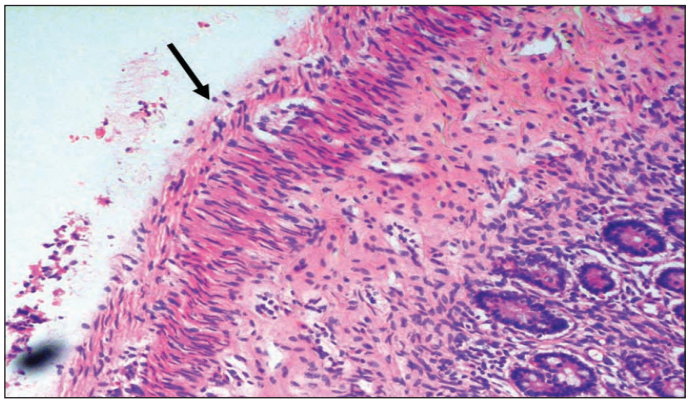

Photo 4. Inflammatory infiltrate upto serosa, H&E, 40X.

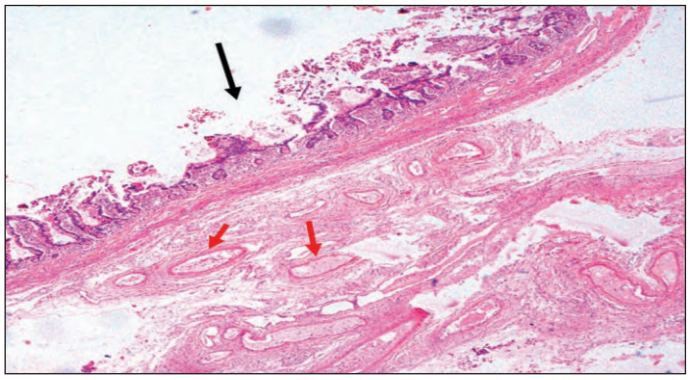

Photo 5. Mucosa showing focal ulceration (black arrow) and dilated lymphatics (red arrow), H&E, 10X.

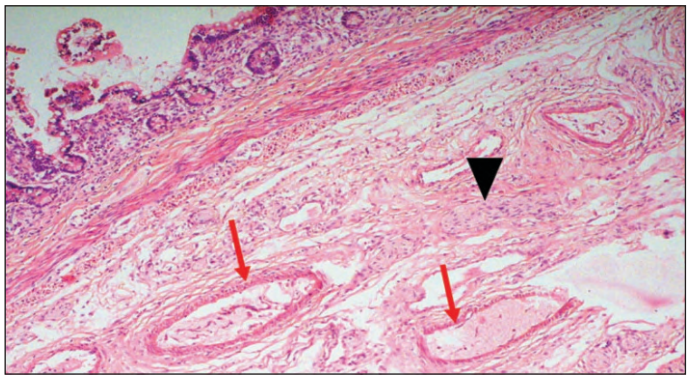

Photo 6. Hypertrophic nerve bundles (black arrowhead) and dilated lymphatics (red arrow), H&E, 40X.

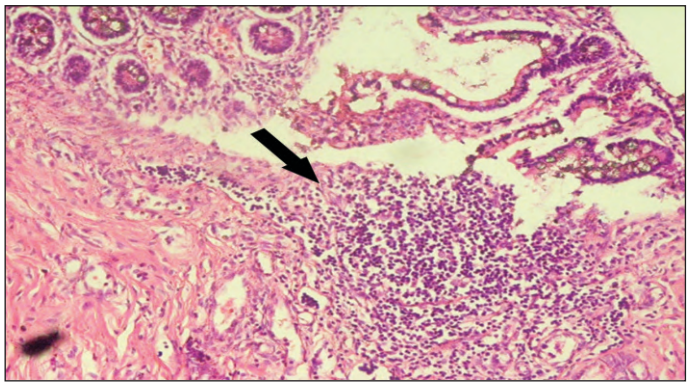

Photo 7. Hyperplasia of payer's patches, H&E, 20X.

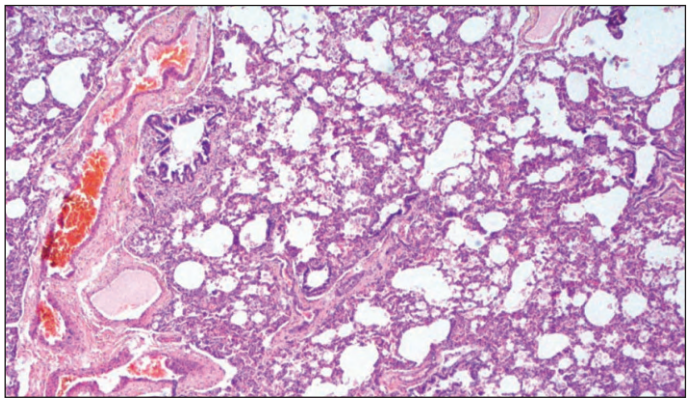

Photo 8. Focal alveolar damage, inflammatory infiltrates in septa and Congested blood vessel. H&E, 4X.

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Histopathological examination of the tissue specimens from the affected segment from intestine showed predominantly lymphocytic infiltration with few neutrophils present in all layers of the ileum (Photo 3 and 4). Also, focal ulceration of mucosa was seen along with dilated lymphatics (Photo 5). Hypertrophic nerve bundle was also evident in the myenteric plexus of intestine (Photo 6). Hyperplasia of payer's patches was also noted in one field on histopathology (Photo 7).

Other remarkable histopathological findings were present in tissue specimens of lungs which showed lymphocytic infiltration in alveolar septae, congestion of large blood vessels and focal alveolar damage at places (Photo 8).

Discussion:

Intussusception occurs when a segment of the intestine, constricted by a wave of peristalsis, telescopes into the immediately distal segment. Once trapped, the invaginated segment is propelled by peristalsis and pulls the mesentery along. Untreated, intussusception may progress to intestinal obstruction, compression of mesenteric vessels, and infarction. The most common type is ileocolic, followed by ileo-ileal, jejunojejunal and colocolic. The age range is four weeks to 13 years, with a male to female ratio of 1.8: 1. Some authors noted age range between 3 to 9 months and a male predominance. Our case was a 7 days old infant.[2] In a developing country like India, where there are health infrastructure constraints, a clinical diagnosis such as intussusception which requires imaging modalities especially in under-communicating neonates are not readily available and this may delay the prompt diagnosis and immediate management of the condition which could significantly contribute to infant mortality rates. The mortality with treatment is estimated to be about 1- 3%, but if untreated the condition is uniformly fatal in 2- 5 days.[1]

Symptoms and signs of intussusception are colicky abdominal pain, abdominal distension, fever, bloody mucoid stools, vomiting and a palpable abdominal mass but symptoms may either be absent or quite subtle.[2,3] Several association and possible causative factors have been identified. Among them are large peyer's patches, polyps, Meckel diverticula, cystic fibrosis, lymphoma, viral etiology particularly adenovirus and heredity. Recent history of upper respiratory illness was also a predisposing factor.[3,4] Death occurs in untreated intussusception from a combination of factors, including intestinal obstruction with resultant fluid and electrolyte imbalances, peritonitis, generalised sepsis and shock from intestinal infarction due to compromise of blood supply.[2,5] According to Iwase et al Demonstrable intussusception with aspiration of vomitus is hallmarks of the diagnosis.[6]

It is important to clearly distinguish agonal intussusception at autopsy from one which has genuinely caused antemortem functional disturbance. Agonal intussusceptions are believed to occur terminally, possibly related to intestinal dysmotility and peristaltic incoordination, and are an incidental finding, not a cause of death. They are easily reducible and macro and microscopic viability of the intussuscepted intestine is obvious.[2] Findings are corroborative grossly and microscopically in antemortem intussusception and not in post mortem agonal artefact.

Most common histological findings in cases of childhood intussusceptions are focal lymphoid hyperplasia, sometimes only edema which may be incidental finding.[3] Some studies reported ischemic necrosis of the intestine associated with vascular congestion and focal hyperplasia of the peyer's patches.[4] On histopathology of the affected intestinal segment, we noted inflammatory infiltrates from mucosa to muscle layer, ulceration of mucosa, dilated lymphatics, hypertrophic nerve bundle & hyperplasia of payer's patches. In lungs, on histopathological examination the findings were of focal alveolar damage, inflammatory infiltrates in septa & congested blood vessels.

Conclusion:

Present case exhibits an uncommon fatal occurrence due to intussusception and demonstrated the importance of forensic autopsy and histopathology in such unexpected infant deaths. It is important to clearly distinguish agonal intussusception at autopsy from one which has genuinely caused antemortem functional disturbance.

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CASE REPORT

Antemortem Injuries or Postmortem Mutilation?- A Case Report

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Abstract:

Only a few cases of homicidal decapitation have been sporadically reported in Forensic literature. Sometimes, the autopsy surgeon may encounter cases in which the distinction between a vital or post-mortem phenomenon is arduous. Suicides by self-decapitation have been reported in India, for instance, individuals deliberately place their necks onto the railway track while a train is approaching. Also, unintentional decapitations are possible in cases of suicide as in hangings. Accidental decapitation may also occur, for example, in train fatalities, industrial accidents and injuries during road and motor vehicular accidents. The most exceptional cases are homicidal decapitation. It has been used as a manner of death to carry out executions for centuries and is still used in some countries today. Dismemberment or post-mortem mutilation of a corpse has always been viewed as more appalling than the homicide itself. It usually occurs when the killing takes place without any prior planning. In this report, an 80-year-old female was decapitated and found in a mutilated state. It was determined that the victim was decapitated and dismembered by her 25-year-old grandnephew, who was receiving treatment for psychiatric illness on and off for the past 10 years and had just been discharged from the inpatient mental health facility only the previous day. Decapitation along with other post-mortem mutilations were present on the body. The motives for dismemberment and decapitation are considered to be aggressive, defensive, and offensive. The combination of history, crime scene findings, and autopsy findings will help to distinguish the mode as well as the nature of the injury whether antemortem or post-mortem. Moreover, we also wish to highlight the role of psychiatric illness and especially the importance of swift intervention and treatment.

Keywords: Decapitation; Mutilation, Dismemberment; Homicide; Parricide; Mental illness.

Introduction:

Decapitation refers to the act of complete separation of the head from the body by cutting, tearing, pulling, or otherwise. It has been utilized as a method of killing throughout history from as early as the Neolithic age.[1] The presence of vital structures in the area of the neck, like the common carotid arteries and jugular veins, and the trachea makes it an ideal anatomy for intentional decapitation. It is the second most common type of non-compressive injuries to the neck.[2] Decapitation by homicidal manner is rare as it suggests the condition of the deceased who was probably defenceless during the attack and a particular weapon, isolated place, and plenty of time. The mode of death in decapitation may be difficult to explain unless there is a proper history, weapon of offense and the decapitated head. “Dismemberment” is the term used to define the detachment of the limbs and/or the head from the trunk at the level of the respective joints, or the subdivision of the thorax, the abdomen, or the limbs into respective segments.[3] It is a relatively rare method that the murderer uses sharp cutting weapons such as saw, axe, etc. in order to sever the limbs and/or cut the body into small pieces alongwith with the evisceration of organs. It is generally carried out immediately after the crime, although less often a long time may pass between the two events. Dismemberment or post-mortem mutilation allows the murderer to clear the scene of the crime. It also makes it easier to transport the body to remote places during daytime without raising suspicion. Finally, it also delays the identification of the victim. Thus, for the above reasons the investigation of crime is delayed. Many studies have shown that there is usually a familial or interpersonal relationship between the murderer and the victim in cases of dismemberment or mutilation. They have also indicated a link between the reason for the crime and the dismemberment.[4–7] In particular, Puschel and Koops have carried out a classification according to the motives of perpetrators consisting of three groups: sexual perversion, psychosis, and other psychiatric disorders.[8]

Dismemberment can occur in life or after death. In some cases, hemorrhage during the dissection of the victim is the main cause of death, while in others, the mutilation occurs after the death due to some other cause. It may be hard to establish the cause of death because the lesions produced during dismemberment may cover or be confused with those that caused the death. The key role of the forensic pathologist is to differentiate the vital injuries from the post-mortem lesions. In many forensic cases, it is complicated to determine the cause of death. In fact, it remains an unresolved query for forensic pathologists and investigators. The crime scene and autopsy findings of a parricide case by decapitation and dismemberment by the victim's schizophrenic grandnephew are evaluated together with the data in the literature.

Case Report:

An 80-year-old widowed female was staying with her grandnephew only since the prior day on the top story of a one-story building. Her grandniece, who was the sister of the perpetrator, was the one who called the police. The deceased and

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Figure. 1 Crime scene showing decapitated and dismembered corpse on mattress with decapitated head on nearby sofa.

Figure. 2 Crime scene showing dismembered organs and body parts in bag along with one of the alleged weapons of offence.

Figure. 3 Decapitation injury at the lower level of neck.

the perpetrator had become uncontactable and were not responding to calls since morning. As she was staying on the ground floor of the house, she went upstairs and knocked on the door mid-morning. The perpetrator answered the door with a knife in his hand and blood-soaked clothes, the deceased was nowhere to be seen. Upon entering the house, the police found the victim's corpse between the sofa and table in a prone position lying on a mattress. The 25-year-old perpetrator was sitting on the sofa. The deceased's lower clothes and undergarments were undressed up to the knees and upper clothes were stripped open. The mattress and the ground beneath the body were blood soaked and there was a large quantity of blood present. The deceased clothes were also blood stained. The deceased's decapitated head was found at one end of the sofa (Fig 1). Her breasts and thorax

Figure. 4 Decapitation injury at the upper level of neck.

Figure. 5 Dismembered corpse showing exposed thorax & mutilated organs.

were dismembered and cut open. The breast, thoracic and parts of abdominal organs were removed and placed in vessels and plastic bags in the room and were recovered after careful and thorough examination of the crime scene (Fig 2). There was no attempt by the perpetrator to clean the blood or crime scene. Two single edged knives were found near the vessels stained with blood. Further probing of the incidence revealed that he had been in and out of mental health institutions for ten years for undiagnosed mental illness and addictions. Their parents were working in the middle east and had not come down to visit due to the strict Covid rules and restrictions. He had been an inpatient at a mental health facility and was discharged only the previous day for reasons unknown.

Autopsy Findings:

The body was that of an elderly woman. The head was completely detached from the trunk and was brought separately. Examination showed that the head had been severed, i.e., decapitation injury at the base of neck. Upper level of decapitation injury had antero-posterior length of 8 cm and a lateral length of 9 cm with the margins at a level 4 cm below the right mastoid, 8 cm below the chin, 5 cm below the left mastoid and 13 cm below the external occipital protuberance. The skull vault and base of the skull were intact. All the deep structures of the neck were severed at the level of C-2 and C-6 vertebrae over upper and lower level respectively with complete disarticulation; multiple grooves present over the cut ends of the vertebral bodies (Fig 3). Lower end of decapitation injury had anterior posterior length of 9 cm and lateral length of 10 cm with margins present 5 cm above the suprasternal notch and 11 cm from right shoulder and 12 cm from left shoulder. All the major vessels of the neck were clean cut at different levels.

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The wound margins of the decapitation injury along with skin and muscles, thorax, oesophagus, and major vessels of the neck were clean cut, with multiple sharp angled ends with extravasation of blood in the underlying soft tissues. C3-C5 vertebrae along with thyroid gland, thyroid cartilage and hyoid bone were missing along with corresponding muscles, soft tissues, nerves, and vessels (Fig 4). Incised wounds were present over the anterior aspect of thorax and upper part of abdomen. The underlying soft tissues and bones of the thorax along with peritoneum, transverse colon, some coils of intestines and liver were exposed. Flap of skin over the upper half of the thorax were missing with thoracic organs visible through intercostal spaces. Disarticulation of the right 6th rib at the level of costochondral junction, the costal arch from the sternum and the left costal arch from sternum. All disarticulated margins were pale in colour with the intercostal muscles of the upper six ribs on both sides being disrupted and separated. Another Incised wound was present on right breast and left breast with removal of the entire breast tissue, areola, and nipple along with pectoralis major and minor muscles. The margins of the wound were pale and clean cut with multiple sharp angles with no extravasation of blood in underlying soft tissue with exposed muscle darkened (Fig 5).

The left lung, heart and liver were completely severed at their attachments and loosely placed in their anatomical positions by the casualty doctor. All of the internal organs were pale. The morphology of the injuries suggested that they had been inflicted by a sharp instrument and had been cut off by several incisions, as indicated by many sharp-angled skin ends and superficial cut wounds. Massive blood aspiration, soft tissue hemorrhage surrounding the lesions and pallor of the inner organs as signs of bleeding out, were present, indicating that the injuries over neck were vital. Death was attributed to massive neck injuries with decapitation in combination with blood loss. The absence of ligature marks on the hands and feet of the deceased and negative chemical analysis report indicates that the perpetrator has probably overpowered her while she was sleeping and also due to the advanced age of the deceased.

Discussion:

Decapitation, which is the severing of the head from the rest of the body, was commonly used as a method of carrying out capital punishment and followed in certain countries even today.[9] In recent headlines, beheadings are increasingly being used as a propaganda tool as well as to carry out hostage killings by many terrorists and insurgent groups.[10,11] Complete and sole decapitation without any further mutilation of the victim is rare. Decapitation has been reported in accidental, suicidal, and homicidal deaths, wherein accidental and suicidal deaths take precedence over homicidal in India. Among suicides, decapitation can be seen in hanging deaths and train trespassing pedestrian fatalities which is also one of the commonest causes of accidental deaths in India, having a robust rail system.[12–14,] Another avenue of accidental deaths is road traffic accidents. A case has even been reported of decapitation in a motorcycle accident.[15] Occasionally, it might be difficult for the forensic pathologist to distinguish between the different modes of death in cases of decapitation. Homicide can be confirmed since part of vital decapitation is indicated at autopsy by a strong vital reaction in the wound margins, massive blood aspiration, and signs of external blood loss. In this case, the finding of complete vital decapitation using a sharp tool, together with the morphology of the wound margins on both ends of the disconnected vertebral column exhibiting countless grooves, any other mode of death could easily be excluded, and the decapitation could be concluded as the primary cause of death. Postmortem mutilation or dismemberment of a corpse is considered a more hideous crime than the actual homicide itself. During the Middle Ages, criminals committing grave crimes were sentenced to death, with an additional punishment., dismemberment (truncatio membrorum) of his corpse, with the remains being, for example, scattered to the four winds.[3] Puschel and Koops divide this group of crimes based on the motives that guide the perpetrators into sexual perversions, psychoses and affects. Perpetrators governed by sexual motives mutilate the corpse in a way that does not raise any doubt as to their motivation, most commonly severing the genital organs or breasts. In some cases, the perpetrator pulls out abdominal organs through the disrupted genital tract.[8] The division into defensive and offensive mutilations was proposed by Ziemke in 1918.[16] In 1987, Puschel and Koops extended this classification to include aggressive mutilations and necromaniac mutilations.[8]

The perpetrators of crime act mostly with the aim of facilitating body removal, covering up the traces of the crime and hindering identification known as defensive mutilation. In aggressive mutilation they are motivated by aggression against the victim, expressed after the victim's death. Dismemberment that accompanies lust murder or necrosadistic murders, i.e., offensive mutilation and winning a trophy as a fetish, i.e., necromaniac mutilation are another two types of mutilation.[17,18] Based on the history and crime scene aggressive mutilation was suggested for our case.

Parricides are defined as the killing of a parent or near relative. It is divided into two categories: adolescents which are often linked to stories of abuse or mistreatment and adults which are usually perpetrated by individuals of psychiatric disorders with conflictual relationships. Some studies have analysed the reasons for parricide and have revealed that parricide could increase in the presence of mental disorders or in the absence of adequate treatment in subjects with psychiatric disorders. Moreover, the attackers are usually suffering from schizophrenia with symptoms of active psychosis at the time of the crime and persecutory motivation is often evident.[19–23] Also dismemberment of a body after death may be a manifestation of a significant psychiatric illness and the crime is usually done at the home of the victim, with the use of weapons which are more conveniently available, which was just the matter in our case.

Conclusion:

The combination of death scene findings and autopsy results will in most decapitations allow to distinguish between homicidal and other modes of death. Postmortem decapitation or vital complete decapitation with sharp tools and the presence of additional injuries (vital or post-mortem infliction) as signs of aggressive mutilation or offensive mutilation always indicates the homicidal nature of the act. Homicides ending with mutilation or

dismemberment are most commonly committed by those who are close to or related to the victim. It is generally prepared at the site of homicide and is not generally pre planned. Further, the case showed a unique relationship between parricide/ homicide, dismemberment, and a lack of antipsychotic treatment in the murderer with mental illness.

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CASE REPORT

Fatality following Deliberate Ingestion of a Chemical Hardener: Two Case Reports of Methyl Ethyl Ketone Peroxide Poisoning

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Abstract:

Industrial chemicals and solvents are usually highly toxic and often corrosive. In India, intentional poisoning by industrial chemicals is relatively uncommon. Methyl ethyl ketone peroxide (MEKP), an organic peroxide, is used as a chemical hardener in industries to cross-link polymers. We report two cases of intentional ingestion of this chemical hardener who presented to the Emergency with complaints of severe abdominal pain and multiple episodes of hematemesis. Despite treatment, they succumbed to death within twelve hours and seven days of ingestion, respectively. On autopsy and histopathology, corrosive features were seen in the esophagus and stomach. The pathophysiology is due to the free radicals derived from MEKP causing lipid peroxidation and cell death. Though the MEKP was not detected in the viscera during the chemical analysis, the evidence from the crime scene investigation and other collaborative sources strongly suggests that the poisoning is due to MEKP. This case emphasizes the significance of clinical presentation, autopsy findings, histopathological features, crime scene investigation, and utilizing appropriate preservatives for chemical analysis in uncommon cases like MEKP poisoning. MEKP ingestions are relatively rare in the literature, with only about thirty reported cases associated with increased mortality and morbidity. These cases highlight the role of crime scene visits and emphasize the clinical, post-mortem findings and histopathological features in an uncommon case of MEKP poisoning. In these cases, the workplace being the source of acquiring MEKP, provisions for safe storage and keeping container count prohibit misapplication.

Keywords: Chemical hardener; Methyl ethyl ketone peroxidase; Corrosive; Poisoning.

Background:

Methyl ethyl ketone peroxide (MEKP) is an organic peroxide available as a colorless liquid and industrial solvent which is highly toxic. It has a minimal acetone-like odor and is used as a catalyst due to its substantial oxidizing property.[1] The history of MEKP begins with experimental work in Germany in the late 1900s and was patented in the mid-1930s and introduced to the public in 1949.[2]

It is commonly used as a hardening agent in fiberglass industries,[2] lamination processes, manufacturing hulls of boats, etc. It is also used as an ingredient in acrylic paints[3] and varnishes. Exposure to MEKP can cause chemical burns and lead to the release of free radicals. Since MEKP has an inherent organic peroxide, it possesses an explosive property in its native form, and slight mechanical shock can explode.[3] Hence, it is commercially available as a 40-60% solution with stabilizing agents such as dimethyl phthalate (DMP),[2,4] cyclohexane peroxide or diallyl phthalate to prevent its decomposition and explosion. Inhalation of MEKP or its direct contact with skin and eyes can cause local corrosive effects.[3] Ingestion of any amount can cause death due to its corrosive and systemic effects. Herein, we report two cases of MEKP poisoning.

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Case 1:

A thirty-three-year-old male was taken to a nearby primary health care center after ingesting about 200 ml of an unidentified liquid from an unlabeled bottle at his residence. He was referred to our tertiary care center with a low pulse rate and non-recordable blood pressure. Upon admission, he had about 15 – 20 episodes of blood vomiting and passage of greenish-brown loose stools. Blood investigations revealed a rise in hemoglobin level to 18.7 gm %, red blood cell count 6.55 million/mm,[3] and hematocrit was 58.2%. There was an initial increase in liver parameters, mainly Aspartate transaminase (AST) and Lactate dehydrogenase (LDH), to 226 and 755 U/L, respectively but then began to reduce subsequently. He was intubated due to a non-palpable pulse and severe respiratory distress and died within 12 hours of ingestion. The body was sent for post-mortem examination with an alleged history of consumption of an unknown chemical liquid. Following an inquiry with family members and co-workers, it was found that he had consumed a colorless liquid brought from his workplace.

During the autopsy, no external injuries were present. Conjunctiva was found congested, with bluish discoloration of the nail beds. On opening the abdominal cavity, about 500ml of blood-tinged fluid was present. Multiple petechial hemorrhages along the inter-lobar fissures of both lungs were present. On the cut section, hemorrhagic spots were present in the left lung. Upon

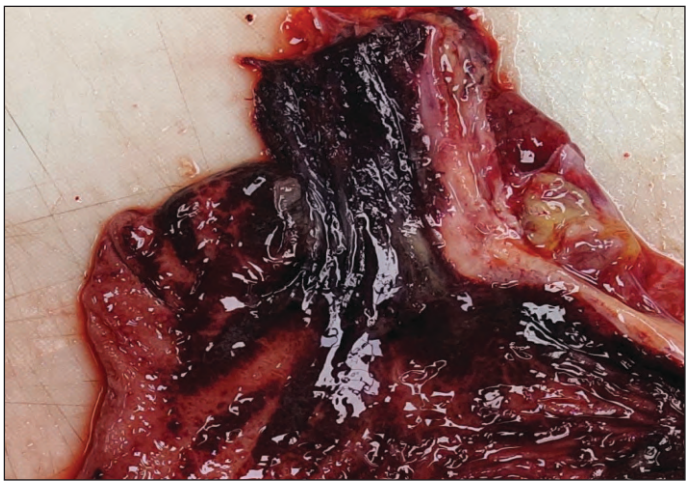

Fig.1a – Shows blackish eroded and hemorrhagic esophageal mucosa.

opening the esophagus, the inner surface was blackish with eroded and hemorrhagic mucosa (Fig.1a). The stomach contained around 500 ml of dark reddish brown colored fluid. The mucosa was eroded and hemorrhagic, with the thickening of the pyloric antrum extending along the rugae (Fig.1b). Other organs were mainly unremarkable.

Histopathology revealed features of loss of mucosal architecture and extensive hemorrhage in mucosa with corrosive ischemic necrosis of the esophagus (Fig.2a). The stomach had focal hemorrhages with lymphocytic aggregates, extensive mucosal hemorrhage with ulceration, and ischemic mucosal necrosis (Fig.2b). Small Intestine had extensive mucosal hemorrhage with ulceration and ischemic mucosal necrosis (Fig.2c). Lungs had alveolar edema and hemorrhage (Fig.3). The liver had micro and macro-vesicular steatosis with mild peri-portal inflammation. Routine viscera were preserved in a saturated salt solution and sent for chemical analysis, which did not detect any poison, toxins, or alcohol. The opinion as to the cause of death was due to alveolar edema and pulmonary hemorrhage.

Case 2:

A twenty-five-year-old male worker in a small boat manufacturing company deliberately ingested 100 ml of MEKP at his residence, which he brought from the workplace. He presented to our tertiary care center with complaints of a burning throat sensation, multiple episodes of bloody vomiting, and abdominal pain. Initially, the physicians managed symptomatically, but his condition progressively worsened. Urea and creatinine levels increased from 16 mg/dl and 0.9 mg/dl on day 1 to 85mg/dl and 2.6mg/dl on day 7, respectively. Hemoglobin levels reduced to 6.3mg/dl. He succumbed on the seventh day. During the autopsy, mucosa of the laryngopharynx, esophagus, and gastric mucosa were found eroded and hemorrhagic. Near the pyloric end of the stomach, mucosa had greenish-black discoloration and thickening with leather-like consistency. Other organs were unremarkable. Viscera were preserved for chemical analysis in rectified spirit. On histopathological examination, the laryngopharynx showed ulcerated mucosa and submucosal tissue congested with inflammatory cells (Fig.4). Stomach and esophagus showed

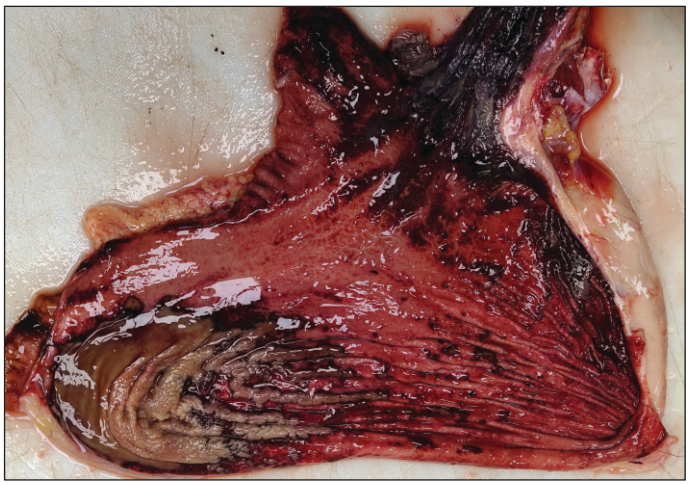

Fig.1b– Shows eroded and hemorrhagic stomach mucosa with thickening.

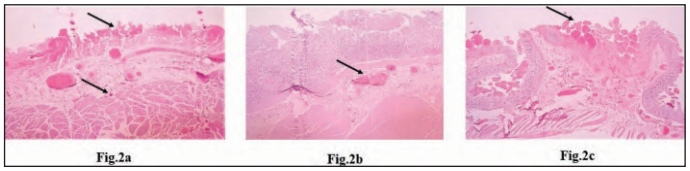

Fig.2a– Esophagus showing loss of mucosal architecture and extensive hemorrhage in mucosa with corrosive ischemic necrosis. H & E 10x.
Fig.2b–Stomach showing focal haemorrhages with lymphocytic aggregates. H & E 20x.
Fig.2c– Intestine showing extensive mucosal haemorrhage with ulceration and ischemic mucosal necrosis. H & E 20x.

ulcerated mucosa and congestion of the wall (Fig.5 and Fig.6). Lungs showed intra-alveolar edema and hemorrhage with acute inflammatory infiltrates and pneumonia-related changes. The chemical analysis of viscera could not detect MEKP or its metabolites. The cause of death was opined multi-organ dysfunction, primarily in the lungs and kidneys.

Discussion:

MEKP is highly hazardous for its highly reactive oxidizing property. It is associated with increased mortality and morbidity. Poisoning through accidental ingestion is more common for its colorless and odorless nature at the workplace than intentional ingestion. However, in both cases, the manner of consumption was suicidal. Chronic exposure and toxicity in unprotected workers in direct contact with this catalyst are expected. MEKP ingestion produces a variety of symptoms, such as airway obstruction due to edema, gastrointestinal bleeding, necrosis and perforation, esophageal stricture, inhalational pneumonitis, optic disc atrophy, severe metabolic acidosis, rapid liver and kidney failure, neurological damage, coagulopathy, and respiratory insufficiency.[3-7] In both cases, the deceased was using MEKP, as it enhances the durability and strength of fiberglass when mixed with polyester resins. The catalytic role of MEKP in the vulcanization process offers more strength and makes it extremely hard.

$$\text{Fiberglass+ Polyester resins} \xrightarrow{\boxed{\text{MEKP}}} \text{Vulcanization} \rightarrow \text{Hardening of ester resins.}^{[8]}$$

(Cross-linking laid across polyester resins)

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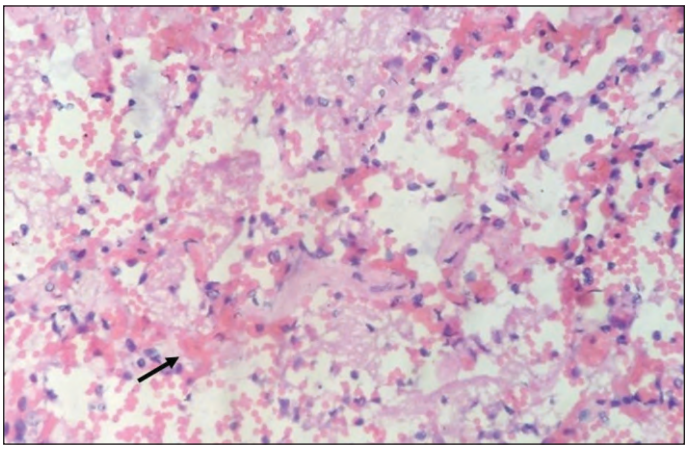

Fig.3– Lung showing alveolar edema and haemorrhage. H & E 40x.

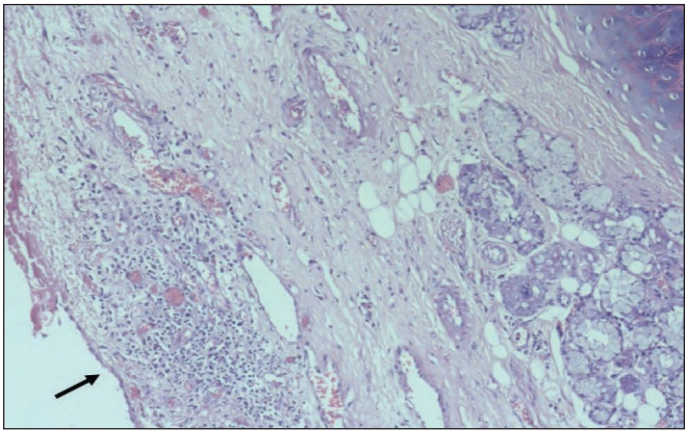

Fig.4 – Laryngopharynx showing ulcerated mucosa and sub-mucosal tissue congested with inflammatory cells. H&E 200x.

Very few cases have been reported of this poisoning since the availability is limited to one's occupation. The toxic oral dose of the commercially available MEKP is 50 to 100 ml.[1,8] On ingestion, it breaks into methyl ethyl ketone (MEK) and peroxide group, which releases free radicals causing peroxidation of lipids leading to cell death. The gastrointestinal damage is due to the direct corrosive effect, while the damage to other organs is due to the absorbed MEKP.[1]

$MEKP = MEK + H_2O_2$

Free radical→ Peroxidation of lipids→ Cell death (GI cells & Hepatocytes)

In the first case, the deceased had multiple episodes of hematemesis and bloody loose stools. The raised hemoglobin and hematocrit were due to the haemo-concentration caused by dehydration and hypovolemia. The initial rise in liver parameters was due to ischemic hepatocyte damage caused by hypovolemia and dehydration. It then subsequently came back to normal limits by blood and fluid resuscitation. The alveolar hemorrhage was attributed due to free radical damage. The esophageal and stomach mucosa was blackish and hemorrhagic due to erosion owing to corrosive action. The antral and pyloric thickening of stomach mucosa was due to coagulative necrosis by the direct effect of the poison. However, the chemical analysis of the viscera couldn't detect the poison. We had to rely on the clinical

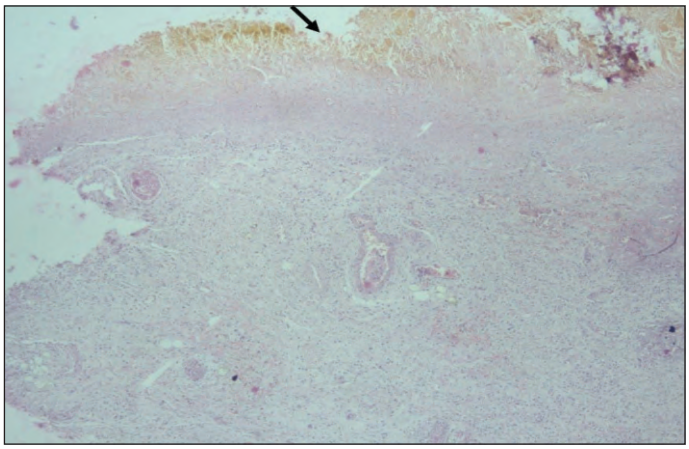

Fig.5 – Stomach and esophagus showing ulcerated mucosa and congestion of wall. H&E 100x.

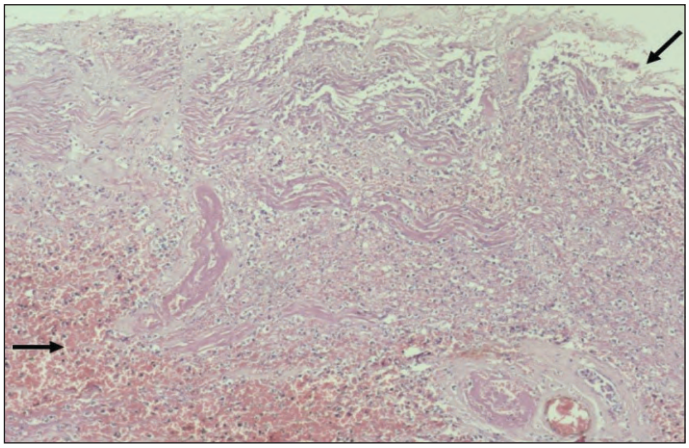

Fig.6 - Esophagus showing ulcerated mucosa and congestion of wall. H&E 200x.

picture, autopsy, and histopathologic findings to correlate features of corrosive poison. Following an inquiry with family members and co-workers, it was found that he had consumed a colorless liquid brought from his workplace. A visit to the deceased's workplace revealed that the water-like liquid consumed was MEKP, which was transferred into disposable unlabeled water bottles for day-to-day utility. In the second case, features present in the esophagus and stomach were due to the direct corrosive effect of the poison, which on aspiration, caused the mucosal ulceration of the laryngopharynx. The rise in renal parameters was due to free radical damage. Upon survival for a week, pulmonary edema and hemorrhage were complicated by pneumonia. Though the viscera were preserved in rectified spirit, MEKP could not be detected in chemical analysis owing to complete metabolism and excretion. In both cases, the chemical analysis of the viscera did not detect MEKP. In the first case, since we were skeptical of the substance used, saturated salt solution was used as a preservative which was ineffective in detecting MEKP. In the second case, although the samples were preserved in rectified spirit (preferred in corrosives), MEKP was not detected since the patient survived for one week. Further research and reports on MEKP poisoning are essential especially when the patient survived for a shorter duration.

Bates and his associates reported accidental ingestion of

commercially available MEKP by a six-year-old child who initially presented with severe esophageal and gastric burns and coagulopathy.[7] After three months, He subsequently developed a stricture of the gastro-esophageal junction and complete fibrosis of the middle third of the stomach. The pathophysiology of acute intoxication of MEKP has been discussed in four stages.[5,9,10] First, there will be respiratory signs like airway obstruction due to edema, subsequent mucosal damage in airway structures, and associated upper gastrointestinal symptoms like vomiting, hemorrhage, perforation, etc. The second stage is mediated by free radical damage to organs, causing harmful effects to the liver and gastrointestinal tract, and the most commonly targeted cells are the hepatocytes & kidneys. Karhunen et al.[4] reported an acute case where histo-pathological findings of the liver revealed massive periportal hepatic necrosis and atypical pseudo-ductular proliferation. In our first case, a histopathological examination of the liver showed micro and macro-vesicular steatosis and mild periportal inflammation. Thirdly, there will be complications due to organic acids liberated by the disintegration of MEKP. Finally, secondary complications such as renal failure due to rhabdomyolysis, ventilator-associated pneumonia, respiratory distress syndrome, and myocarditis can be seen in the fourth stage.

Zeiger's experimental animal study of topical application of MEKP over mice showed extensive coagulative necrosis of the skin layers and epidermal regeneration and hyperplasia. Secondary to dermal lesions included increased spleen hematopoiesis, increased bone marrow myeloid hyperplasia, and dose-dependent liver hypertrophy at higher doses.[8] MEKP may disintegrate into organic acids such as formic acid leading to a wide range of complications. Van Enckevort et al.[5] reported a case in which MEKP caused severe metabolic acidosis due to formic acid accumulation leading to optic nerve lesions. Long-term exposure to the vapors of this chemical solvent may be categorized into occupational hazards. The workers must follow safety precautions. In the instant cases, chemical analysis of viscera did not detect MEKP due to its property of rapid breakdown.[10] Reasons for not detecting the metabolites of MEKP may be attributed to the following:

a) Inappropriate preservation of viscera in saturated salt solution instead of rectified spirit, leading to the neutralization of MEKP.

b) Unstable nature of the metabolites of MEKP.

c) No proper analytical method was devised.

Conclusions:

The first case highlights the importance of a crime scene visit to the workplace that helps in unveiling the causative agent behind the corrosive features. The second case highlights the clinical features, laboratory investigations, autopsy findings, and other ancillary investigations like histopathological examination in MEKP poisoning. When it comes to detecting the presence of a specific uncommon poison like MEKP, choosing the appropriate preservative is the key. The appropriate preservative can help maintain the stability and integrity of the poison, increasing the chances of its detection during subsequent laboratory analyses. While chemical analysis reports are important in toxicological investigations, a negative result does not definitively exclude the possibility of poisoning. Therefore, ancillary investigations like histopathological examination can assist in reaching a conclusive diagnosis. The need for more data and reports on MEKP toxicity is essential to detect this poisoning in the future.

List of Abbreviations: MEKP – Methyl Ethyl Ketone Peroxide

DMP – Dimethyl phthalate **AST** – Aspartate transaminase

LDH– Lactate dehydrogenase

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CASE REPORT

A Neck Pain Alone Causing Death?

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Abstract:

Neck pain is pain in or around the spine beneath the head. It is a common symptom of many injuries and medical conditions which can be acute or chronic. Common causes of neck pain are increased physical strain, trauma, osteoarthritis, rheumatoid arthritis, meningitis, tumours of spine etc. Most cases of acute neck pain can resolve with or without treatment. But red flags which may signify serious pathologies such as myelopathy, atlantoaxial subluxation, meningitis, metastasis etc. should be promptly identified. A 29 year old male with complaints of neck pain was brought to the casualty of a local hospital in Thiruvananthapuram and expired after 6 hours due to cardiac arrest. The autopsy revealed a mass in the fourth ventricle. Cause of death was brain oedema following tumour in fourth ventricle.

Keywords: Neck pain; Tumour; Brain oedema; Mass in fourth ventricle.

Introduction:

Hamartoma lesions anywhere in the body are considered as rare entities and Lhermitte-Duclos Disease (LDD) or dysplastic gangliocytoma of cerebellum is an extremely rare hamartoma. It is a congenital malformation which is classified as a hamartoma. Lhermitte-Duclos disease arises in the cerebellum and is a unique tumour. Although it has characteristics of a benign neoplasm since categorized as a WHO grade 1 tumour histologically, it is more hamartomatous, containing dysplastic cells in an enlarged abnormal cerebellar folium.[1] There is no gender preference and whilst the condition is mostly diagnosed in the second and third decade of life with posterior fossa symptoms,[2] rare cases with childhood onset were also reported.[3] It has chances for recurrence otherwise no reports of malignant transformation have been found. Here a case is discussed which showed a different presentation.

Case report:

A 29 year old male with no previous comorbidities developed sudden onset of dizziness and vomiting. He went to a local hospital where he was diagnosed as benign paroxysmal positional vertigo and was conservatively managed. After three weeks, his symptoms persisted and developed neck pain. On examination, the patient had elevated blood pressure for which he was given antihypertensives and referred to an orthopaedician who advised conservative management.

Patient consulted another hospital where he was advised to take an MRI scan of his brain. The MRI scan of the brain showed an ill-defined parenchymal mass lesion measuring 4.5x3.5x5.5 cm involving inferior cerebellar vermis appearing heterogeneously hypointense on T1WI, hyperintense on T2 FLAIR sequence with a striated appearance. The lesion was protruding into and narrowing fourth ventricle causing obstructive hydrocephalus with inferior herniation of cerebellar tonsils along with diffuse effacement of cerebral sulcus and sylvian fissures. He collapsed after the MRI scan and despite all resuscitative efforts, the patient expired.

The body was brought for autopsy to the mortuary wing of Govt. Medical college, Thiruvananthapuram. On dissection, brain was congested, showed signs of raised intracranial tension and weighed 2241g. A soft mass of size 5x3.5x3 cm was present in the fourth ventricle arising from the left side of the cerebellum. The mass was sent for histopathological examination which revealed deranged laminar cellular organisation, loss of purkinje cell layer and infiltration of granular cell layer with dysplastic ganglion cells. It was diagnosed as dysplastic gangliocytoma of the cerebellum (otherwise known as Lhermitte-Duclos disease).

Discussion:

Lhermitte and Duclos first described the cerebellar dysplastic gangliocytoma in 1920. They reported on a 36-year-old man who suffered occipital headaches and diminished hearing on the left side that was progressive over 10 months. During the few weeks before his presentation he suffered paroxysmal vertigo with recurrent falls, gait ataxia, disorientation, and memory deficits. At the time of admission, he exhibited confusion, disorientation, dysarthria, nystagmus, and cerebellar ataxia. His condition worsened and he died.[2] Lhermitte - Duclos Disease is a very rare hamartomatous lesion. It is associated with Cowden's syndrome and is classfied as a phakomatoses/phacomatosis pigmentovascularis which includes rare disorders arising from embryonic ectoderm. These disorders have a cutaneous and neurological involvement, often with dysplasia of other organs. The typical presentation includes cerebellar ataxia, lower cranial nerve palsies, signs and symptoms of raised intracranial pressure and visual disturbances.[1]

It usually affects patients aged 30-50 years, even though in rare

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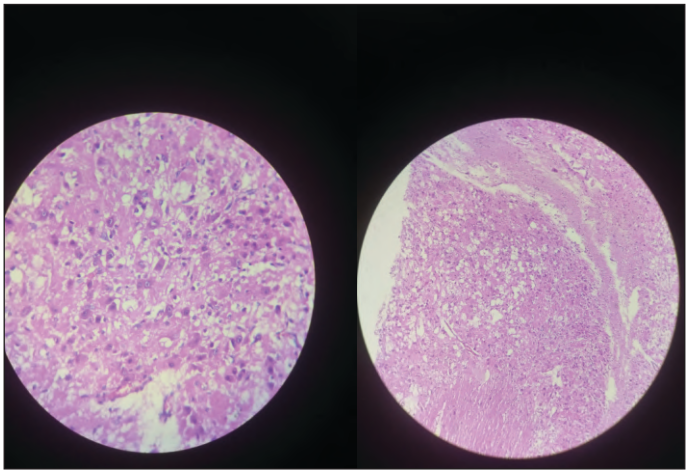

cases, it is found in infants and adults over 60 years of age. There is no known sex or race preference. There is difference of opinion regarding the cause of this disease: it can be hamartomatous, neoplastic, or congenital malformative origin. There can be associated malformations like macrocephaly, syringomyelia, polydactyly, multiple haemangiomas and mucocutaneous lesions as well as breast, thyroid and gastrointestinal malignancies. Hence, a genetic correlation between Lhermitte- Duclos disease and Cowden's syndrome has been postulated.[1,2,4,5]

Small tumours may be asymptomatic or only present with comparatively subtle cerebellar signs. Since the tumour grows very slowly, the onset of any symptoms is gradual. When the tumour increased in size, the signs and symptoms are due to raised intracranial pressure, obstructive hydrocephalus or cerebellar signs.[2]

Lhermitte- Duclos disease is a germline loss of the PTEN allele and the subsequent loss of the second allele leading to pathological growth of the granular cells along with additional mutations in the EGFR and SDHB-D. Due to the rarity of this disease, clinical diagnosis can be challenging. Imaging, however, is crucial, and the typical appearance of 'tiger stripes' on T2 MRI can be pathognomonic for Lhermitte- Duclos disease which is also known as corduroy or laminated appearance. The lesion is described as focal, well-circumscribed, isolated to a single cerebellar hemisphere with a characteristic gyri- form pattern and hypertrophy of the folia as the dysplastic ganglionic cells infiltrate and hypertrophy in the granular layer of the cerebellum. MRI scan is very sensitive in detecting enlarged folia with T2 showing the characteristic tigroid appearance, which is considered specific.[1,4-6]

The initial treatment is based on treating hydrocephalus. Surgical resection is almost curative in most cases with few cases of recurrence. Since there is a possible association to Cowden's syndrome, increased risk of other neoplasms should be expected. Therefore, a recommendation for further imaging or clinical assessment of possible tumours should be included.[7,8]

The significance of identifying such rare conditions is to widen the spectra of differential diagnosis for physicians and extend the investigations keeping in mind such unique diseases also. Thus a timely diagnosis may not only save a life but also prevent occurrences of medical negligence in the future.

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REVIEW ARTICLE

DNA Finger priniting in Indian Criminal Justice system: Future Prespectives

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Abstract:

DNA Fingerprinting has brought a new revolution in the crime scene analysis in the recent years. It has helped to identify the criminal and absolve the innocent in many crimes and is also being used extensively for identification purposes and determining the biological parentage of an individual. Human DNA profiling on one hand is proving extremely useful in providing justice, but on the other hand its regulation is imperative to ensure its use only for lawful purposes. DNA profiling is scientific, reliable and unbiased. The main areas of concern are the cost effectiveness, lack of experts, sample collection and preservation and avoiding errors like cross contamination. Much needs to be done both at technical and at medico-legal fronts before making full use of the potentials of DNA profiling.

Keywords: DNA fingerprinting; Crime; Justice; Criminal Law.

Introduction:

Crime has always been and will be a part of human civilization. Forensic science aims to collect the evidence that may be helpful in proving or disproving the association of an individual to a particular crime. Forensic DNA analysis or DNA Fingerprinting has transformed the criminal investigation all over the world. DNA fingerprinting has added new dimensions to crime investigations and has proved to be very helpful to police and judicial system. Databanks are planned to be set up at both national and regional levels to store DNA profiles received from accredited labs. Collection, preservation and transportation are the integral part of DNA fingerprinting. DNA fingerprinting has proved useful in various areas like -

- Paternity conflicts
- Sexual assaults
- Crime scenes
- Mass Disasters

Earlier forensic scientists were using techniques like blood grouping, HLA typing and isozyme grouping on the biological samples found at crime scenes.[1] These tests used proteins, which get naturally degraded and denatured. Thus, there was necessity for some living material which is stable and at the same time variable and individual specific.[2] The discovery of DNA fingerprinting proved to be exactly the biological material needed. DNA fingerprinting has had a major impact on the criminal law after it was first used in 1980's. It has been extensively used in criminal law to establish guilt or innocence, establish paternity in family law and also prove blood relationships or to establish citizenship in immigration law and identification purposes in mass disasters.[3] Legal system has now given DNA fingerprinting the exact credit that nature has given it, it is referred as "The blue print of life".

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What is DNA fingerprinting?

DNA is the carrier of genetic traits. On September 10,1984, Prof. Alec Jeffreys and his team at Leicester university identified a 'barcode' and realized that this barcode can be used as an identification tool for living things. Except in the case of identical twins, a part of the DNA varies from individual to individual. Some portion of DNA is thus as unique to an individual as fingerprint.[4] Alec Jeffreys and his colleagues named the process for isolating and reading these DNA markers as "DNA Fingerprinting". This provides a full proof method of establishing identity of a person. The first case where DNA was used was in 1983 in Leicestershire village of Narborough involving the rape and murder of two 15-year-old girls.

DNA fingerprinting is a technique that detects DNA portion unique for every individual. It is an extensive process that involves molecular biology, genetics and analysis. DNA analysis is a reliable tool for resolving certain critical issues in crime investigation.[5] A major portion of DNA is the same, it is only 0.1% DNA that is unique. Forensic scientists go through 15 different regions of DNA fragment and use this data to create a DNA profile of that individual. In criminal cases, DNA is extracted from different samples like hair, nail, bone skin etc and analysed for the presence specific DNA regions (markers). When we talk about DNA fingerprinting, we often tend to think of television shows like CID or CSI, in which DNA sample is collected, sent to lab and within minutes suspect is identified. The real picture of DNA analysis is entirely different because it is often not possible to get adequate and perfect sample of DNA from crime scenes. Contamination of DNA samples or " DNA mixtures" because of being handled by more than one person and degradation of the sample available are some major issues faced by forensic experts at crime scenes.

Techologies used in fingerprinting –

(i) Restriction Fragment Length Polymorphism (RFLP)- This was first technique that was adopted for forensic DNA analysis, but it required a greater amount of better quality DNA.

(ii) PCR Analysis- In Polymerase Chain Reaction (PCR) exact copies of DNA are made from the available biological samples. Hence small amount of DNA is sufficient for analysis.

(iii) STR Analysis- This is the most recent method of DNA profiling. Short tandem repeat (STR) is also called microsatellite analysis has advantage of higher discrimination and also lesser time is required to obtain results. It also needs a smaller sample size. STRs are locations (loci) on chromosome that repeat within the DNA. The repeat sequence is of 3-7 bases, the entire length of STR is less than 400 bases. So, the susceptibility of STRs to degradation is less and it can be obtained even from bodies or stains that have undergone decomposition. The "Federal Bureau of Investigation (FBI)" employs a standard set of thirteen specific STR region.

The steps in STR analysis are as follows:

- Extract and purify DNA from biological sample.
- Amplify selected genetic markers through polymerase chain reaction.
- Genotyping.
- Statistical analysis and final interpretation of the DNA sample.

(IV) Mitochondrial DNA analysis (mt DNA) mt DNA is valuable in investigation of long standing unsolved cases.[6] Older biological samples like hair, bones and teeth can be analysed with mt DNA. Mitochondrial DNA is proving to be useful in maternity disputes because mitochondria is from mother's egg cell. Male sperm contributes only nuclear DNA to the embryo.

(V) Y-chromosome Analysis- The Y-chromosome passes from father to son and hence proves useful in paternity issues.

(VI) Rapid DNA ID Microchip-based Genetic Detectors- this included laptop analysis units that can be used at crime scenes.

Applications of DNA Fingerprinting: DNA fingerprinting has proved to be of utmost importance in both civil and criminal cases

(A) Civil Cases

1. To prove paternity/maternity of an individual
2. Solve 'switched babies' cases
3. Determine the immigration status
4. Identify victims of accident, fire, natural disasters etc
5. Forming family lineage

(B) Criminal Cases

1. Solve murder crimes
2. Link a victim and culprit in sexual assaults

Figure 1. DNA Fingerprinting.

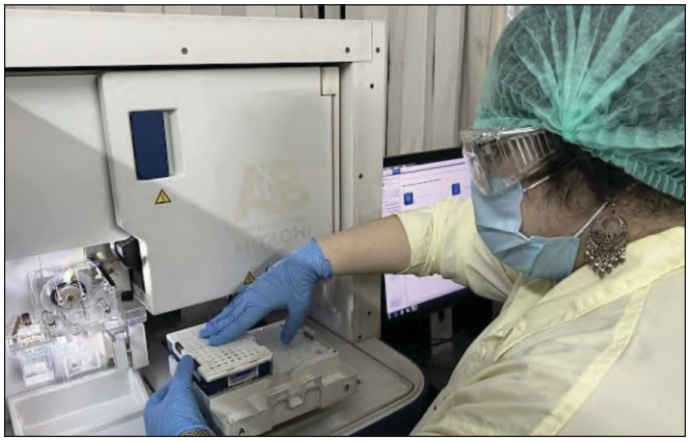

Figure 2. DNA forensic lab in India.

3. Identify mutilated bodies and skeletons or remains.
5. Solve crimes involving animals
6. Solve crimes involving plants or poisons.

DNA Fingerprinting- Scenario in India- DNA fingerprinting is extensively being used in India especially in cases of unidentified bodies, paternity and maternity issues and sexual assault cases to establish link between victim and accused.[7] The method of DNA profiling being done in India is PCR and STR. Dr. Lalji Singh was the first Indian to use this technology of DNA fingerprinting in 1988. He is called the "Father of DNA fingerprinting". Though many states have their own forensic DNA fingerprinting lab, still there is a need of many more. In the state of Rajasthan, there are presently three labs, one each in Jaipur, Jodhpur and Ajmer. The central government labs are also there, state of art lab doing extensive DNA profiling is the " Centre for DNA fingerprinting and diagnostics (CDFD), Hyderabad". It is now possible to identify an unidentified or decomposed body even if a fragment of bone is available. In mass disasters, it is now easier to identify persons by this technology.[8] Question of bacterial, other microorganism or foreign DNA contamination does exist but newer techniques of DNA collection, sampling and transportation are overcoming these issues. These techniques are helping the judicial system of India to provide justice in cases of crimes as early as possible in the courts of law.[9] National DNA

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databanks are planned to be set up in India soon . Many countries already have databanks. When a DNA sample of a suspect from a crime scene matches the DNA from a National databank, that link is known as "Cold Hit". Cold Hit is very helpful to the police to identify the accused. Touch DNA is proving to be very useful in crime scene forensic investigations.[10]

DNA Profiling and Constitutional and Legal Provisions in India-

The fundamental legal document is the Indian Constitution. Part III of our constitution guarantees Fundamental Rights of freedom to the people of India.

Article 20(3) of the Constitution provides safety of an individual from being a witness against himself. Further, Article 21 prohibits unauthorised interference in the life and personal freedom of each person. Hence DNA profiling technology must meet the requirements of Article20(3) and 21 of the Constitution.

"Code of Criminal Procedure (CrPC)" under section 53 and 53-A establishes the framework for DNA profiling of persons in criminal investigations. "Section 53(1) provides for DNA profiling of the accused at the request of the Police. Section 53A also provides for DNA profiling of those accused of rape. The Indian Evidence Act 1872, under sections 45-51, provides for the "admissibility of expert opinion as a relevant fact in courts."

Article 21 of The Constitution of India declares that "No person shall be deprived of his life or personal liberty except according to procedure established by law".[11] The Indian Supreme Court declared DNA profiling to be a reliable and effective technique to compare suspect DNA with sample DNA collected at the crime scene.[12] DNA evidence is now a predominant forensic technology to identify criminals.

DNA fingerprinting is not considered as evidence under Indian Evidence Act 1872 and Criminal Procedure Code 1973. DNA needs to be properly collected, preserved and documented before being presented to the court as evidence.[13] Section 53 of Code of Criminal Procedure 1973 gives authority to a police officer to get the assistance of a medical practitioner for investigation purpose."

The amendment of CrPC by the CrPC (Amendment) Act ,2005 includes two new sections. This allows the investigator to collect DNA samples from the body of the individual accused and the victim with the help and under the guidance of a medical practitioner. Still there are doubts about presenting DNA as evidence in courts even though courts do not deny the accuracy and reliability of DNA fingerprinting. There is a definite and urgent need to re-examine these sections of Criminal law so as to manage the science and technological issues in order to provide justice. The DNA technology bill 2019 is to regulate the use of DNA fingerprinting technology in India.

Conclusion:

DNA fingerprinting is a significant development in forensic criminal science. It is being used extensively in forensic and judicial system but new laws need to be implemented for its correct use in legal matters. In coming years, new technologies of DNA fingerprinting are going to revolutionize the legal system of our country. Till date India does not have DNA legislation like Canada and many other countries. Much needs to be done before DNA technology can be used to its full potential for criminal and civil matters. It is however clear and well accepted that DNA fingerprinting will soon emerge to be the most reliable and useful tool in criminal investigation.

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REVIEW ARTICLE

A 10 year Review of Judgments on Alleged Medical Negligence Cases by the Supreme Court of India

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Abstract:

Doctors have obligations to their patients, and if those obligations are broken, they may be considered negligent. More than ever, Indians are aware of their rights as consumers under the Consumer Protection Act (CPA). As a result, more people are suing doctors for medical negligence and turning to redressal forums for assistance in minimising their loss or harm. As a result, it is necessary to recognise and take care of the crucial elements that influence how a case of alleged medical negligence is decided. For this study, a review of rulings from the period of January 2012 to December 2021 (10 years) was taken from the Supreme Court website using a free text search for the term "medical negligence". 63 judgements in total were discovered; 34 of these were excluded, and 29 were included in this study. When compared to medical specialties, surgical specialties are at a higher risk of being sued for medical negligence, according to the examination of the rulings. The majority of lawsuits were brought against obstetrics and gynaecology. Overall, the result favoured doctors and hospitals in 55.2% of the decisions. Medical records were a major factor in the decision in 87.5% of all verdicts in favour of the doctor or hospital. The medical community must accept that there is significant space for improvement in patient care since medical negligence lawsuits against doctors continue to be a major problem in India.

Keywords: Consumer protection act; Judgment; Medical negligence; Medical records; Supreme court.

Introduction:

A contract preserving the core components of tort exists between a doctor and patient. A doctor has obligations to the patient and may be found negligent if those obligations are broken. In order to decide cases of medical negligence brought against physicians and hospitals, courts of law have developed over time while keeping up with contemporary medical practise. The Supreme Court ruled in the 1995 case of V.P. Shanta v. Indian Medical Association that the services provided by medical professionals were within the purview of the Consumer Protection Act (CPA).[1] Indian citizens have grown more conscious of patient rights and the CPA. As a result, more people are suing doctors for medical negligence and turning to redressal forums for assistance in minimising their loss or harm.

Despite a recent trend in India showing an increase in charges of medical negligence brought against hospitals and doctors under the CPA, these accusations are frequently unfounded.[2] Medical professionals frequently find it difficult to defend themselves and must deal with the stress and unpredictability of the legal process. The doctor is frequently subjected to the anger of the family and the community, with insulting remarks being disseminated on social media, in print, and on electronic media without giving the doctor a chance to respond. Given all of this, a doctor may be seen as the second victim in a medical malpractice case.[3] Doctors are frequently unaware of the myriad issues, such as legal intricacies, prior court decisions, etc., that affect the outcome of a medical negligence case. However, the legal system makes an effort to be logical, reasonable, and scientific in making decisions. In India, hospitals and doctors should stay current on court rulings involving medical negligence and the justifications for them. This might enhance patient care and stop such incidents from occurring.

The medical community should keep in mind that if a doctor fails to exercise reasonable care, the party who was wronged will receive justice. Thus, the major factors that help the court/ tribunal decide on a case of medical negligence must be identified and addressed in order to properly prepare healthcare service providers for this litigious age.

Methodology:

This is a narrative analysis based on decisions taken from the Supreme Court of India website (https://main.sci.gov.in /judgments) using a free text search with the phrase "medical negligence" made between January 2012 and December 2021 (10 years).

Inclusion Criteria: Cases where final decision of Supreme Court was pronounced

Exclusion Criteria: Cases which met either of the following

1. Trial is ongoing/ pending
2. Directed by Supreme Court for retrial

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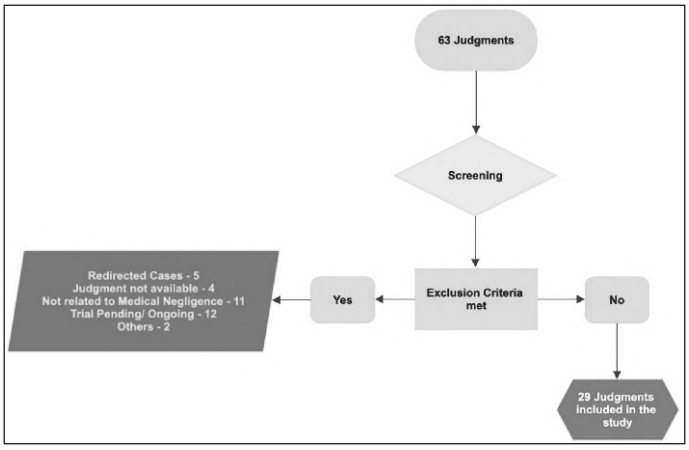
Figure 1. Process of selection of judgments in the study.



3. Non availability of judgment copies
4. Cases not related to medical negligence
5. Others (Complaint not maintainable, final judgment yet to be pronounced, etc.)

Based on this, 63 judgments were downloaded from the Supreme Court of India website. As shown in Figure No. 1, out of these, 29 cases were included in the study while 34 cases were excluded.

The list of cases taken into consideration for this study is given in the Annexure no. 1

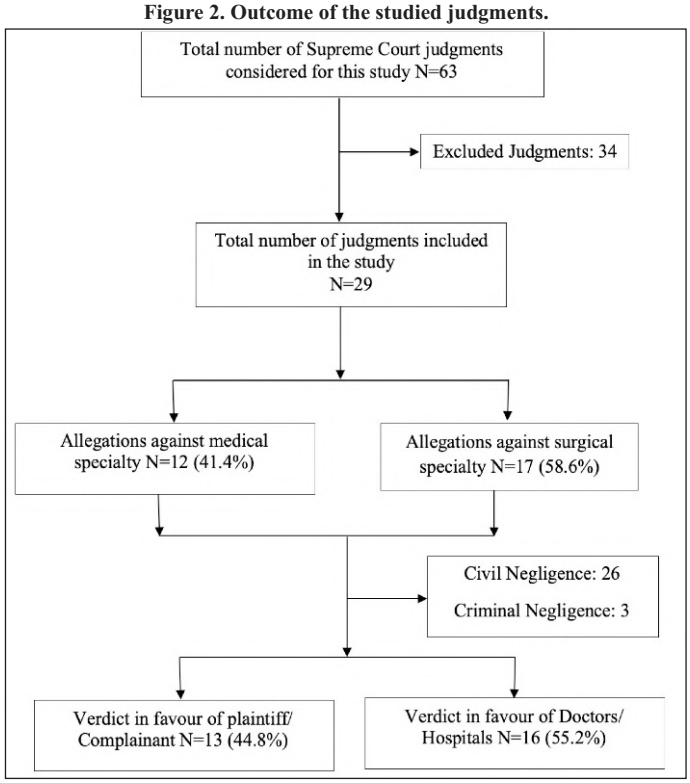
Results:

For this study, a total of 29 Supreme Court rulings were taken into account after screening. Figure No. 2 shows the outcome of the studied rulings.

According to the analysis of the data, claims against the medical and surgical specialties were made in 17 (58.6%) and 12 (41.4%) cases, respectively, out of the 29 judgements. With 7 (24.1%) cases, the Obstetrics & Gynaecology (OBG) specialty received the most allegations, followed by General Surgery and Medicine, each with 6 (20.7%) incidents. Among the 29 cases, 26 (89.7%) were submitted as civil negligence cases (seeking compensation), and 3 (10.3%) as criminal negligence cases (seeking punishment). Table No. 1 highlights the several reasons why medical negligence lawsuits are brought, including concerns with diagnosis, investigation, post-operative care, consent, and referral. According to Table No. 2, Group 2 medical errors accounted for 31% of all alleged medical negligence instances, followed by group 3 and group 4 medical errors, which accounted for 27.6% and 20.7% of cases, respectively.

The primary grounds for accusations of medical negligence in the judgements studied were causing damage to patient in 10 (34.5%) cases and death of patient in 15 (51.7%) cases. The complaints were related to acts of commission and omission in 8 (27.6%) and 17 (58.6%) of the cases, respectively. Only 12 (41.4%) cases involved the court requesting an expert's view, and only 2 (6.9%) involved the doctor arguing contributory negligence as a defence. In three (10.3%) of the cases where the court felt Res Ipsa Loquitur applied, the burden of proof was shifted to the doctors or the hospital, who had to show that they had provided standard

Figure 2. Outcome of the studied judgments.



care in the course of their duty.

13 (44.8%) of the Supreme Court's verdicts found the plaintiff's claim to be true, whereas 16 (55.2%) of the judgements found the doctors not guilty. In 14 (87.5%) of the verdicts in favour of doctors, medical records and paperwork were viewed as essential proof to refute charges of negligence. Finally, the Supreme Court increased the compensation awarded by the lower courts in 6 (20.7%) of the analysed judgements; in one judgement, it affirmed the National Commission's decision to reduce the compensation awarded by the State Commission.

Discussion:

There has been an unprecedented surge of accusations made against the medical community in a time when consumers are well aware of their rights and have access to consumer forums that are flexible and less expensive to contact.[4] An analysis of the data from our study reveals that the surgical specialties were the subject of the most allegations (58.6%), which is consistent with the results of other studies.[2,5-11] Numerous studies have found that surgical specialties are targeted by lawsuits more frequently than medical specialties, a pattern that is not only observed in India but also around the world.[11-14] Even among the surgical specialties, the department of obstetrics and gynaecology received the most complaints, which is consistent with other studies' findings and accounted for 24.1% of the cases. This may be because the mother's health and the life of the unborn child are frequently in jeopardy, and in the event of a bad outcome, the relatives choose to file lawsuits out of an emotional inclination.[3]

The group 2 error, which was seen in 31% of the cases where there were reported medical errors, was followed by the group 4 error

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Table 1. Allegation wise distribution of alleged medical negligence cases

S. No.	Allegation	No. of Cases (%)
1	Failure to do timely investigations	8 (27.6%)
2	Informed written Consent was not taken	3 (10.3%)
3	Timely/ appropriate referral not given	3 (10.3%)
4	Doctor went abroad when patient was under his/her care	2 (6.9%)
5	Failure to examine and treat properly	2 (6.9%)
6	No anaesthetist/non-qualified anaesthetist were present during the surgery/ procedure	2 (6.9%)
7	Pre-anaesthetic check-up was not done	2 (6.9%)
8	Screening of ROP was not done for pre-term baby	2 (6.9%)
9	Telephonic instructions without examining patient	2 (6.9%)
10	Ventilator/ Operation Theatre was not available	2 (6.9%)
11	Administering anaesthesia without proper care	1 (3.5%)
12	Allergic reaction to drug – test dose not given	1 (3.5%)
13	Alternative surgical procedure (Girdle arthroplasty) was chosen over THR	1 (3.5%)
14	Arterial cannulation instead of venous cannulation	1 (3.5%)
15	Biopsy not taken from the diseased site	1 (3.5%)
16	Carelessness led to aortic dissection	1 (3.5%)
17	Cyst was not removed completely	1 (3.5%)
18	Direct blood transfusion	1 (3.5%)
19	Emergency surgery done without ICU facility	1 (3.5%)
20	Failure to administer factor VIII	1 (3.5%)
21	Failure to safeguard while the patient was delirious	1 (3.5%)
22	High dose of Inj. Depomedrol given	1 (3.5%)
23	Ligation of Common bile duct during the surgery which lead necrosis of bile duct	1 (3.5%)
24	Liver failure not diagnosed	1 (3.5%)
25	No qualified radiologists were present in the hospital	1 (3.5%)
26	Patient was started on oral antibiotics when there is active infection	1 (3.5%)
27	Surgeon never waited for the physician to discuss the details	1 (3.5%)
28	Surgical mop was left in the body	1 (3.5%)
29	Suturing was not done properly, and products of conception was retained in Utero	1 (3.5%)
30	Tubectomy done on one side only	1 (3.5%)

Note: While the main allegations are presented in the table above, more than one allegation was made in some instances.

(27.6%) and the group 3 error (20.7%). He et al. found that types 1, 2, and 5 medical errors were the most frequent, accounting for 50.5%, 18.6%, and 19.6% of instances, respectively, in their analysis.[15] Whether damage happened as a result of the alleged medical negligence is an important question for doctors and hospitals to answer since the presence of damage encourages the patient or their family to file a lawsuit to seek recompense for their harm or loss.

Similar findings were obtained by Vora et al. Acts of omission were found to be the primary cause of the claims in 58.6% of the judgements.[5] In 10.3% of the cases studied, the phrase "Res Ipsa Loquitur"—which means the object speaks for itself—could be applied. In such a case, the onus of proof switches to the physician or medical facility (defendant), who must persuade the court that there were no flaws in the care they provided while treating the patient. Also, in 3 (10.3%) cases, the failure to get consent has been mentioned as the cause of litigation. Since the Supreme

Table 2. Classification of medical negligence adapted from.[14]

Group No.	Description	Examples
1	Negligence (Omitting the necessary treatment), therapeutic omissions	Diagnostics insufficiency (no CT after head injury, ECG not done after cardiac emergency) Delayed action on post-operative complications Hospital admission is delayed or non-admission to ICU
2	Complications at and/or after surgery, peri-operative complications	Complications (Intra-operative) during the surgery (Surrounding organs get injured) Complications during endoscopic procedures Complications in the Post-operative period Mishaps due to Anesthesia
3	Wrong treatment, Inappropriate treatment	Transfusion related reactions Diagnosing through telephone without examining the patients Wrong/ improper treatment Instruments retained or left behind
4	Sub-optimal care, mistake in care	Prophylaxis insufficiency for decubitus ulcer Prophylaxis insufficiency for thrombosis Improper positioning during the procedure/surgery
5	Adverse drug event, medication errors	Wrong dosage of drug, wrong drug Wrong application/administration Improper frequency Neglecting the drug allergy Misinterpretation of given orders Illegible order

Court reaffirmed in the Samira Kohli v. Dr. Prabha Manchanda & Anr. case that an act of unauthorised invasion and interference with a patient's body constitutes an act of assault and battery, it is always advisable that the treating doctor or a doctor from the treating team obtain the appropriate consent prior to any procedure.[16]

In 2 (6.9%) of the cases, contributory negligence was used as a defence, but the defendants were unable to establish this in court due to a lack of supporting material in the medical records. In the case of Kunal Saha, contributory negligence was raised as a defence, arguing that the complainant's status as a physician caused him to interfere excessively with the patient's care. However, the court declined to accept this justification because there was no supporting evidence in the charts.

In 41.4% of the cases, an expert opinion was required to assess if negligence occurred. The court chose which expert committee or board of experts' opinions to rely on and accept in order to decide the issue if there were two opposing opinions. Additionally, if the court is unable to reach a decision based on the expert testimony offered by the panel of experts, it will declare such reports to be inconclusive and determine the matter on the basis of the merits and its own findings.

In order to respond to legal action, the doctor or hospital must maintain accurate recording and maintenance of medical records. Medical records were correctly maintained and stored in 87.5% of the cases where the doctors or hospitals proved guiltless. As a result, even when under the scrutiny of experts, treating physicians and hospitals could prove that they carried out their tasks with the utmost care. This is in agreement with the ruling made in the matter of the Maharaja Agrasen Hospital, which reads “It is well-settled that a court is not bound by the evidence of an expert, which is advisory in nature and the court must derive its

Annexure 1. List of supreme court judgments studied.

S. No.	Details of the Case	Year of Judgment
1	Jaswinder Singh & Anr. v. Santhokh Nursing Home & Ors.	2012
2	Mehta Charitable Hospital v. Shanti Devi	2012
3	Dr. Balram Prasad v. Kunal Saha & Ors.	2013
4	Dr. Sanjeev Manktala v. Dr. Ajit Sood & Ors.	2013
5	Dr. S.K. Jain v. Shaveer Singh	2013
6	Arun Kumar Jha v. Dr. Parth Pratim Pandey & Ors.	2013
7	ESIC & Anr. v. Sudha Dhobriyal & Anr.	2013
8	Alfred Bennedict & Anr. v. Manipal Hospital & Ors.	2014
9	Kanta v. Tagore Heart Care & Res. Centre Pvt. Ltd & Anr.	2014
10	Ashish Kumar Mazumdar v. Aishi Ram Batra Charitable Hospital & Ors.	2014
11	Krishnakumar v. State of Tamilnadu & Ors.	2015
12	Vishnu Dutt Tiwari v. State of UP & Ors.	2015
13	Asit Baran Mondal & Anr. v. Rita Sinha & Anr.	2016
14	Kozhy Varghese v. T.P.Basheer Ahammed	2016
15	Bijoy Sinha Roy v. Biswanath Das & Ors.	2017
16	Vipul Subodh Chandra Shah & Ors. v. Gujarat Res. & Medical Institute & Ors.	2017
17	Dr. Jayshree Ujwal Ingole v. State of Maharashtra & Anr	2017
18	Rajesh Taneja v. Kaiser Hospital & Ors.	2018
19	Baby Zachariah v. B.K. Memorial Hospital & Anr.	2018
20	Dr. Jhunjhunwala v. Dhanwanthi Kaur & Ors.	2018
21	Arun Kumar Manglik v. Chirayu Health & Medicare Pvt. Ltd. & Anr.	2019
22	Maharaja Agrasen Hospital & Ors. v. Master Rishabh Sharma & Ors.	2019
23	Devi Lal Parikh v. Harbans Singh & Anr.	2019
24	Shilaben Ashwinkumar Rana v. Bhavin K Shah & Anr.	2019
25	Vinod Jain v. Sanktoba Durlabhji Memorial Hospital & Anr.	2019
26	Anjana Agnihotri & Anr. v. State of Haryana & Anr.	2020
27	Dr. Sheela Pahlajani v. Anjali Srivastava	2021
28	Dr. Harish Kumar Khurana v. Joginder Singh & Ors.	2021
29	Bombay Hospital & Research Centre v. Ajay Jaiswal & Ors.	2021

own conclusions after carefully sifting through the medical records, and whether the standard protocol was followed in the treatment of the patient."[17]

Although the doctors or hospitals won the majority of the cases (55.2%) in the end, they fought the legal battle for several years. As more patients and families accuse carelessness either as a reflex to express their anger or sadness or with the purpose of extorting money, there is an increase in vexatious or frivolous accusations against doctors and hospitals that cannot be ignored.[2]

In this regard, it is essential for the medical community to be knowledgeable about the most recent rulings and legal regulations pertaining to medical negligence. Hopefully, this will lessen some of the doctors' fears and/or anxieties and keep them from taking dramatic measures to avoid facing the criminal charges that are frequently falsely brought against them. Sadly, an obstetrician in Rajasthan recently committed suicide out of dread of being arrested after a FIR for murder was filed against her after her patient passed away from postpartum haemorrhage (PPH).[18] Similar pressures and accusations affect a lot of doctors, although they are rarely reported.

In six (20.7%) of the judgements studied, the Hon'ble Supreme Court increased the awarded compensation, whereas in one case there was no loss of income or patient income, hence the amount was lowered. The "Bolam test" is used by Indian courts to evaluate the level of care and decide whether or not the doctor was negligent. The propriety of the expert's opinion should not be called into question by the court if their actions are endorsed by a group of experts in the field. In other words, other medical experts in the field, not judges, should determine whether or not a doctor is guilty of negligence.[19] The practise of relying on the opinions of "medical experts" to provide a decision is changing in popularity around the world, and numerous tribunals/courts are now logically assessing the advice provided by the medical experts.[20-23] Doctors should remember the oft-repeated adage that in a court of law, "poor records means poor defence and no records mean no defence."[24]

One cannot argue that the judicial system is faulty or incapable of handling cases of medical negligence. It has been determined via a series of judgements that the Indian judiciary puts to rest the speculative nature of adjudication in cases involving medical negligence liability and makes plainly clear that if the complainant's charges are proven, then fair justice would be done. Additionally, it is equally obvious that there cannot be a presumption that medical professionals cannot make mistakes when providing patient care and treatment.[25] According to studies, doctors in India are not familiar with the concepts of medical negligence and the consumer protection act. Therefore, it is imperative that administrators and healthcare professionals take the appropriate efforts to improve their legal knowledge.[26,27]

Recommendations to doctors and hospitals:

a. Precautions to avoid litigation

1. Establish a strong line of communication with patients, their guardians, and/or family members about the condition, disease, and treatment strategy. They should also be informed on a regular basis how the treatment is going.
2. Avoid bringing up contentious issues pertaining to the treatment in front of patients, their loved ones, or guardians since this could send the incorrect signals.
3. In order to prevent misunderstandings and miscommunications, the treatment and action plans must be shared with even the junior doctors on the treating team. Patients or their loved ones may become suspicious as a result of these misunderstandings.
4. Either the treating physician or a physician from the treating team should get consent for treatment from the patient or their relative or guardian.

a. When describing surgical operations, it is best to use diagrams or drawings whenever possible.

b. Consent must always be obtained before the start of a procedure or surgery with the signature of a witness (the consent form should specify the witness's relationship to the patient).

5. The following information needs to be recorded in operative/ procedure notes:

a. The start and end times of the surgery

b. The names of the surgeons and anaesthetists (if any) engaged

c. Intraoperative observations

6. Never inflate patients' expectations or guarantee a full recovery.
7. If a patient, patient attendant, or legal authority makes a formal request through proper channel for a copy of the medical records, you must give it to them within 72 hours (as per current rule); The proposed regulations by the National Medical Commission (NMC) stipulate that it must be provided within 5 working days.[28,29]
8. Retrospective changes to medical records should be avoided.
9. You should never falsify medical documents.
10. Document the situation with the date and time if a patient disobeyed your orders or interfered with the treatment procedure.
11. If a patient dies, exercise caution when expressing regret to the deceased's family because this could be used against the doctor in court as evidence of guilt.
12. Refrain from prescribing over the phone without first seeing the patient.
13. Stay up to date on the most recent evidence based medical recommendations and treatment techniques.

b. To plan the defence if litigation is initiated

1. Use the services of a competent attorney. The hospital and/ doctor are entitled to legal representation from an attorney.
2. The medical professional or facility should refute all of the claims. It should be made clear that standard protocol was followed, and even though the adverse event was regrettable, it was not the doctors' fault, even though the doctor may feel empathetic to the patient or their loved ones.
3. Don't include all of your defences in the letter in response to the accusations presented by the patient/ patient party or their advocate.
4. In accordance with the terms and conditions of their policy, a doctor must notify their insurance agency whether they have indemnity insurance.
5. It's crucial to file all paperwork on time, including written declarations, affidavits, and other records.
6. It's crucial to retain medical records, treating physicians' affidavits, investigative findings, etc. appropriately.
7. The expert testimony of a licenced and impartial medical professional requires special consideration. Affidavits from experts should be submitted as well.
8. To mount a strong defence at trial, supporting medical literature on the subject should be supplied.
9. Case law that is pertinent to the issue will aid in mounting a strong defence at trial.
10. Become familiar with the rules and rulings that may control the course of alleged medical negligence claims.

Conclusion:

The medical community is understandably worried about protecting itself from speculative and vexatious claims. Even if there are undeniably incidents of medical negligence, the problem that concerns the medical fraternity is that speculative allegations frequently result in permanent harm. As a nation, we are experiencing a malpractice crisis. Thus, the medical community must realise that there is potential for improvement in patient care, particularly in diagnostics, surgery, post-op care, documenting, maintaining medical records, providing counselling and medications, etc.

Limitations: As the cases were chosen via a free text search on the Supreme Court of India website with the keyword "Medical Negligence," there was an inherent bias in the selection process. As there was no option to segregate or choose all judgements relating to medical negligence or in accordance with the law, i.e., Consumer Protection Act, it is likely that certain judgements were missed.

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Conflict of Interest: None

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REVIEW ARTICLE

Ethical concerns in Telemedicine- An Indian perspective

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Abstract:

Telemedicine is the welcome evolution of health care delivery initiated by phenomenal advances in digital communication technology. Improved access, delivery and reduced health care cost can be considered the gold standard of telemedicine which has come a long way both in terms of quality health care and acceptance at all levels in countries like India. Telemedicine has immense potential and promise and offers innumerable opportunities and is set to revolutionize the traditional health care delivery. However, there are certain issues, concerns and challenges which are usually encountered in the beginning of any innovative approach and are likely to be faced during practice of telemedicine. The important ethical concerns include protection of autonomy of the patient, his right to privacy, confidentiality and non-disclosure of sensitive data, issues of ownership and right to its access, sound doctor patient relationship, establishment of duty of care and its standard and issues revolving around liability of doctors. These issues are of immense importance and need immediate attention and hence, this effort to discuss them within the scope of Telemedicine Practice Guidelines along with existing legal provisions controlling medical profession and practice in India and other relevant guidelines and other binding provisions including laws related to information technology.

Keywords: Telemedicine; Telehealth; Ethics; Telemedicine practice guidelines 2020.

Introduction:

Telemedicine literally means 'Healing from the distance' which implies the use of ICT resources in increasing the accessibility and affordability of health care delivery to the disadvantaged or underserved population living in remote areas. With passage of time, advances in technology have broadened the scope of Telemedicine and has come to be seen as an effective tool in improving the patient outcomes in diverse situations as highlighted in recent pandemic of Covid-19.Although there is no universal definition of telemedicine, WHO group of consultation on Health Telematics, it is the delivery of health care services by all health care professionals using information and communication technologies for the diagnosis, treatment, and prevention of disease and injuries, as well as research and development.[1]

Indian Medical Council Regulations of 2020 contains 'Telemedicine Practice Guidelines,' which are designed to facilitate, motivate, and assist doctors and provide a guiding framework for them.[2] The guidelines adopt the same definition of Telemedicine as that of WHO. As per these guidelines, there is a subtle difference between telemedicine and telehealth as "Telemedicine refers to a clinical service offered by RMP, whereas Telehealth refers to its use of technology for health and health-related activities, which encompasses Telemedicine."[2]

Indian perspective: Telemedicine has become more relevant in countries like India where population is around 130 crores with a large population having issues of affordability, rising costs of treatment, deficient and inequitable distribution of health care services, low doctor- patient ratio, rising concentration of specialists and super specialists mostly in urban and to some extent in semi-urban regions and underprivileged population living in remote areas with limited access and availability of convenient and affordable transport etc.

In India, the Indian Space Research Organization (ISRO) took the lead and launched the Telemedicine Pilot Project in 2001, connecting Apollo Hospital in Chennai with its rural hospital in Andhra Pradesh using satellite technology. Today, the activity has picked up speed, and ISRO now has a network of roughly 100 hospitals spread across the country, with 78 rural sites linked to 22 speciality hospitals in major cities.[3]

The Ministry of Health and Family Welfare and the Department of Information Technology are jointly responsible for telemedicine services in the country, and they have made a number of initiatives. The National Telemedicine Portal was created by the Ministry of Health and Family Welfare's Telemedicine Division with the goal of developing a National Medical College Network (NMCN) to connect medical colleges and implement a National Rural Telemedicine Network for e-Healthcare delivery.[4] Other significant projects include the government's establishment of the National Digital Health Authority of India, the government's National Rural AYUSH Telemedicine Network, ISRO's Village Resource Centre (VRC), and ICMR's Arogyasree.[5]

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Critical Issues in Practice of Telemedicine: Increased access to quality health care, ease and convenience in getting medical opinions, seeking consultations from specialists and super specialists across geophysical barriers and mitigating their shortage to some extent, cost effective and timely care, desired follow up, and better quality of health care are some of the benefits of using technology in providing health care services.[6] However, the use of technology also brings with it issues such as a scarcity of funds, equipment failure, electronic and technical glitches, including disruption of connectivity, the need for proper training of manpower, including health care providers, and certain inherent legal and ethical issues that require immediate action. In view of current guidelines restricting the use of Telemedicine in India, the purpose of this study is to focus on ethical difficulties that arise in Telemedicine and approaches to alleviate them.

In response to concerns about a lack of clarity and subsequent ambiguity, the Ministry of Health and Family Welfare of the Government of India issued 'Telemedicine Practice Guidelines-2020,' which were developed in collaboration with the 'National Institution for Transforming India' (NITI Ayog), a premier 'research institute' of the Government of India that provides policy inputs to the Government of India.[6] These recommendations offer helpful advice on topics such as the doctor-patient relationship, consent, liability, and negligence as well as confidentiality and privacy.They also address evaluation, management, and treatment, as well as prescribing, health education, and counselling services.[2]

Informed Consent: Consent is a legal and ethical aspect of health care that highlights an individual's essential right to make choices and conscience, which is established in Article 21 of the Constitution.

Consent is considered a contract under Section 13 of the Indian Contract Act, which describes it as when two or more persons agree on the same thing in the same sense (manner). Subsequent parts of the legislation go through to say that agreement should be free and not the consequence of undue pressure, fraud, distortion of facts, or error.

Consent is as crucial in teleconsultation, and the rules specify that informed consent in teleconsultation has the same medico-legal value as consent in face-to-face discussions.[7] The patient's consent for teleconsultation is a must and can be in the form of either text, email or audio-video message.It may be oral or written depending upon the circumstances, but should always be informed, voluntary and explicit and should be obtained after explaining fully (doctrine of full disclosure) to the patient in simple and understandable language, the nature and scope of communication, costs involved, need for transmission of patient's health data, its privacy and security and related issues concerning confidentiality. The patient is expected to take 'informed decision' and is at liberty to refuse consent or withdraw it at a later stage if he/she desires so.

The consent should be obtained prior to providing consultation in all communications initiated by the practitioner or the caregiver. Implied consent can be considered valid when patient himself/herself initiates telemedicine services.[2] In case, the primary teleconsultant desires to obtain and seek senior's or specialist's opinion or advice during consultation or refers the patient to him, a fresh consent shall be required. This view has been earlier endorsed by World Medical Association's Statement on Guiding Principles on the Use of Telemedicine for Health Care, 2009.[8]

Confidentiality, Privacy and Ownership of Data: Article 12 of the Universal Declaration of Human Rights, 1948 and article 17 of the International Covenant on Civil and Political Rights (ICCPR), 1966, both of which India ratified in 1979, recognise the right to privacy as a fundamental human right.[9] "No person should be deprived of his life or personal liberty," declares Article 21 of the Indian Constitution. But according to procedure established by law" The Supreme Court of India has, in Puttuswamy v. Union of India case (2017) held that right to privacy is a fundamental right and is an integral part of right to life and liberty.[10] Information privacy is defined by the International Association of Privacy Professionals as "the right to have some control over how your personal data is produced and utilised.[9]

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) in the United States and the Data Protection Act of 2018 in the United Kingdom are two examples of different legal frameworks for collecting and disclosing health-related data.[7] In India, third parties are expected to secure and maintain the safety and security of patients' medical histories and other health records under the requirements of the IT Act and Rules This includes the patient's "sensitive data," such as information on the patient's physical and psychological health, albeit the term "sensitive data" has yet to be defined.[7] Following the Supreme Court's ruling that the right to privacy is a basic right protected by the Constitution, the Indian government introduced the Personal Data Protection Bill, which was introduced in Parliament in late 2019 and is still under review.

In India, the recent guidelines, although, do not provide specific inputs regarding the issue, the doctors and third parties are expected to make'reasonable' efforts towards providing protection to and maintenance of privacy of patient's health data, ensuring avoidance of spillage of information or illegal transmission of sensitive data. In other words, according to the laws governing practice of medicine in India, a doctor or a corporate body is legally required to obtain a patient's data only after receiving his informed consent on the one hand, and to maintain its confidentiality and disclosure only with informed consent or in compelling situations on the other, as described by the laws governing medical practice in India

A related problem is the patient's right to access personal information received with his agreement but produced or maintained by the doctor, as medical records compiled by the doctor are regarded RMP's property in several countries. Although there is no legislation in India, the government gives a "Charter of Patient's Rights," which is inscribed in the Indian Constitution.[7] The National Human Rights Commission (NHRC) of India has adopted a Convention of Human Rights that includes the right to confidentiality and access to medical data..The Guidelines 3.7.1-3 emphatically state that the principles of medical ethics, confidentiality and privacy including

maintenance and transfer of data, as laid down in IMC Act, relevant sections of I.T. Act, Data protection and privacy laws etc shall be binding and must be upheld and protected. It further clarifies that the doctor may not be held liable in situations where the breach of confidentiality and privacy, provided that the said breach has occurred due to technical error.[4]

Doctor-Patient relationship: A good doctor patient relationship is essential for satisfaction of the patient, proper understanding of his ailment, compliance with doctor's advice and treatment and its outcome.[11] Generally speaking, doctor patient relationship is established when the doctor accepts the patient for consultation. The Guidelines provide that RMP can and should use his professionalJudgement and is free to decide whether to go for tele-consultation or for in person consultation. He is also at liberty to choose which telemedicine platform is best suited in the given situation. Proper communication helps to establish rapport and trust between the two leading to the patient confiding his secrets in the health care professional, in absence of which, in person consultation gets an edge over tele-consultation. The American Medical Association emphatically endorses the importance of trust in doctor patient relationship. It suggests, "The patient-doctor relationship is built on trust, which gives rise to the doctor's ethical responsibility to take on priority the patient's welfare over his or her own self-interest or obligations to others, to use sound medical judgement on the patient's behalf, and to advocate for the patient's rights."[12] Despite the fact that telemedicine changes the setting of face-to-face consultations, the formation of a good doctor-patient connection is just as crucial. The better the communication, the greater the mutual trust, which assures more acceptability and compliance with the doctor's advice and treatment, minimising the likelihood of future claims and counter-accusations.

Standard of Care: The doctor is required to use the same level of care and expertise that any other doctor of his standing would use in identical circumstances. The Guidelines advocate a telemedicine level of care that is comparable to face-to-face consultation. However, tele-consultations have obvious limitations and the guidelines allow doctors to only provide consultation, prescribe a restricted number of drugs, suggest first aid, and advise the RMP to use his or her judgment in determining whether emergency measures or face-to-face consultation are required in appropriate situations. When a tele-consultant believes a face-to-face consultation is required, the Guidelines propose that the patient attend a doctor in person.[7]

The World Medical Association (WMA) statement on telemedicine ethics, as amended by the 69th WMA General Assembly in Iceland in October 2018, suggests that healthcare quality provides focus be put in place and used on a periodic basis to maintain patient safety and security, as well as the best diagnostic and treatment during telemedicine procedures.[13] It also emphasises that, to the extent possible, telemedicine services must adhere to evidence-based procedures in order to promote patient safety, high-quality care, and beneficial health outcomes.

Summary: Technological advances and innovations bring progress and also new challenges but are here to stay and so is telemedicine. It is not expected to totally replace traditional practice but it is here to offer cost effective and timely health care services to the underprivileged population across geophysical barriers where patients can be examined, monitored and treated.

In spite of success stories in and outside India, telemedicine brings with it certain concerns and challenges including important ethical issues. The critical ethical issues include maintaining confidentiality and security of patient's health data, liability in cases of noncompliance and misinterpretation of the data and consequences arising out of unauthorized access to confidential information and data ownership. The protection of the right of the patient to autonomy and self determination and importance of his free will and informed consent in accepting telemedicine is another important issue. Mutual faith and trust in the wake of changed contours of doctor-patient relationship is also paramount. All these important issues can be looked into and taken care of in the light of The Guidelines along with existing legal framework governing medical practice, Codes of Ethics and relevant provisions pertaining information technology.

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REVIEW ARTICLE

Forensic Meteorology- Reconstructing the Weather: A Review

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Abstract:

Forensic Meteorology is the science of using historic weather records, atmospheric data, eyewitness accounts, and re-enactment simulations to determine the weather conditions at a specific time and location for litigation purposes. Forensic meteorologists frequently visit the scene of the accident or crime to look at the terrain and conditions present. A Forensic Meteorologist could be called to corroborate or disprove an alibi, to supply context for an accident, or to work out if the conditions could have reasonably been anticipated or were an unexpected event. They may be called to provide context for disputes that arise from weather-related events; either between private parties, or in validating insurance claims, in vehicle accidents, agricultural disputes, weather modification, building collapses, or in something as simple as people slipping and falling.

Keywords: Forensic science; Forensic meteorology; Forensic climatology; Forensic meteorologist.

Introduction:

Forensic meteorology is scientific study of weather, applied to the method of reconstructing weather events for a particular time and site. This is done by acquiring and analysing local weather reports such as surface observations, radar and satellite images, other data, and eyewitness accounts.[1,2] Forensic meteorology is most often used in court cases, including insurance disputes, personal injury cases, and murder investigations.[3,4] This is most often the case when weather conditions were a possible factor, as in fall downs after snow and ice, wind, flooding, after aviation and nautical accidents, etc. With increasing losses from severe weather in recent years, the demand for forensic meteorological services has also grown.[4,5] And many forensic meteorologists are certified by the American Meteorological Society (AMS)'s rigorous Certified Consulting Meteorologist (CCM) program.[6,7]

Review:

Although the term “forensic meteorology" (or forensic climatology) has only been used for the past 30 years or so, the practice of applying weather and related knowledge to legal matters is nothing new. In the March 1900 issue of Monthly Weather Review, Professor H.J. Cox, who at the time headed-up the U.S. Weather Bureau's Chicago office, provided the following summary of his experiences in the courtroom that since the opening of the present term of court, last fall, he has been in court thirty-three times to testify as to the condition of the weather at a particular time and as to what bearing it might have on the case at issue. In addition to these thirty-three cases many cases are settled out of court on the records of the weather department. Such cases are principally damage suits arising from the shipment of perishable goods. Although the National Weather Service (NWS) still provides forensic services to other government agencies involved in the investigation and litigation of weather-related accidents (such as the National Transportation Safety Board), weather service employees generally are prohibited from testifying in court, except in cases involving the federal government or the role of providing expert witness testimony for cases.[8,9]

Conrad B. Gosset, MS (Meteor), a consulting meteorologist felt that meteorologists who were provide these services should have a professional name. He introduced the phrase “Forensic Meteorologist” within the mid-1960s, and discussed in his unpublished keynote address at the primary Conference on Forensic Meteorology, November 5–6, 1976, in New Orleans in conjunction with the annual conference of the American Meteorological Society.[9] The first use of the term by The New York Times was in reference to Mr. Gosset's work in a 1982 article.[9]

Essentially, a forensic meteorologist may be a quite weather detective. They reconstruct events associated with weather, often providing consulting and witness testimony to legal firms and insurance companies, consistent with its GOV's website. The job of this type of “weather detective” is to assist provide information regarding the precise role that weather (cold, snow, wind, rain or other types) may have played in a fire or accident that has caused damage to people or property. Sometimes accidents like these have legal and insurance repercussions, and therefore the forensic meteorologist is named upon to offer their insights in court or in other settings.

A successful forensic meteorologist needs to have a blend of technical expertise and the ability to present the facts of a case effectively, especially when serving as an expert witness. This calls for what Haggard referred to as jury presence. “You can't be the world's greatest meteorologist and a bumbling idiot. It makes sense to be a pretty good meteorologist and a person that the jury believes. Jury credibility is essential.”[10,11]

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Forensic meteorology requires the utilization of the many different sorts of tools and instruments additionally to solid reasoning in math and science. Someone working within the field will likely make use of satellite images, computer weather modelling and various eyewitness reports as they reconstruct a timeline surrounding a weather event. A forensic meteorologist will often be called to a scene within the wake of a serious storm or weather catastrophe. When such a serious storm hits (hurricane, flood or tornado), sometimes local weather stations aren't ready to function, which is when a meteorologist must rely more on modelling and prediction skills. In addition to being present after major events, the talents of forensic meteorology could be useful in determining the explanation for an accident involving ice or lightning hazards.

A forensic meteorologist must have a firm grounding in atmospheric science. There are bachelor's degree within the field, though many who continue to review meteorology at the graduate level begin with a bachelors during a related field such as geoscience, physics, chemistry or math. Really any of these fields would be a useful preparation for becoming a meteorologist, and can likely be studied at advanced levels in an atmospheric science degree. Computer programming is another important skill during this field. One of the more important resources for professional development within the field is that the American Meteorological Society, whose career centre offers many information about different careers in meteorology as well as insight into a number of the settings where meteorologists may apply their knowledge and skills, including private companies, government offices or universities.[12,13]

Often, the meteorologist's analysis of a particular case is hindered by the fact that the closest weather station to the site in question can be some distance away. “That's when you have to dig into the many layers of data that are available to the forensic meteorologist,” Falconer said. He credits the NWS modernization program during the 1990s with increasing the value of the forensic meteorologist as someone who knows the capabilities of new equipment and where to find ancillary information regarding a particular case. Regardless of the source of the data, it is the job of the forensic meteorologist to piece together as many elements of the weather puzzle as possible and determine what actually happened to a reasonable degree of certainty. “The reason why forensic meteorologists are so important to attorneys in a litigation contest is that you cannot really accept the anecdotal evidence of what the weather was like on a particular date and location,” said Roger Haerr, a partner in the real estate litigation group of Luce, Forward, Hamilton & Scripps LLP of San Diego. “Forensic meteorologists can really make the difference between winning and losing to the extent that the case depends on some influence of the weather.”[13]

Described as a mixture of science, art and interpretation, forensic meteorology mirrors the work that detectives do to unravel crimes. Cases may involve whether lightning sparked a fireplace or, if someone slips and falls, whether ice on a property was responsible. Data comes from various sources, including observations, weather stations at airports, Doppler radar and satellite imagery, National Weather Service bulletins, and even tidal gages. Forensic meteorologists can also take their own measurements, like wind velocity. Cases are mainly site-specific, and far of the problem-solving involves knowing what synoptic, or generalized, data is required to reconstruct the micrometeorology at a specific location.

A lot of what we rely on is experience, but we'd like tools of the industry, like Doppler radar and good observations" to unravel mysteries associated with weather, Lombardo says. He recounts one among his cases during which a crane collapsed near a building, injuring the operator. Lombardo visited the location on each day that had similar conditions as when the accident occurred, and on noticing that Grus was positioned near a nine-meter wall, wondered if that had influenced the site's wind velocity. He measured the wind speed using an anemometer, noting that the wind intersected the wall at a 70 to 80 degree angle. By calculating simple vectors, he discovered that the wind speed near Grus was around 29 to 48 kilometers per hour, right at the sting of what Grus could withstand. It was a function of the wind converging on the wall, which increased the wind pressure on Grus, causing it to collapse."[13-15]

Sometimes, data that's needed to decipher how atmospheric conditions affected a specific location and case isn't available. Stephen Wistar, a forensic meteorologist with Accu Weather, consulted on many cases concerning Hurricane Katrina. Most of his investigations centered on insurance claims about whether wind or storm surge caused property damage He utilized a massive computer model called "ADvanced CIRCulation" (ADCIRC), which predicts tidal and storm surge elevations and velocities over large areas. Combined with information he retrieved from Doppler radar sites outside of latest Orleans, and on-site investigations he conducted himself, he was ready to reconstruct time lines of property damage and state which hit property first-the wind or the water.

In his Katrina inquiries, Wistar also discovered that "trees were very helpful" in solving cases. In areas of mobility, where complete neighbourhoods were torn apart, he often examined tree damage for clues about what caused property destruction. He knew the direction of the wind at various points within the storm, both before and after the storm surge, and thus could determine which direction trees would have fallen at those same points. By noting fallen tree locations and directions, he determined time lines for property devastation, even when there have been no structures left standing.

" Another concern is that the uptick in weather and related events occurring on a planet-wide basis, like El Niño and La Niña. Generally, forensic meteorologists' examinations are limited to a specific site. "If climate change continues to occur, however, and we see more worldwide events in increasing frequency, will that change how we look at local events? It may," ponders Lombardo. He cites a worldwide weather phenomenon, called atmospheric blocking, as an example of a planet-wide occurrence that's has already affected his forensic micrometeorology endeavours. Atmospheric blocking obstructs winds that come across the Pacific and forces them north into Alaska, Siberia and the North Pole. The winds then head south, "creating a pool of cold Arctic air that moves and provides a source for ice storms to develop," he says. In the past two years, up and down the eastern seaboard, atmospheric blocking has directly led to snowfall in areas where

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heavy snow is rare, and consequently, "hundreds of slip-and-fall cases" have come across Lombardo's desk. "Atmospheric blocking leads to localized storms that produce the conditions that are favourable to generating future forensic work," he says[15]. As Wistar notes, more people have migrated to regions on the earth "where the weather tends to be more dangerous," like the southern U.S. With more people in harm's way, there'll undoubtedly be more legal, insurance and engineering cases during which forensic meteorologists' expert contributions are going to be vital.

Can a person with a degree in Meteorology do past weather reports? Yes and no. There is no legal certification required for a Meteorologist to testify in court; however, the Meteorologist must demonstrate that he/she has the professional experience and academic requirements to render such expert opinions. In order to make sure the general public receives qualified and reliable experts within the field of Meteorology, the American Meteorological Society (AMS) offers a licensed Consulting Meteorologist (CCM) certification. To earn the CCM credential, a Meteorologist must pass a stringent written and oral, demonstrate a broad background in Meteorology alongside detailed knowledge during a particular field of specialization, show exemplary qualities of character, and devotion to high professional standards.

With the recognition of the forensic sciences on the increase, an interest in learning more about forensic meteorology. Unlike a number of the opposite forensic sciences, forensic meteorology is a smaller amount concerned with utilizing research project within the solving of crimes than it's with utilizing such research to help settle property loss and insurance claims.[15]

Though this is often an unlicensed profession, most who testify voluntarily undergo certification from their professional organisation. The other requirement is that meteorology must be relevant to the case at hand, that the analysis is predicated on reality, their analysis uses logical processes, which the expert remains objective. According to an interview with Dr. Elizabeth Austin, a Forensic Meteorologist, when temperatures rise, criminal activity increases. Austin goes on to mention that there is significantly higher crime rates in cities when the temperatures are appreciably above average. She noticed that extreme rainfall results in increased conflict among people, and developing countries are more vulnerable to conflict and wars when agriculture is threatened by drought conditions and hot temperatures. When solving a crime, the temperature and humidity conditions around where the body was found are most vital for timing a murder.[15,16]

Can Forensic Meteorologists Assist DNA Analysis? In her interview, Dr. Austin tells of a case that she worked on where weather helped to nab the criminal after a criminal offense was committed. While investigators continually searched for ways to collect the perpetrator's DNA, he refused to drink from cups or lick an envelope that they had given him. Luckily for investigators, it had just rained on the day that they were tailing him, so when the suspect spit onto the ground, they were able to scoop the saliva off the highest of a rain puddle to gather his DNA.[16]

Currently, there are only a few Forensic Meteorologists within the world, but the word is spreading. In Fall of 2018, The Weather Channel debuted a replacement show entitled “Storm of Suspicion”, which highlights ways in which weather and crime are intertwined. Will this show span a new 'CSI Effect'? They have to watch and see if lightening really can strike twice. Are there tons of forensic meteorologists across the world? No there aren't. They all know each other since it's such a small group. There are all different sorts of forensic meteorologists though. For example, some people just specialise in hurricanes and tropical weather. Some focus on air pollution meteorology. In addition to there not being that a lot of, they have their niche areas, making even smaller groups. Here at Weather Extreme, they have six forensic meteorologists, three of which are hurricane experts. Which weather elements are typically the foremost helpful when solving a crime?

Temperature, humidity, winds, precipitation, and sun. It's really a case by case basis, sometimes it's something small or all the above. For timing a murder, temperature and humidity and conditions around where the body was found are mostvital.[17,18]

Forensic meteorology has been utilized in all kinds of circumstances. While writing for Physics Today, Austin and Hildebrand tracked down a slew of lawsuits where a meteorologist was employed as an witness , including: murders, suicides, bombings, vehicle accidents, traffic accidents, skiing accidents, bad aircraft landings, kitesurfing accidents, agricultural disputes, property insurance disputes, building collapses, people slipping and falling, fires, and as a defence for stealing, looting, or trespassing. The range of weather involved in these cases can be equally as diverse-rain, snow, ice, tornadoes, hurricanes, air pollution, drought, floods, microbursts and epic storms can all lead to situations where a meteorologist takes the stand to carefully explain what the weather conditions were and how it impacted the environment.[19,20]

The frequency of particular weather events may be a common theme in civil cases. Did a city adequately anticipate normal severe rainfall when designing their sewage system and were overwhelmed by hit or miss freak event, or did they underestimate the predictable pattern of storms and fail to build an adequate system? When a roof collapses under the load of piled snow, was it a failure of engineering to create for the expected environment, or was the roof adequate and therefore the snowfall far above any reasonable expectation? A forensic meteorologist's analysis of the relative rarity of specific high-impact events are often pivotal testimony in determining fault during the next insurance and building disputes.[21-23]

Not every expert's testimony influences the case's outcome. A driver was hit by a bit of falling ice while crossing a bridge, with the fragment breaking his windshield and hitting him within the eye. He claimed the ice was a part of an icicle breaking freed from the bridge, while the local transportation authority claimed the ice must are flung off a passing truck. The forensic meteorologist testified that ice from a truck while be opaque, while an icicle growing on the bridge would be clear. An eyewitness said the ice was clear, leading the meteorologist to support the driver's accusation. Despite this, the jury found in favour of the bridge,

concluding that a truck was responsible for flinging ice.

Grundstein et al. did the study to quantify the influence of different ambient air temperatures and radiation values on vehicle cabin temperatures. It uses a singular maximum cabin temperature dataset that's linked with meteorological data on ambient air temperatures, solar radiation, and cloudiness. The study period included a spread of ambient air temperatures alongside a variety of cloudiness and radiation conditions. The first portion of this study investigates maximum cabin temperatures. These temperatures ranged from 41°C to 76°C. The magnitude of maximum cabin temperatures varied by both season and cloud coverage, which influenced the amount of solar radiation. Clear days in the spring average 61°C versus 68°C in the summer. The higher values are related to the higher ambient air temperatures in the summer. McLaren also found that the maximum cabin temperature was dependent on the initial ambient air temperature. Maximum cabin temperatures on cloudy days averaged approximately 10°C cooler than clear days with temperatures of 50°C in the spring and 58°C in the summer. The purpose of this research is to demonstrate that cabin temperatures can reach hazardous levels even under relatively mild conditions (i.e., cloudy with mild ambient air temperatures).

Using the cabin temperature and meteorological datasets, two models of maximum car temperatures were developed in this study. The models were designed to maximise the potential temperature and thus assume no ventilation and maximum sun exposure. They were also designed to use average daily meteorological values which will be more commonly available. When solar radiation data are available, the solar-based model is recommended because of its superior performance. These models could also be of use in forecasting hazardous conditions and helping to tell the general public of the risks of leaving children and infants unattended in vehicles. They can also be utilized in conjunction with the utmost vehicle cabin temperature indices that assign danger levels- “vehicle interior heat advisory” and “excessive vehicle interior heat warning”- that are consistent with official NWS terminology. In addition, the models could also be utilized in forensic analysis to reconstruct cabin temperatures. Guard and Gallagher found that over 25% of vehicle-related hyperthermia deaths occurred when parents or other caregivers intentionally left a child unattended in a vehicle, indicating a clear lack of knowledge about the heat-related hazard. Public advisories are documented to boost awareness. Sheridan noted that 90% of survey respondents from several urban areas were aware of heat warnings. However, many of the respondents did not actually modify their behaviour because they did not perceive a threat to their health. A warning of the danger of high cabin temperatures may be successful at both raising awareness and modifying behaviour if it clearly communicates the vulnerability of children and the distinct health outcomes, including serious heat-related illnesses or death.[24-26]

While for now it is somewhat obscure, forensic meteorology is slowly gaining credibility so far differently of bringing science and fact-based testimony into the courtroom. Even better, the quantity of knowledge available to tug into these cases is extensive, with detailed radar archives, rainfall gauges, volunteer observer reports, wind maps, and more to assist meteorologists with their analysis. But the important question is: how will forensic meteorology be glamorized when it makes its inevitable forced an entry the tv with its own crime-solvinghero?[27-30]

Conclusion:

The examples keep on coming. Every major natural catastrophe will bring out forensic meteorologists to work out what exactly happened. Inclement weather will elicit attempts responsible any accidents on the weather, leading meteorologists to make a decision where weather fits alongside human judgement, company policies, and equipment limitations. As we expect to stay getting more intense and more frequent extreme weather events as climate changes, forensic meteorology is simply getting to keep getting more important in sorting out what happened and how predictable it was.

Conflict of interest: The authors declares that there is no conflict of interest.

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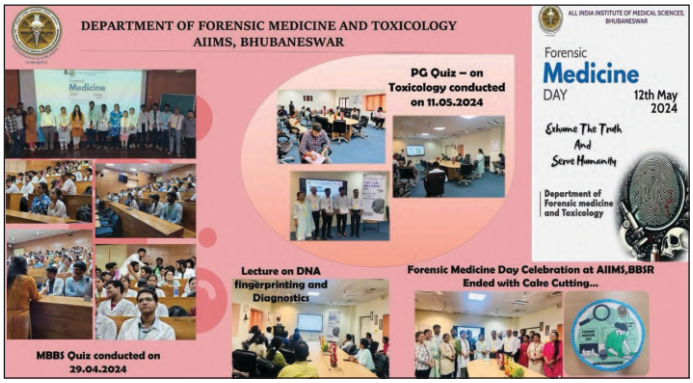

OBITUARIES

Dr. Vasudha Apte

Dr. Vasudha Apte, pioneer and one of the early pillars of our association has left for heavenly abode on 28.04.2024. She was a symbol of knowledge and hard work, instilling some of these qualities into the people she came in contact with. It was due to her sheer determination and hard work that not only she was the first female in Maharashtra to become a forensic medicine expert but also became the first female president of Indian Academy of Forensic Medicine (IAFM). Our thoughts and sympathies go out to her family and loved ones as we pray that God grants them strength, peace and comfort during this difficult time.

May her soul rest in peace.

-Indian Academy of Forensic Medicine (IAFM)

Dr. Shaikh Khaja

Birth : 1/07/1944; Passed away on: 8/06/2024. MBBS from JN Medical College, Belgaum. MD from Osmania medical college, Telangana, 1978. Former professor and HOD of MRMC Gulbarga Karnataka. Former Professor and HOD at AI Ameen medical college. Former Principal at AI Ameen medical college, Vijayapura, Karnataka, Professor and HOD - Dean, Controller of examinations, First private medical college MD forensic medicine and toxicology started at Mamata medical college, Khammam, Telangana. One of the founder of Indian academy of Forensic medicine in 1971, at Panaji, Goa. Founder and Former President of IAFM. Organising secretary of VIII annual conference of AP academy of Forensic medicine march 2nd and 3rd, 2003.


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