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Case Study

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A Different Case of Suicide by Hanging: Case Study of the Event

Deependra Awasthi[1], Akhilesh Agarwal[2], Puneet M. Awasthi[3], Soni Verma[4], Rahul Dev[5], Piyush Kumar Gangwar[6]

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Abstract

A thorough analysis of circumstances and examination of the death scene is crucial before determining the manner of death in cases of hanging. While there are numerous reports of suicide and homicide by hanging in India, instances where the deceased is found with hands and/or feet bound and with feet touching a chair, the ground, or a bed, are considerably uncommon, as illustrated in this particular case (figure no.1). Hanging is indeed one of the methods used in suicides due to its accessibility and the perception that it may lead to a quick death. However, it's important to note that the choice of method can vary greatly depending on individual circumstances and cultural context. It is very easy to locate the place (indoor/outdoor) as well as commonly available hanging materials like rope, long napkin, belt, saree, dupatta, and long cloth (dhoti). Partial hanging suicide with hand-tied rope/dupatta cases are very less in number. Data on suicides, such as those reported by the National Crime Records Bureau, provide important insights into patterns and risk factors for suicide, essential information for public health interventions, and policy-making aimed at preventing such deaths. A total of 1,70,924 suicides were reported in the country during 2022[9]. Sometimes suicidal tendency of the victim is so high that he/she can tie his/her hands with ligature material so that he/she cannot escape from the suicidal situation. We can also learn about partial hanging and postmortem blisters from this case study.

Key words: Hanging, Suicide, Partial Hanging, Ligature, Tide Hands

Introduction

In India, more and more accounts depict hanging as an adult's preferred way of attempting suicide. A person who is fully or partially hanged is said to be hanging if they die from external pressure on their neck when a ligature is placed around their neck[11-12]. Violent asphyxial deaths are the major contributing cause to deaths due to unnatural suicide, homicide, and accidents. There are violent asphyxial deaths like hanging, choking, strangulation, throttling, smothering, drowning, traumatic asphyxia, etc., the most common form of suicide is by hanging; in which there is a suspension of the body by a tying

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or ligating which mainly causes neck compression externally and the weight of the body being the constricting force[10]. Suicide is specifically referred to as hanging, and partial hanging is frequently used as a diagnostic tool for suicidal methods of death. It has been questioned, although, how frequently partial hangings are as documented in the literature1. Sometimes murder is arranged as a hanging, or murder is staged as a suicide. There have also been cases of inadvertent cervical compressions that mimic murder[2-4].Hanging has been a common method of capital punishment since the Middle Ages and is the primary execution method in numerous countries and regions. We report one different case of hanging where the ligature mark was well-preserved with whitish discharge around the neck circumferentially despite putrefactive changes in the body possibly the putrefaction is delayed in a ligature mark. This case study can help to differentiate Partial Hanging findings from Complete Hanging. This Case report is different in its way as the victim was found in a closed isolated place after 23 days of missing report.

Case Report

An 18 year old male person found dead in a room. According to victim's brother statement the victim had gone to party with his friends but did not told the place where they were going, the victim was missing since then about 23 days. Deceased was working in A tannery and was found in a closed colony near his house. When the forensic team reached at crime scene person was found hanged with thin rope and both hands were tied with green coloured dupattaa/ stole like rope.Right lower limb was touching the bed and other lower limb was straight downside.as we can clearly see in the figure no.1 Deceased with tide hands.

Figure 1: Deceased with tide hands

History was taken from deceased brother and panchanama, both were saying that the person was missing from 23 days.Informed consent was taken from deceased's brother for the use of victim's history in our case study.

AUTOPSY FINDINGS

External Examination:

Average built body, Eyes partially open, Mouth partially open. The body color was greenish-black, and post-mortem blisters were present at places over the body including the lower limb, upper limb, abdomen, scrotum and sole, bilateral forearm and lower limb discoloration was there. abdomen, penis, scrotum was distended. Both forearms and lower. limbs were circumferentially greenish-black in color bilateral pedal edema was there, and the whitish greenish fungus was there around the neck at the ligature mark. The tips of the fingers of both hands were mummified. Lips were dry black, and both eyes were swollen and bulging out. Scalp hair loose. A non-continuous ligature mark with a gap of 5cm on the back of the neck was obliquely placed between the larynx and chin following the line of mandible reaching up to the left mastoid region. External signs of putrefaction are slippage of skin, and the formation of putrefactive fluid-filled blisters as shown in picture figure.3

Figure 2: Ligature mark **Figure.3 Post Mortem Blisters**

INTERNAL EXAMINATION:

Lungs- right 240gm left-215 gm. soft reddish black in appearance

Trachea soft, Heart -210 gm. Soft, Stomach empty,

Liver- 870gm gall bladder-soft,Spleen-70gm soft,

Kidney- left -75gm right-80gm soft

All samples were collected and sent for FSL (Forensic Science Lab) to rule out any possibility of poisoning status. The cause of death was asphyxia as a result of antemortem hanging.

All related figure of the case are shown in the adjacent .

Figure 4: Liquified brain material

Figure 5: Hyoidbone intact no fracture

Discussion

Suicide by hanging is one of the most common techniques employed worldwide[1]. Every suicide is a private tragedy that ends a person's life too soon and has a lasting impact on the lives of friends, family, and communities. In our nation, more than one million individuals take their own lives each year. Suicide can have several reasons, including issues with one's job or career, feelings of loneliness, abuse, violence, family issues, mental illness, alcoholism, loss of business profits, chronic pain, divorce proceedings, etc. Police-recorded suicide cases provide the NCRB with statistics on suicides. A total of 1,70,924 suicides were reported in the country during 2022[9].

Human beings are inherently emotional creatures. While many can endure and surmount the pressures of life, some faced with overwhelming challenges, opt to end their lives through suicide. Others can manage, and even flourish, despite difficult conditions, yet numerous individuals end their lives in this manner. It is widely acknowledged that stress and depression are pivotal risk factors for suicide. Experiences such as the passing of a partner, job loss, academic setbacks, family discord, financial struggles, marital dissatisfaction, and exposure to abuse and violence can act as catalysts for individuals contemplating suicide.[6-8]

Sometimes, since high ligature points (such hooks or pipes) have been removed, partial suspension or partial weight-bearing on the ligature is utilised, especially in jails, mental hospitals, or other facilities where complete suspension support is challenging to construct[13]. In very few instances of partial hanging, the deceased is found with their hands and feet restrained and in contact with furniture such as a bed or chair, often with their hands bound by a rope. In our case study Autopsy results confirm asphyxia as the cause of death due to antemortem hanging.

Ethical clearance: Taken from G.S.V.M Medical College Kanpur Nagar committee dated 22/02/2023 .Refrence no.**EC/65/Feb/2023**

Conflict of interest: None to declare

Source of funding: Self

Conclusion

The conclusion of this case is Suicidal Hanging as the cause of death is supported by assessments of an undisturbed crime scene and the position of the body. The distinctive binding of the wrists suggests the individual was restrained to prevent any struggle or self-defence. This case study we can learn if we report a missing as soon as a person is missing to the police, There is a possibility to save one's life. Sometimes suicidal tendency of the victim is so high that he/she can tie his/her both hands with ligature material so that he/she could not escape from suicidal situation as we can see in figure.1.We can also learn about partial hanging and postmortem blisters figure.3 from this case study

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Case Study

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Asphyxialdeath Due to Fracture of Thyroid Cartilage, Cricoid Cartilage and Arytenoid Cartilage as Result of Blunt Trauma of Neck in a Motorcycle Accident: An Autopsy Report

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Abstract

Laryngeal fracture is rare but fatal traumatic injury which is mainly caused by severe blunt trauma from interpersonal violence, motor vehicle accident or sports injuries. Laryngeal fracture can lead to severe airway collapse and death. Mortality decreases to less than 5% once the airways made patent and laryngeal injuries are corrected. People must take motorcycle riding safety course to learn how to ride safely. Always follow traffic rules. The motor vehicle accident can be prevented largely through public awareness and education.

Keywords: Laryngeal fracture, Contusion, Thyroid cartilage, Cricoid cartilage, Arytenoid cartilage

Introduction

Fracture of larynx is very infrequent and potentially fatal traumatic injury with documented incidence of 1 in 30000 cases present to tertiary care trauma centre[1,2,3,4]. Rarity of this injury is due to elasticity and mobility of cartilaginous laryngotracheal complex, and protection offered by mandible and sternum[5]. Laryngeal injuries mainly caused bysevere blunt trauma from interpersonal violence, motor vehicle accident or sports injuries. Laryngeal fractures may be missed by clinician due to its rare occurrence, often go undiagnosed and have delayed referral due to low physician experience[3,4]. Laryngeal fracture can lead to severe airway collapse and death[2].Laryngeal trauma has mortality 80% in prehospitalization[6].Mortality decreases to less than 5% once the airways made patent and laryngeal injuries are corrected[7].The laryngeal skeleton is made of three unpaired larger cartilages (thyroid, cricoid and epiglottis) and three smaller paired cartilages (arytenoid, cuneiform and corniculate cartilages), all connected by membranes, ligaments and muscles[8].

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Case report: A sealed dead body of 22 years old male brought by police to mortuary Lucknow, for autopsy to find out cause of death by motor vehicle accident. Family members gave history that the dead person was going on motorcycle with very high speed and suddenly collided with the back of four-wheeler and died due to injuries to neck.

Autopsy Finding: Autopsy was performed at Mortuary, King George's Medical University Lucknow with post-mortem. The body was that of an average build male, of age 22 years. Rigor mortis was present all over the body. Post-mortem lividity was present on the back and dependant parts of the body in supine position. Nails were cyanosed. A contusion of size5cm×3cm was present at lateral aspect of right arm which was 12 cm below from right acromion process and 10 cm above from right cubital fossa. An abraded contusion of size 4cm×2cm was present below body of mandible on left side, which was 6 cm from left angle of mandible and 5 cm below and lateral to chin. Another abraded contusion of size 2cm×2cm was present, 6 cm below to first contusion. There was no other external injury present on the body.No injury present on scalp, on opening cranial cavity there was no injury to meninges and brain tissue. Cranial and facial bone was intact. On opening thoracic and abdominal cavity, heart, lungs and all visceral organs were congested and intact.

On neck dissection, strap muscles of neck were highly contused at various places. Thyroid cartilage was fracture anteriorly and linearly down the thyroid prominence and both the wing of thyroid was flattened (Figure 1). Cricoid cartilage was fractured at upper central portion of anterior surface (Figure 2). Contusion present at posterior aspect of anterior aspect of cricoid. Left arytenoid was fractured at its base and dislocated anteriorly. Entire laryngeal apparatus was filled with clotted blood. Tracheal rings were intact. Epiglottis and trachea were congested. Hyoid bone was intact.

Death was due to sudden blockage of respiratory passage as a result of fracture thyroid cartilage, cricoid cartilage and arytenoid cartilage.

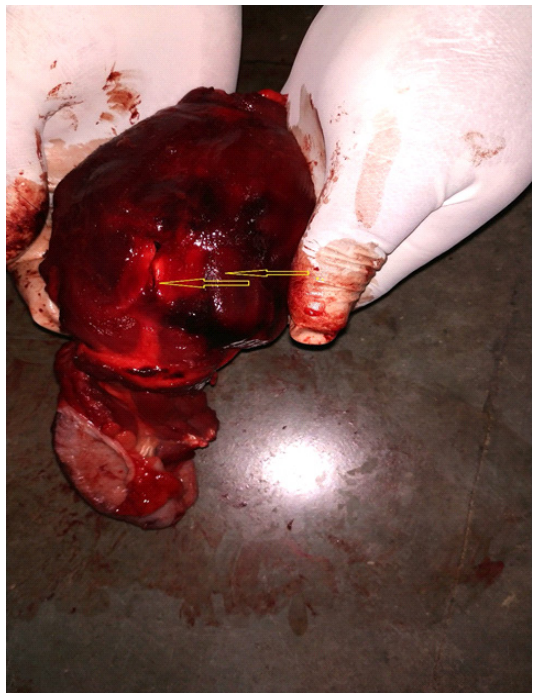

Figure 1. Thyroid cartilage fracture. (SHOWN BY YELLOW ARROW)

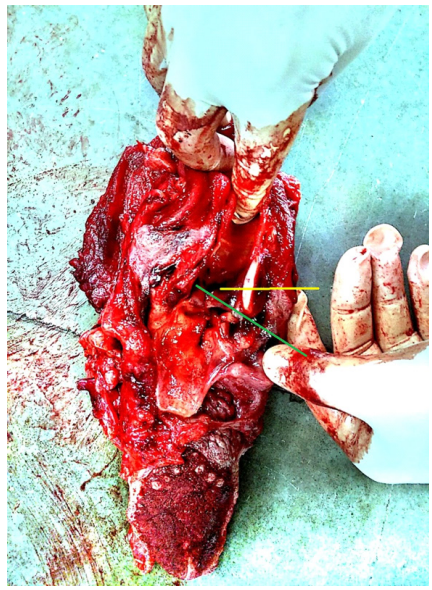

Figure 2. Cricoid cartilage fracture(shown by yellow line) and arytenoid cartilage fracture(shown by green line)

Discussion

Laryngeal fracture is a rare type of injury. Blunt anterior trauma to neck from motor vehicle accident, interpersonal assault or sport injury is most common cause of laryngeal fracture[3,9]. Motor vehicle collision accounts for 59% of all blunt airways' trauma[10]. In

motor vehicle accident, the major cause of laryngeal fracture is direct anterior impact on larynx[1,11,12]. But in recent years laryngeal fracture has a decreasing tendency due to improvement of airbags and abundant safety devices for riders[13]. Penetrating neck trauma due to gun shot or stab wound is second leading cause[14]. In our case laryngeal trauma was from direct impact in motor vehicle accident.

The mortality rate in laryngeal fracture for blunt trauma is more than 40%, whereas for penetrating trauma, it is less than 20%, reflecting greater severity of injury in blunt trauma[5]. The overall mortality rate of laryngeal trauma is 17.9% to 40%, with associated severe airways injury and multiple organ injury many patients died before reaching tertiary care centre[14]. Open laryngeal fractures are quite rare, and likely to be missed only by failure to examine the neck. On the contrary, fractures of laryngeal framework appear more likely to be open internally through mucosa rather than skin and therefore more likely to be missed by external examination[15].In our case, there was no external wound present on the neck. Fracture of thyroid, cricoid and arytenoid were seen only after dissection of neck. This may be caused by high torsional force leading to over extension of neck during the accident.

Fracture of thyroid cartilage occur when it is forced against the cervical spine, eventually, it reaches maximal flexibility, springs back into position, resulting in an anterior linear fracture down the thyroid prominence[16].The same mechanism is applicable in our case wherein the patient's neck collided against the back of four-wheeler.

Conclusion

People have to take a motorcycle riding safety course to learn how to ride safely. People should be aware of road condition or obstruction at road. Always follow traffic rules. The motor vehicle accident can be prevented largely through public awareness and education. Traffic police should be more alert and ensures strictimple mentation of the legislation regarding roads traffic.

Conflict of Interest: Nil

Source of Funding: Nil

Ethical Clearence: Not required

Consent: Informed consent was taken from the relative of deceased's for publishing the photographs and sharing the information of the deceased.

Source of funding: Not required

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Case Study

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A Case of Ratol Poisoning and Review of Literature

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Abstract

We report a case of a 17 year old lady who presented with severe abdominal pain for 4 days. Patient developed fulminant hepatitis and disseminated intravascular coagulation during her hospital stay. History of Ratol (3% yellow phosphorus) ingestion was revealed on the second day of admission. She was managed with NAC infusion for 3 days along with supportive treatment and was discharged on the 10th day of admission. Accidental ingestion of Ratol is common in rural India. Early diagnosis and management of yellow phosphorus can improve the outcome of the patient. It is important to identify predictors of outcome of patients with toxin-induced liver injury.

Keywords: Yellow phosphorus poisoning, Acute liver failure, Disseminated intravascular coagulation, N-acetylcysteine, Toxin Induced Liver Injury

Introduction

Ratol (3% yellow phosphorus) is commonly used as a rodenticide in the agricultural industry in India. Yellow phosphorus is readily absorbed by mucous membranes of the gastrointestinal tract and metabolized by the liver. It can cause direct toxicity to the liver[1][2].

Current scientific literature suggests that a dose of >1mg/kg of yellow phosphorus can be lethal. Yellow phosphorus acts as a protoplasmic poison. Liver injury and neurologic manifestations are commonly reported, with the latter being associated with a poorer prognosis. Bone marrow suppression and ventricular arrhythmias have been reported[2,3,4]. One autopsied case also reported pancreatic damage due to Ratol poisoning. There is no antidote available and treatment is mainly supportive. While some patients have been treated with N-acetylcysteine infusion, the results have been inconclusive. Some patients may also require plasmapheresis. Accidental ingestion of the paste is not uncommon.

Few cases report complete recovery after exposure. We report a case of a 17 year old lady who presented to us with severe liver injury and pancytopenia after Ratol ingestion. Informed consent was taken to share the patient's case from her parents for academic purposes.

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Case Study

A 17-year old lady presented chief complaints of severe epigastric pain and three to four episodes of vomiting and diarrhea, which were non-bloody, non-bilious and lacking any specific odor for four days.

She initially presented to another hospital("Hospital A") where an abdominal ultrasonography(USG) suggested changes of subacute pancreatitis and mild ascites. A CECT abdomen was suggestive of an ileo-ileal intussusception. Blood amylase and lipase levels were elevated, along with thrombocytopenia, leucopenia and transaminitis(see Table 1 below). Dengue IgM and IgG were negative. She was treated with broad spectrum intravenous antibiotics and supportive treatment for four days before she presented to our hospital("Hospital B").

Fig 1: CECT abdomen suggestive of an ileo-ileal intussusceptions

Table 1: Complete blood count, LDH, Ferritin, Troponin levels

Parameters	Day 0 [26/12/23] Hospital A	Day 4 [29/12/23] Hospital B	Day 7 [1/1/24]	Day 13 [7/1/24] DISCHARGE Hospital B	Reference values
Hemoglobin (g/dL)	12.7	11.9	10.4	8.3	12-14 g/dL
RBC count (x106/mm3)	5.01	4.8	3.88	3.04	4-5 million/ mm3
Hematocrit		37.5	30	24.6	Male 41%-53% Female 36%-46%
Reticulocyte count		2			0.5%-1.5%
WBC count (x103/mm3)	12.32	1.7	2.46	11.08	4500-11,000/ mm3
Platelet count (/mm3)	217,000	49,000	23,000	206,000	150,000-400,000/mm3
LDH		1352		351	45-200 U/L
Ferritin		>1650			Male 20-250 ng/mL Female 10-120 ng/mL
CRP	7.1	1.6		0.6	<0.9 mg/dL

Table 2 Liver Function Tests, Renal function tests, Coagulation profile & electrolytes

Liver Function Tests	**Day 0 [26/12/23] Hospital A**	**Day 4 [29/12/23] Hospital B**	**Day 13 [7/1/24] DISCHARGE Hospital B**	**Reference values**
Total Bilirubin (mg/dL)		3.43	2.86	0.1-1.0 mg/dL
Direct (mg/dL)		2.5	1.92	0.0-0.3 mg/dL
Indirect (mg/dL)		0.93	0.94	<0.7 mg/dL
SGPT or ALT (U/L)	147	423	121	10-40 U/L
SGOT or AST (U/L)		328	76	12-38 U/L
ALP (U/L)		91	216	25-100 U/L
Total Protein (g/dL)		4.95	5.66	6.0-7.8 g/dL
Serum Albumin (g/dL)		3.13	3.27	3.5-5.5 g/dL
S. Globulin (g/dL)		1.82	2.39	2.3-3.5 g/dL
Renal function				
Creatinine (mg/dL)		0.72	0.33	0.6-1.2 mg/dL
Urea nitrogen		44.5	9.8	7-18 mg/dL
Coagulation profile				
PT/INR		91.9/7.4	16.4/1.11	11-15 seconds /0.8-1.1
APTT		60.3	33.1	25-40 seconds
D-Dimer		3.05	2.09	≤250 ng/mL
Electrolytes				
Serum Na+	123	136	139	136-146 mEq/L
Serum K+	3.26	2.34	3.5	3.5-5.0 mEq/L
Serum Mg2+		1.16	1.7	1.5-2.0 mEq/L
Serum Ca2+		6.9	9.1	8.4-10.2 mg/dL

On presentation to our hospital, she was afebrile, hypotensive (blood pressure was 90/60mmHg) and had tachycardia(Heart rate 100/min, regular). She weighed 60 kgs. The abdomen was non-tender without any guarding and there was no hepatosplenomegaly. She had mild pallor and icterus. She had presented on the sixth day of her menstrual cycle with persistent heavy bleeding with clots and a change of three pads/day. A gynecology opinion was sought and she was treated with tranexamic acid and injectable vitamin K.

Repeat abdominal ultrasound at our hospital ("Hospital B") was normal. A repeat CECT abdomen showed mild hepatomegaly and minimal free fluid in pelvis and peripancreatic area. There was no evidence of active pancreatitis. Blood analysis revealed leucopenia, thrombocytopenia, transaminitis, hypokalemia (2.67 mEq/L), hypomagnesemia (1.16 mEq/L) and hypocalcemia (6.5 mEq/L), altered coagulation profile and elevated serum amylase and lipase. Serum LDH and Ferritin levels were elevated[Tables 1,2]. The electrocardiogram was suggestive of sinus tachycardia. 2D ECHO showed preserved ejection fraction with no regional wall abnormalities.

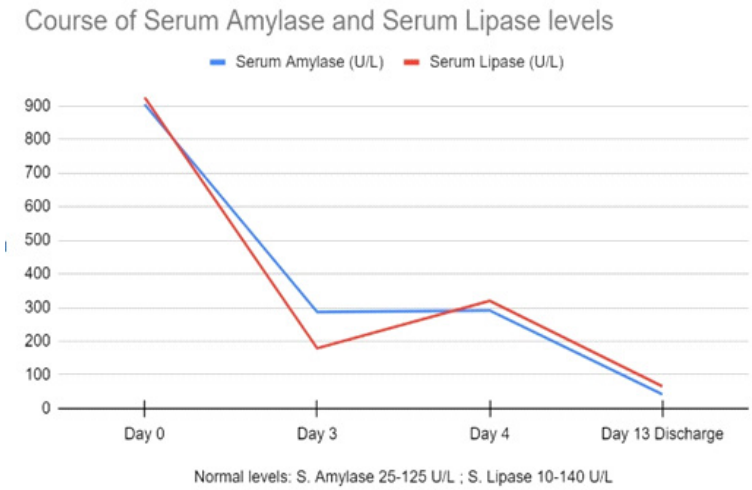

Figure 2: Graphical representation of S. amylase and lipase levels

On the second day of admission to our hospital, she revealed a history of ingestion of Ratol (3% yellow phosphorus), five days prior. The amount of ingestion of the substance could not be retrieved.

Eight Units of Fresh Frozen Plasma(FFP) and four units of Platelet-Rich Concentrates (PRCs) were administered. Menstrual bleeding subsided on the fourth day of admission. All culture reports were negative. A gastroenterology opinion was sought and a diagnosis of toxin induced pancreatitis and hepatitis was made.

A final diagnosis of toxin induced disseminated intravascular coagulation (DIC) (6 Points according to ISTH Criteria- s/o overt DIC), subacute pancreatitis with hypokalemia and pancytopenia was made. She was started on N-Acetylcysteine(NAC) infusion; supportive fluids and broad spectrum antibiotics were continued. She was continued on NAC infusion for three days and then switched to oral form. Intravenous Folinic acid was given for four days in view of pancytopenia.

Her general condition, counts and electrolytes started improving on the third day of admission. A psychiatric evaluation was sought and she was counseled for suicidal attempt prior to discharge. She was discharged on the tenth day of admission at hospital B.

Discussion

Yellow phosphorus is a common ingredient used in fireworks and rodenticides. Accidental or intentional ingestion of yellow phosphorus is quite common, especially in developing countries[1,4]. It is a protoplasmic poison and direct toxicity to the liver has been described. It undergoes exothermic reactions to produce phosphoric acid which causes tissue damage and also forms phosphorus pentoxide which further reacts with organic molecules[5]. Calcium binds preferentially to phosphorus in serum which may result in hypocalcemia[6].

The clinical sequelae of acute phosphorus poisoning are commonly divided into three phases: In the first phase, the patient usually experiences gastrointestinal symptoms like nausea, vomiting, diarrhea and burning pain in mouth, throat and retrosternal chest pain. This phase generally lasts for the first 24 hours. This phase is followed by an asymptomatic phase which may last for the next 48 hours. The third phase (>72 hours) is characterized by systemic toxicity where gastrointestinal symptoms may reappear. Patients may develop pancreatitis, acute liver failure, acute renal failure, pulmonary edema, severe metabolic acidosis, shock and cardiotoxic manifestations like arrhythmias, ischemia or even arrest [1,2,4,7]. Previous studies show that patients presenting with neurological manifestations like hallucinations, confusion, headache, tinnitus, delirium, psychosis and coma, have generally poorer prognosis. Leukopenia and thrombocytopenia have also been described [3,7].

Our patient also followed the classical course of illness. The patient presented to us on the fourth day of Ratol ingestion,in the third phase of toxicity. Initial radiological investigations at the previous hospital were contradictory- suggesting that the patient had developed subacute pancreatitis or intussusception. A case report by Prabhat et al described a 23 year old lady who developed pancreatitis four days after ingestion of yellow phosphorus[8]. Autopsy findings in a case report by Jai Prakash Soni et al showed focal fat necrosis along with necrosis of large areas of pancreatic parenchyma [9].

Ultrasonography and CT abdomen at our hospital revealed no active changes in the pancreas and serum amylase and lipase levels were also in a reducing trend, suggesting that the inflammation was resolving [see Chart 1]. This may be attributed to the treatment that patient had received prior to presentation at our hospital. However, blood investigations were suggestive of severe leukopenia, thrombocytopenia and electrolyte abnormalities-hypokalemia, hypocalcemia, hypomagnesemia, along with transaminitis and features of disseminated intravascular coagulation (DIC) (elevated Fibrin degradation products(FDPs), reduced fibrinogen levels, raised D-dimer) (6 points for overt DIC according to ISTH Criteria).

Decontamination and supportive therapy is given to patients as there is no antidote for yellow phosphorus. Since our patient revealed a history of ingestion on the fourth day since onset of symptoms, gastric lavage wasn't done.

Reports on clinical improvement after timely initiation of NAC are conflicting. In our case, treatment with NAC showed a good outcome compared to the report of Nanditha et al [1]. NAC acts as an antioxidant thus is used for treatment of yellow phosphorus poisoning.

Patients might need plasma exchange, if supportive measures fail, or even a liver transplant if severe organ damage has occurred. Delayed resuscitation, jaundice, hepatic encephalopathy, the elevation of AST and ALT to >1000 IU/L, metabolic acidosis, and refractory shock are reliable predictors of a bad outcome [10]. Ravi Mohanka et al suggested that patients with lower dose ingestion (<17.5 g), absence of cardiotoxicity, <grade 3 HE, lactate < 5.8, SOFA score < 14.5, and increase in SOFA score by < 5.5 were more likely to survive. Apart from hepatic encephalopathy, markers of severe acute liver injury such as PT-INR > 6.0, MELD score > 37, persistently elevated serum lactate despite resuscitation and with plasmapheresis PT-INR > 2.5; at least 12 h after second cycle have been proposed for indication for liver transplantation [2]. Our patient presented with jaundice, transaminitis and pancytopenia. The dose of toxin ingested by our patient could not be determined. Our patient also had a markedly raised PT/INR and SOFA score of 5 points (<33% mortality) on admission and a MELD score of 34 points (52.6% estimated 3-month mortality). Our patient also had an R-factor of 13.9 suggestive of hepatocellular injury- indicating toxin induced liver injury. These were suggestive of poor prognosis for the patient.

As reported in literature, victims of yellow phosphorus poisoning may be initially asymptomatic; however, recovery is observed after 2-3 days, and later on, signs of acute hepatic failure develop [2]. In our case, the patient had an acute progression of complications. Hence, patients with acute yellow phosphorus poisoning warrant close monitoring for at least a week. Psychiatric evaluation and counselling to prevent recurrent suicide attempts should be performed.

There is a statistically significant association between the patient's age, amount of poison consumed, time taken between poison consumption and seeking medical help and the outcome of discharge or death. The study done by McCarron et al. has shown varying mortality rates - 23% for patients with GI symptoms and 73% for those with CNS manifestations [11]. Patients in the younger age group and having a lower dose of ingestion were more likely to recover.

Conclusion

Diagnosing yellow phosphorus poisoning in a patient presenting in emergency is imperative and if treated in a timely manner, patients may show full recovery. Liver damage is found to be the most common complication of yellow phosphorus poisoning. Accidental ingestion of rodenticide should be suspected in cases of severe liver injury, especially in developing countries.

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Conflicts of interest: None

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Case Study

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Acute Ischemic Stroke After Russell's Viper Snake Bite, Rare Presentation: A Case Report

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Abstract

Snake bites are a global health hazard and are a noteworthy cause of mortality and morbidity especially in Southeast Asia. Cerebral complications after snake bite are rare. It can be attributed to various factors such as vasculitis, vasospasm, endothelial damage; toxin-induced procoagulant effect, and disseminated intravascular coagulation. We present a case of a previously healthy 22-year-old woman who suffered acute multiple cerebral infarctions following Russell's viper bite. Imaging revealed significant non-hemorrhagic infarctions in the left middle cerebral artery territory and right pons, indicating rare yet severe neurological complications of viper envenomation. The patient experienced serious complications including rhabdomyolysis and acute kidney injury, ultimately leading to her demise due to aspiration pneumonia and septic shock. This case underscores the potential neurological impact of viper envenomation and underscores the challenges in managing delayed procoagulant effects of snake venom, despite the administration of anti-snake venom. Early detection and intervention remain vital in addressing such devastating outcomes.

Keywords:Ischemic stroke; Cerebral infarct; Russell's viper; Snakebite; Polyvalent antisnake venom; daboia russelii; Acute ischemic stroke

Introduction

The World Health Organization (WHO) estimates that about 5 million snakebites occur each year, resulting in up to 2.7 million envenomings. WHO added snakebite envenoming to its priority list of neglected tropical diseases (NTDs) in June 2017[1]. A nationally representative study (Million Death Study) noted 45,900 annual snakebite deaths nationally. Around 90% of snakebites in India are caused by the 'big four' among the crawlers - common krait, Indian cobra, Russell's viper, and saw-scaled viper[1]. Many victims do not attend health centers or hospitals and instead rely on traditional treatments[2] thus the epidemiology of snake bites has not been adequately studied. About 94% of snakebite deaths occurred

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in rural areas, and 77% occurred out of hospitals[3]. Viper being the most common cause of bite [4], local envenomation is the frequent manifestation, followed by hemostatic abnormalities and neurotoxicity [5,6,7]. Coagulopathy if present is diagnostic of viper bites in South Asia. As reported, the most common species were Russell's vipers with a higher incidence of ischemic stroke than intracranial hemorrhage (ICH) [14]. Whereas in Borthrops ICH was frequently reported[8,14]. Ischemic stroke, when present, commonly involves anterior circulation. Here we describe a polyvalent anti-venom treated patient with multiple infarcts in the left MCA territory, right pons, and right parieto-occipital region with mid-line shift.

Case Report

We report a case of multiple ischemic infarctions following a viper bite in a previously healthy person. A 22-year-old pre-morbidly well female was admitted with a history of snake bite on her left foot above the ankle joint from the Satara district of Maharashtra, south India on 25th June 2023. The snake was identified as Russell's viper, as per the photograph shown by relatives (figure 1). A few minutes after the bite, the patient noticed minimal swelling over the Left foot and ankle joint. 30mins later, the patient developed breathing difficulty and consulted a nearby center, from there patient was referred to an ASV center, meanwhile patient deteriorated and became unconscious. The patient was taken to a civil hospital and Received 10 vials of polyvalent anti-snake venom, atropine-neostigmine within three hours of bite. The patient was referred to a tertiary center with intubated status after 8 hours of snake bites, meanwhile patient received 30 vials of polyvalent anti-snake venom& 4 unit FFP. On arrival (8 hours after bite) patient was moving all 4 limbs, off sedation. Complete blood count was normal with Serum Platelet of 1.56L, PT/aPTT / INR was normal, and serum urea 68 creatinine 2.2, CPK 3160. Suspected rhabdomyolysis with acute kidney injury. The next day (22 hours after the bite) patient was desaturated and the endotracheal tube was blocked with multiple large clots. X-ray showed right upper lobe haziness; due to O2 requirement bronchoscopy was withheld.

Figure 1: Photograph of Russel's viper taken from an attendant phone

48 hours after the bite ICU doctors noticed right hemiplegia with right plantar mute. D-dimer >69000, FDP 217. The 2D echo was normal.MRI+MRA showed an acute Large Non-haemorrhagic infarct in the Left MCA territory with acute infarct in right pons, a right parieto-occipital region with 7mm midline shift to the right side without herniation (figure 2).suspected hypercoagulable state andthe patient received LMWH, anticoagulants, and other supportive measures. The patient was discharged at the request& took the patient to Assam by road for 3 days.

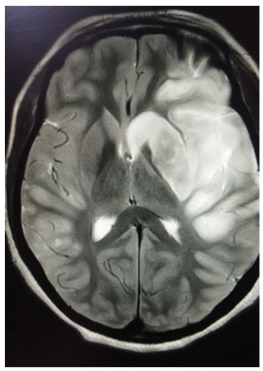
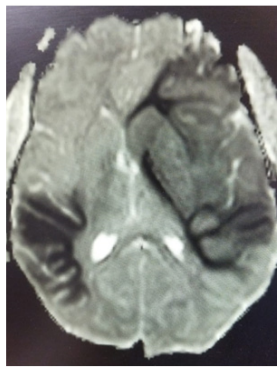


Figure 2 (a)



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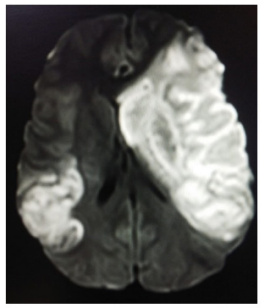

Figure 2 (c)

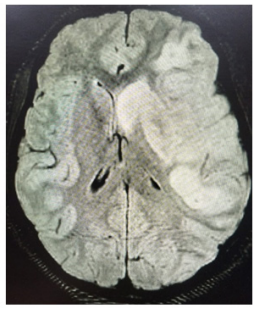

Figure 2 (d)

Figure 2 (e)

The patient received our hospital with a poor Glasgow coma scale (GCS) score of 4/15, increased breathing effort, Temperature of 104*F, coarse crepitation bilaterally, and hypotension. The patient was intubated and a repeat CT scan was taken showed hypo density in the left fronto-parieto-temporal lobes (figure 3),The chest X-ray showed bilateral patchy consolidation. Repeat the Routine investigation shown in Table 1.

Patient admitted to ICU with mechanical ventilator support, ionotropic, and antibiotics in view of aspiration pneumonia and septic shock.

Table 1: Laboratory investigations

Sl.no.	Laboratory parameters (units)	Value
1	Hb (g/dL)	10.9
2	PCV (%)	34.9
3	Platelets (x10³/ul)	452
4	TLC (x10³/ul)	28.80
5	PT (sec)	14.1
6	INR	1.24
8	D-dimer (mcg/mL)	4.28
9	Fibrinogen (mg/dL)	<200
10	LDH (U/L)	412
11	Bilirubin(mg/dL) Direct	0.9
		0.7
12	SGOT(IU/L)	73
13	SGPT(IU/L)	33
14	Albumin(g/dL)	2.7
16	Urea (mg/dL)	235
17	Creatinine(mg/dL)	4.6
18	CPK	230

However, she died on the 14th day of admission despite our best efforts.

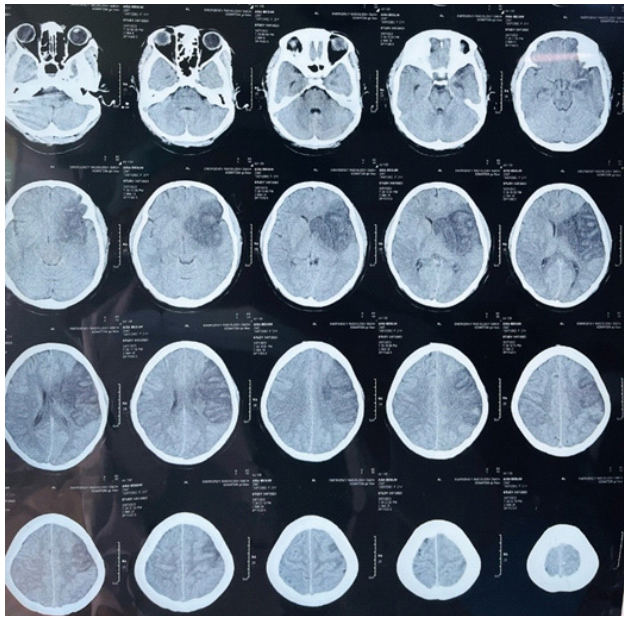

Figure (3): NCCT Brain-Area of hypodensity noted in left fronto-parieto-temporal lobes with loss of gray white matter. There is presence of mass effect as evident by midline shift of 4.5 mm towards right side & compression of ipsilateral lateral ventricle & dilatation of contralateral ventricle

Discussion

Viper bite is the most frequent snake bite in the Indian subcontinent. The presentation of envenomation by viper bite leads to local envenomation, followed by abnormal coagulation [6]. A systematic review yielded 87,590 snakebite cases in India (both fatal and non-fatal) from 2000 to 2019 based on screening 1417 papers and including 78 studies from 24 states or union territories in India, Russell's viper (*Daboia russelii*) constituted 43% of Case-fatality followed by other species [15]. The various toxins present in the viper venom can be categorized both as pro-coagulant and anticoagulant. The toxins with well-established pro-coagulant/platelet aggregating properties are cerastobin [9], factor IVa [10], cerastocytin [11], cerastotin [12], and afaacytin [13]. These various protein products have thrombin-like enzymatic activity. Different toxins activate different parts of the coagulation cascade [9-13]. Their activity is inhibited by monoclonal antibodies against GP1b or GPIIb/IIIa or thrombin receptors.

In a Scoping Study on stroke associated with snake envenomation between Jan 1995 to Oct 2018, 83 published cases were reviewed. 66.3% of the cases were younger than 50 years of age. The mean time for the onset of the symptoms is 23.8±10.9 hours after exposure(In our patient cerebral infarction was noticed 48 hours after the snake bite) 77.1% of the cases were found to have an ischemic stroke, 20.5% with intracranial hemorrhage, and both infarction and hemorrhage in 2.4%[14]. The infarct commonly involves the anterior circulation, with hemiparesis being the frequent presentation[16-19]. Cerebral infarction after snake envenomation is a complex multifactorial mechanism. It includes direct cardiotoxic effects of venom leading to dysrhythmias. This may cause cardiac thromboembolism and hyperviscosity due to hypovolemia and hypofusion secondary to hypotension.In this patient, ischemic infarctions due to hypotension are unlikely as she was normotensive. The possibility of a cardiac source of embolization was excluded.

Disseminated intravascular coagulation is also an associated risk factor in viper bite patients. Disseminated intravascular coagulation can be a cause of neurological disorders, largely due to vessel occlusion [20]. The toxin itself can cause vasospasm which can lead to a cerebrovascular accident.

In a study by Thomas, et al [21] of the 33 patients with envenomation by Bothrops lanceolatus who had not received ASV or received ASV after 8 hours of envenomation, 14% developed thrombotic complications and 4 of the 14 patients who had not received ASV died. Of the 70 patients who received ASV within 6 hours of envenomation, no thrombotic complication. Our patient, despite treatment with ASV within 3 hours of envenomation developed delayed cerebral infarction on the second day. Thrombin-like activities of venoms are not inhibited by heparin [22]. It has never been proven effective in clinical trials [23], even in victims of Russell's vipers (*D.russelii* and *D. siamensis*) envenoming in whom there is some slight theoretical basis for its use [24] Heparin increases the risk of hemorrhage in victims of viper bites and should never be risked in the treatment of these patients[25].

Conclusion

After a viper bite, neurological manifestations can be attributed to various reasons, such as toxin-induced vasculitis, procoagulant effect, endothelial damage, disseminated intravascular coagulation, and hypotension. Though large-vessel thrombosis and infarction are rare clinical entities associated with viper envenomation, they should be considered in Indian patients.Furthermore, this case depicts the fact that even after the early administration of polyvalent antisnake venom, delayed procoagulant properties of snake venom can't be completely preventable. The early detection of the viper bite and the administration of anti-snake venom may prevent this rare but devastating complication.

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Consent to Publish: Consent was obtained from the patient's parents for the publication of this Case Report and any accompanying images.

Consent form is available on request.

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Cardiac Metastasis from Carcinoma Gall Bladder: A Rare Case Detected on Autopsy

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Abstract

Metastasis to the heart is uncommon compared to other organs, posing notable diagnostic challenges. Incidence in autopsy studies typically ranges between 0.7% and 3.5%. Lung, breast, and hematologiccancers are the main sources of such metastases, leading to varied clinical presentations and severe complications. Postmortem viscera from a 47 year old male with a suspected history of jaundice. Only limited information was available. Gross examination showed a solid mass in the gall bladder with areas of hemorrhage and necrosis, while no other abnormalities were observed in other viscera received. Brain examination showed congested blood vessels, while heart sections exhibited atypical cell deposits in the pericardium and myocardium. Coronary arteries displayed pathological thickening. Lung and liver sections also displayed similar metastatic atypical cell deposits, infiltrating tissue and causing necrosis. Gall bladder examination revealed irregular glandular formations lined with polygonal tumor cells positive for cytokeratin. The final diagnosis based on histomorphological features and immunohistochemistry confirmed gall bladder adenocarcinoma metastasising to the heart, liver and lungs.

Keywords: Carcinoma, cardiac metastasis, gall bladder, rare.

Introduction

Cardiac metastasis is relatively rare as compared to metastases in other organs. This may be due to the heart's unique microenvironment due to continuous movement and high blood flow within the heart, which hinder the attachment and proliferation of cancer cells. The incidence of secondary metastatic tumors involving the pericardium, myocardium, major blood vessels or coronary arteries ranges from 0.7% to 3.5% in autopsy studies of the general population and can increase to 9.1% in individuals with known malignancy.[1,2]

Typically, cardiac metastasis from various types of tumors such as lung cancer, breast cancerand hematologic malignancies, contributed to around 36-39%, 10%-12% and 10%-21% respectively.[3] The

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clinical presentation is nonspecific and varies based on their location and size. Cardiac involvement can be life threatening in the form of lethal arrhythmias or many are asymptomatic and incidentally identified posthumously.[4,5]

Imaging tests are vital for detecting cardiac metastases, providing essential information about the size, location, and dynamics of cardiac masses from various tumors. These insights are crucial for understanding their implications on patient health.[6,7] While imaging studies can aid in diagnosing cardiac metastasis, tissue histology remains the most reliable method for distinguishing between neoplastic and non-neoplastic masses.[8]

Case Report

Post mortem viscera of a 47 year old male was received in the department of pathology with alleged history of jaundice. No other significant details regarding past history or investigations were available in the post mortem papers. Piece of brain, whole heart, pieces of lung and liver were received. Piece of brain weighed 50 gm and measured 9x4x1cm. Specimen of heart weighed 220 gm and measured 10x8x3 cm. On cutting open, the right ventricular wall, left ventricular wall and interventricular septum thickness were 0.3 cm, 1.3 cm and 1.1 cm respectively. The circumferences of tricuspid, pulmonary, mitral and aortic valves are 10.6, 8.0, 9.0 and 68 cm respectively. The stump of aorta measures 25 cm, in length. Both the coronaries were traced as far as possible. A piece of lung weighing 60 gm & measuring 9x5x4.5 cm. No abnormality was identified in the various viscera pieces on gross examination. Piece of liverweighed 230 gm and measuring 10x9x6 cm along with attached gall bladder at base of liver piece. On cut section, gall bladder revealed a solid grey white mass almost filling the cavity measuring 4x3.5x2 cm with focal areas of hemorrhage and necrosis. There adjacent mucosa shows mucosal irregularity and thickening.

Microscopic examination from brain showed no significant pathological change. Representative sections from heart revealed deposits of atypical cells arranged in small groups and ill-formed glands in the pericardial tissue and reaching upto myocardium. Sections from right and left coronary arteries revealed the presence of pathological intimal thickening. Sections from pieces of lung and liver also revealed multiple foci of similar metastatic deposits of atypical cells arranged in papillary and glandular pattern as seen in the heart. Sections from gall bladder revealed irregular, angulated or poorly formed glands lined by polygonal tumor cells with enlarged nuclei showing vesicular chromatin, prominent nucleoli or sheets of pleomorphic tumor cells with bizarre nuclei. The tumor cells were positive for cytokeratin and negative for negative for vimentin and S-100. The focii of tumor deposits infiltrating the myocardium were highlighted by cytokeratin. The final diagnosis on the basis of histomorphological features and IHC was given as gall bladder adenocarcinoma with metastasis to heart, liver and lungs.

Figure 1: Grossly heart shows no abnormality.

Figure 2: Gross examination shows an infiltrative, grey white solid mass in gall bladder with unremarkable liver on cut section.

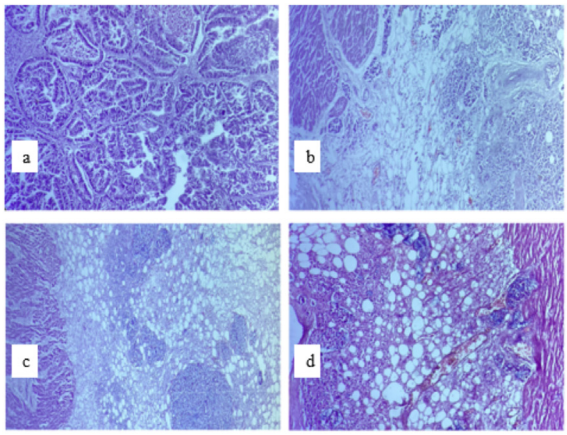

Figure 3 (a) Microphotograph from gall bladder mass shows irregularly shaped glands lined by tumor cells(H & E stain X100), 3 (b, c) Microphotograph showing tumor cells arranged in glandular pattern in the pericardium (H & E stain X100), 3 (d) Microphotograph showing foci of tumor cells infiltrating the adjacent myocardium. (H & E stain X100)

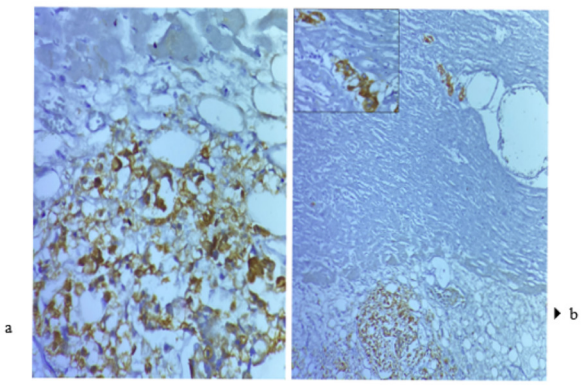

Figure 4a. Microphotograph showing tumor cells in pericardium positive for cytokeratin (IHC cytokeratin X400)

Figure 4b. Microphotograph showing tumor cells in pericardium and myocardium positive for cytokeratin (IHC cytokeratin X100) inset shows tumor cells in myocardium positive for cytokeratin (IHC cytokeratin X400)

Discussion

Metastasis involving the heart is rare and often discovered incidentally during autopsy as more than 90% are clinically silent with only a few cases documented in literature. Studies indicate that cardiac metastasis are found in 1.5% to 20% of autopsies of cancer patients and merely 0.2% to 6.5% in general autopsy cases.[8] These metastasis typically are seen in pericardium but can uncommonly affect the endocardium, myocardium or coronary arteries. Common symptoms and signs include difficulty breathing, irregular heartbeat, leg swelling, and chest discomfort.

Various imaging techniques can play important role in the diagnosis of cardiac metastasis. Echocardiography (ECG) is typically the first imaging method used to detect pericardial effusions and evaluate any cardiac metastases. It show presence of nonspecific ST-T–wave changes and new atrial arrhythmias. Chest X-ray may reveal water bottle sign, indicating the presence of a pericardial effusion. Cardiac magnetic resonance imaging (CMR), computed tomography (CT) and positron emission tomography can provide additional noninvasive characterisation of cardiac masses.[8] Although clinical diagnosis of cardiac metastasis can sometimes be made on imaging but tissue histology remains the most definitive and despite the advances in imaging techniques in recent years, malignant cardiac metastasis are mostly not discovered until autopsy.[1]

In a study conducted by Luis M[9] et al, a total of 1294 adult autopsies were reviewed over a span of 35 years. A total of 124 cases of secondary cardiac tumors were identified out of which 61 cases were confirmed cardiac metastases of solid cancers. The age range of affected individuals was 32 to 85 years. All cases also exhibited multiple extracardiac metastases, with 56 cases (91.8%) showing distant metastases in four or more different organs. The study revealed an incidence of cardiac metastasis at 4.71%, with lung cancer being the primary contributor to cardiac metastases. Carcinoma emerged as the most prevalent histological type observed. Furthermore, the pericardium was identified as the most common site of metastasis.

In another study by Inoue[10] et al 68 year old woman presented with hematemesis, high fever, and right upper quadrant pain, revealing an elastic hard mass upon examination. Imaging confirmed gallbladder carcinoma invading the liver. Biopsy confirmed poorly differentiated adenocarcinoma. Esophagogastroduodenoscopy revealed duodenal

invasion and subsequent examination showed new gastric lesions, both biopsied as poorly differentiated adenocarcinoma. Despite supportive care, she succumbed a month later. Autopsy revealed a large gallbladder adenocarcinoma with widespread metastasis to liver, pancreas, duodenum, kidneys, adrenal glands, lungs, bones, and heart, including pericardial and myocardial tumors with coronary artery involvement. All metastatic nodules were confirmed as poorly differentiated adenocarcinomas.

Gunjiganvi[11] et al reported a case of 54 year old woman with a history of laparoscopic cholecystectomy four years prior presented with breathing difficulty and chest pain. Subsequent diagnosis revealed advanced adenocarcinoma. She underwent radical cholecystectomy and chemotherapy, with normal post-treatment scans. However, she developed cardiomegaly, pleural, and pericardial effusion. Despite conservative treatment, her condition deteriorated. Further tests indicated metastatic tumor spread. Surgical intervention drained a massive pericardial effusion, confirming metastatic adenocarcinoma in the pericardium. Despite efforts, her condition worsened, leading to respiratory distress and eventual demise. Histopathological analysis of pericardial tissue confirmed metastatic adenocarcinoma infiltration.

Parmar[12] et al reported a case of 40 year old male, previously diagnosed with gallbladder cancer, collapsed suddenly, leading to a postmortem examination to determine the cause of death. The autopsy revealed a tumor originating from the gallbladder, perforating its upper part, with metastatic nodules found on the liver's surface. The heart, brain, spleen, lung, and kidney specimens were examined. The heart weighed 210g with multiple nodules observed in its walls. Lung and kidney sections showed similar nodules, while the liver displayed various nodules ranging from 1.6 to 4.0 cms. Histopathological analysis confirmed adenocarcinoma infiltration in the gallbladder, liver and nodules in the heart, lung, and kidney, with spleen sections showing congestion only.

Other single case reports have been published for cardiac metastasis from other tumors like study conducted by Siqueira[13] et al a reported a case of following surgery for recurrent penile squamous cell carcinoma, a 79-year-old man developed cardiac complications, with autopsy showing carcinoma mimicking endocarditis, confirmed microscopically and another study by Gibbs[14] et al documented two cases of metastatic malignant melanoma where patients presented with nonspecific lung symptoms. One patient had successful surgery to remove a large tumor, relieving symptoms. The other underwent a biopsy of a right ventricular mass, resulting in severe complications and unsuccessful resuscitation, with postmortem confirmation of melanoma

In the present study, there was no history or investigations available in the post mortem papers. Gross examination of heart revealed no abnormality, however the microscopic examination revealed cluster of tumor cells in pericardium and myocardium along with multiple such foci of metastatic deposits of atypical cells in lung and liver also.

Although clinical diagnosis of cardiac metastasis remains challenging, advancements in laboratory techniques enable timely and precise identification. The cases discussed, including ours, underscore the necessity of considering cardiac metastasis in the differential diagnosis in patients presenting with acute coronary symptom in known malignancy cases. Heightened awareness and vigilance are crucial for ensuring timely detection and appropriate management of this condition.

Conclusion

Cardiac metastases are often clinically silent, they should always be considered in any individual with new cardiac symptoms and known malignancy. The clinical sequelae of cardiac metastasis is varied, numerous and depends on the anatomic localisation of tumor. Echocardiography is the initial imaging test for the detection of cardiac metastasis cardiac CT and positron emission tomography/CT may help to further characterise and delineate the extent of both cardiac and extracardiac disease.

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Ethical Clearance: Not required as it is a case report. The identity of the deceased is masked and therefore permission from relatives was not obtained.

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Systematic Review

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Examining the Effect of Disorders upon Impulsive Behavior in Criminal Actions and its Legal Implications in Emergency Department: Systematic Review

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Abstract

Background: There are significant concerns regarding the relationship between mental health and criminal culpability since impulse control problems have long been linked to the genesis of criminal behavior. In trying to clarify the complex legal ramifications that result from this link, this study explores the close link between diseases that inhibit impulse control and their possible role in criminal behavior in patients coming to emergency department.

Aim: This research aims to explore how impulse control disorders contribute to criminal actions, emphasizing significant correlations and calling for transformative changes in the emergency help for psychiatric patients and in criminal justice system.

Methodology: This study utilized Bullion Words for a literature review, identifying 24,400 hits, and narrowing down to 24 papers after rigorous selection. The systematic review explores the interplay between impulse control disorders and criminal actions, emphasizing legal implications. Ethical considerations ensure confidentiality. The study concludes with key findings, relationship insights, legal discussions, and future research suggestions.

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Result: This systematic review reveals a nuanced understanding of how impulse control disorders contribute to criminal actions. Identifying specific disorders like kleptomania and intermittent explosive disorder emphasizes the complex interplay of genetic, environmental, and psychological factors. The legal implications highlight the need for a paradigm shift in the criminal justice system, advocating tailored interventions and rehabilitation strategies, and offering a novel perspective for future legal frameworks.

Conclusion: This systematic review provides a comprehensive overview of the complex interconnection between impulse control disorders and criminal actions. The findings underscore the importance of recognizing these disorders in legal contexts and advocate for a nuanced approach to sentencing and treatment. Future research should focus on refining diagnostic criteria, exploring intervention strategies, and elucidating the long-term impact of impulse control disorders on legal outcomes. Overall, this review contributes to a more informed understanding of the legal implications surrounding impulse control disorders and criminal actions.

Keywords: Criminal culpability, Criminal behavior, Impulsivity disorders, Legal Implications, Mental health and crime, Psychiatric disorders, Emergency Department.

Introduction

The study of impulsivity disorders has become a focal point for researchers, medical professionals, and legal experts delving into the intricate interplay between mental health and criminal behavior.[1] This systematic exploration delves into the legal consequences arising from the complex relationships between criminal conduct and impulse control challenges. Understanding the nuanced link between mental health and criminality is crucial, as it holds profound implications for judicial systems striving to dispense justice.[2,3] An increase in tension and anxiety precedes an impulsive act in people with impulse control problems, and the act itself is accompanied by feelings of pleasure, satisfaction, or relaxation. [4] Impulse control disorders, exemplified by conditions such as kleptomania and intermittent explosive disorder, disrupt conventional notions of criminal responsibility. Due to psychological problems, many people may harm themselves or others by burning and come to the emergency departments.[5,6] Individuals grappling with these disorders may find themselves entangled in harmful behaviors, acting without full awareness or control. [7] Legal outcomes become contingent on factors like the individual's mental state and comprehension of their actions. Some may even be deemed not criminally responsible, necessitating comprehensive evaluations by both mental health and legal experts. [8] Treatment avenues, including psychotherapy and medication, are employed in emergency department to address underlying issues and mitigate the risk of future impulsive actions. [9]

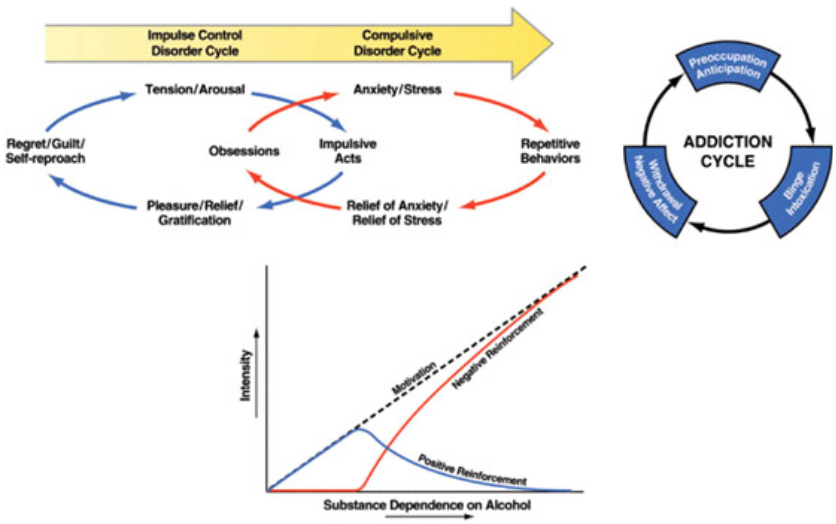


Fig 1: Impulse control disorder and compulsive disorder cycles

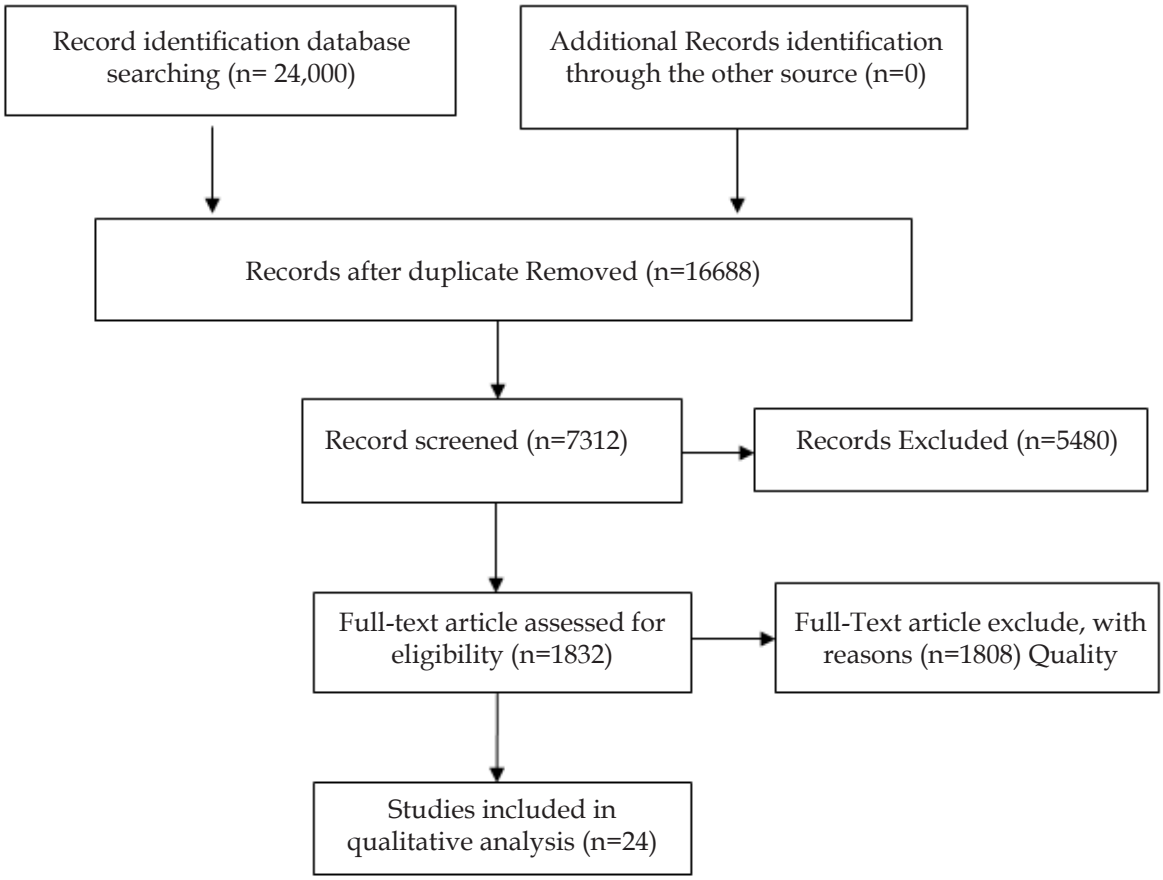
This systematic review aims to elucidate how impulse control problems serve as catalysts for

criminal behavior through a meticulous analysis of the available literature. Extensive academic study has long investigated the intricate relationship between mental health and criminal conduct, with an accumulating body of evidence suggesting that impulse control problems not only precede criminal activity but also play a pivotal role in its development. [10,11] The study seeks to comprehensively synthesize the existing knowledge about the relationship between impulse control problems and criminal activities by closely scrutinizing empirical data. The legal implications stemming from this intricate relationship are expansive, thrusting courts and legal systems into the intricate challenge of adjudicating cases involving individuals with impulse control disorders. [12] Questions about criminal responsibility, intent, and the appropriateness of punitive measures come to the forefront. As societal awareness of mental health evolves, the legal framework must adapt to ensure a fair and just system that takes into account the complexities of mental health conditions. [13] This systematic investigation adopts a multidisciplinary approach, drawing on insights from criminology, psychiatry, neuroscience, and law to thoroughly examine the intricate facets of impulse control disorders and their correlation with criminal behavior. [14] The primary objective is to contribute to a more comprehensive understanding of the intricate relationship between mental health and crime by amalgamating research from diverse domains. The design of this review stems from a systematic and comprehensive analysis of the entire body of available literature. The initial phase provides an overview of impulse control disorders, exploring their diverse manifestations and the criteria for diagnosis. Subsequently, empirical research on the frequency of impulse control issues in individuals engaged in criminal activity is examined. [15] This investigation also scrutinizes the potential pathways through which these disorders may influence criminal behavior.[16] Additionally, a critical assessment of the methodologies employed in prior studies is conducted, illuminating the shortcomings and gaps in the literature to guide further research. The section addressing legal implications delves into pivotal decisions, legal theories, and jurisprudential perspectives grappling with the complexities associated with impulse control disorders in the legal system. [17] This systematic review serves as a comprehensive examination of the body of research, aiming to clarify the intricate link between impulse control problems and criminal behavior. Ultimately, it aspires to contribute to a more informed and compassionate judicial system by elucidating the legal ramifications and enriching ongoing conversations about the relationship between mental health and the realm of criminal justice. [18]

Methodology

In conducting this study's literature review, a digital database, Bullion Words, was employed to search through various publications, yielding 24,400 hits. After careful consideration, 16,688 articles were selected as a representative sample. A further analysis narrowed the examination to 7,312 samples, with 5,480 disregarded due to download issues. Following the elimination of 1,832 articles for quality concerns, 1,808 articles underwent full-text analysis, resulting in the final selection of 24 papers (n=24). The systematic review aims to explore the interplay between impulse control disorders and criminal actions, emphasizing legal implications. It commences with a comprehensive literature review, using keywords such as "impulse control disorders," "criminal behavior," and "legal implications" in databases like PubMed and PsycINFO. Inclusion criteria are defined to filter studies within a specified timeframe, accommodating diverse methodologies. A thorough screening process based on predefined criteria is applied to selected studies, followed by systematic data extraction considering factors like sample size and methodologies. Thematic and sub-group analyses have been conducted to synthesize and categorize data, exploring variations in study designs, populations, and legal frameworks. Throughout the review process, ethical considerations were prioritized, ensuring confidentiality and responsible data handling. The study is concluded with a comprehensive summary, a few conclusions on the relationship between impulse control disorders and criminal actions, and discussions on legal implications, accompanied by suggestions for future research.

Prisma Flow chart:



Results

This systematic review unravels a nuanced understanding of how disorders impacting impulse control intricately contribute to criminal actions. It uncovers a significant correlation, emphasizing the complex interplay of genetic, environmental, and psychological factors. Unique to this study is the identification of specific disorders, including kleptomania and intermittent explosive disorder, as potent contributors to criminal behaviors. The legal implications underscore the need for a paradigm shift in the criminal justice system, advocating for tailored interventions, mental health assessments, and rehabilitation strategies to address the intricate dynamics and underlying issues, offering a novel perspective for future legal frameworks.

Discussion

In a systematic review conducted in August 2011 by Kiepek N, Magalhaes L, and colleagues, the study delves into the complex connections among impulse control disorders, criminal behaviors, and legal ramifications. The findings unveil a nuanced interaction between mental health and legal frameworks. [19] In a 2019 review by Focquaert F., the study investigates the prevalence and expressions of impulse control disorders within criminal contexts. It emphasizes a noteworthy correlation with criminal behaviors, challenging conventional perspectives on criminal culpability. The diverse spectrum of findings underscores the necessity for nuanced legal considerations. [20] In a 1998 study led by Downs DA and colleagues, the focus is on the legal implications arising from the interplay of impulse control disorders and criminal behavior. Through an analysis of landmark cases, the study reveals challenges in adjudicating cases involving these disorders. This underscores the imperative for legal frameworks that are finely tuned to the complexities of mental health conditions. [21] In a 2022 study by Mendenhall E and colleagues, an examination of heterogeneity in study designs and populations

sheds light on the intricate interplay between mental health conditions and criminal behaviors. Sub-group analyses uncover variations, enhancing our nuanced understanding of the relationship. [22] In a study conducted in 2022 by Ward T, Arrigo B, and others, a critical examination of legal cases brings attention to challenges and emphasizes the evolving perspectives within jurisprudence in response to our deepening understanding of mental health. Ethical considerations probe into matters of confidentiality and responsible data handling, with a priority placed on the well-being and rights of the individuals involved. [23] The development of facilities for counseling and psychological and psychiatric treatment is highly recommended in reformatory schools. [24]

Conclusion

In conclusion, the systematic review establishes a significant association between impulse control disorders and criminal actions, challenging conventional views on criminal culpability. Legal implications underscore the complexities faced by legal systems in cases involving individuals with these disorders, emphasizing the need for nuanced frameworks. The study also highlights evolving jurisprudential perspectives and ethical considerations at the intersection of mental health and the legal system, contributing to a comprehensive understanding of this intricate relationship.

Recommendations:

In light of the conclusions drawn from this systematic review, it is recommended that legal systems evolve to accommodate the complexities arising from the association between impulse control disorders and criminal actions. Nuanced frameworks should be developed to account for the unique challenges presented by individuals with these disorders, challenging conventional notions of criminal culpability. Further, legal authorities should consider incorporating evolving jurisprudential perspectives and ethical considerations when addressing cases involving mental health issues. This calls for ongoing collaboration between legal and mental health professionals to establish guidelines that reflect a more comprehensive understanding of the intricate relationship between impulse control disorders and the legal system.

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Source of funding: None

Ethical Clearance: Not Applicable

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Original Research Article

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Histopathological Spectrum of Cardiac Tuberculosis on Autopsy: Series of 11 Cases

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Abstract

Background: Tuberculosis (TB) is leading cause of morbidity and mortality worldwide. However, this endemic disease rarely involves heart. Cardiac TB can involve any structure of heart with pericarditis is most frequent manifestation.

Methods: This retrospective study was conducted at Department of Pathology from January 2012 to December 2020. Autopsy records of all cases suggestive of tuberculosis in any part of heart were selected and slides were reviewed.

Results: A total of 11 cases of cardiac TB were recorded on autopsy, including 6 cases of isolated myocarditis, 2 cases of myopericarditis 2 cases of isolated pericarditis and one case of necrotizing arteritis in left coronary artery. Concomitant pulmonary TB was present in 72.7% cases.

Conclusion: This study highlights that in all patients of pulmonary tuberculosis with appearance of any cardiovascular sign or symptom, cardiac TB should be suspected as one of the differentials.

Keywords:, Caseating granuloma, fibrinous pericarditis, necrotizing arteritis, tuberculous myopericarditis

Introduction

Tuberculosis (TB) is a communicable disease caused by *Mycobacterium tuberculosis* and is a major cause of morbidity worldwide and the leading cause of death from a single infectious agent. TB is endemic in India and has the highest burden of tuberculosis accounting for 26% of the global cases as per Global TB Report 2020.[1] This slowly developing disease may affect any organ in body and can have variable presentations that can pose diagnostic difficulties.

Cardiac tuberculosis is rarely reported and is usually seen secondary to lesions elsewhere in the

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body. It occurs in 1 to 2 % of patients with pulmonary TB.[1] Pericardium is the most frequently affected part of heart by TB, however few cases of involvement of myocardium, endocardium, valves, aorta and coronary artery are reported in literature.[2,3,4,5]TB accounts for pericarditis in approximately <5% of cases clinically and can presents as acute pericarditis, pericardial effusion, cardiac tamponade and constrictive pericarditis.[6,7] Incidence and mortality found to be higher in cases associated with immunodeficiency states.[7,8] Tuberculosis is the most common cause of constrictive pericarditis in endemic countries, accounting for 38% to 83% of the cases.[9]

Myocarditis is exceedingly rare presentation of this endemic disease and mostly reported in association with pericardial involvement. Literature in past had reported prevalence of 0.14%, 0.2% and 2-5% in various series.[7,10,11] It was suggested that either due to continuous myocardial contractility which prevents lodgment of tubercle bacilli or the production of lactic acid through muscular activity protects heart from tuberculous infection.[12]

Autopsy studies are helpful in not only finding the cause of death, but also an opportunity to study the whole human body as a whole to fill the gaps in existing knowledge about etiopathogenesis and effect of rare diseases. Here we are presenting a series of eleven cases describing histopathological spectrum of cardiac TB on autopsy from a tertiary care center of north India.

Material and Methods

This retrospective study was conducted at Department of Pathology, Bhagat Phool Singh Government Medical College for Women, Khanpur Kalan, Sonepat from January 2012 to December 2020. Routinely, post-mortem specimens of various organs were received in our department along with postmortem examination report from forensic expert. Grossing of 10% formalin fixed specimens was performed and sections were taken from various organs including heart, lung, liver, spleen, kidney and brain for histopathological examination. Sections were processed and Hematoxylin & eosin stained sections were examined. Ziehl-Neelsen (ZN) staining for acid fast bacilli using 20% H2SO4 was performed as per requirement. Records of histopathology reporting of autopsy specimens were reviewed and cases with either of the findings were included in this study: (i) caseating granulomatous inflammation in any structure of heart with/without AFB positivity with ZN stain (ii) AFB negative granulomatous inflammation in heart with AFB positive granulomatous inflammation in lung. Relevant data including demographic details, cause of death, gross and microscopic findings were noted. Histopathology slides were reviewed and findings were recorded.

Results

In the present study, a total of 11 cases of cardiac TB involving different cardiovascular structures (0.28%) were observed out of 3923 autopsy heart specimens received during 9 years. This study showed male preponderance with M:F ratio of 10:1. Age range was from 24- 65 years with mean age 39.1 years. We observed 8 cases (72.7%) in below 45 years age group while only 3 cases in more than 45 years age group. Postmortem papers mentioned cause of death as sudden death in 5 cases, chronic illness in 3 cases while TB in 2 cases.

In our study, 6 cases of isolated myocarditis, 2 cases of myopericarditis 2 cases of isolated pericarditis and one case of necrotizing arteritis in left coronary artery were reported. Concomitant pulmonary TB was present in 72.7% cases. ZN staining for AFB was positive in only 54.5% cardiac TB cases while positive in lung of all cases of pulmonary TB with heart involvement. Disseminated TB was reported in two cases with miliary tubercles in various organs.

Grossly, all four cases of pericarditis revealed that both visceral and parietal layers of pericardium are grey white, opaque, thick and adhered firmly to underlying myocardium. On microscopy, two cases reveal myopericarditis with eosinophilic fibrinous exudate and chronic inflammatory infiltrate in pericardium. Other two cases showed caseating granulomatous inflammation with fibrosis.

We observed 6 cases of isolated myocarditis and 2 cases of myopericarditis. Left ventricle was the most common area (75%) involved in myocarditis

followed by apex and interventricular septum. Grossly, grey white areas identified in myocardium ranging from 2 mm to 1.5 cm diameter in 37.5% cases. Histopathology revealed variable number of granulomas ranging from a single caseating granuloma to multiple coalescing epithelioid cell granulomas replacing large areas in myocardium along with lymphocytes, Langhans giant cells and caseation necrosis at places. In three cases, miliary myocarditis with miliary tubercles in other organs was present. Pulmonary TB was reported in 80% of cases showing myocardial involvement.

Only one and very rare involvement of coronary artery by TB was also reported in our study in a 43 years male presented with history of sudden death. Grossly, no abnormality detected in any part of heart expect for thickened left coronary artery wall with narrowing of lumen. Microscopy revealed necrotizing arteritis with presence of occasional granuloma in the arterial wall and ZN staining for AFB was positive. Lung and liver were unremarkable grossly as well as microscopically in this case (Table 1).

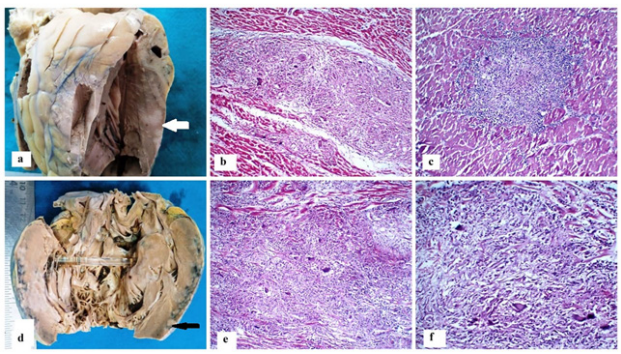

Figure 1 (a) Gross specimen of heart revealing multiple grey white areas in the left ventricular wall (thick white arrow), (b) Microphotograph from same case showing multiple epithelioid cell granulomas with multinucleated giant cells infiltrating the myocardium (H&EX40), (c) Microphotograph from another case showing occasional necrotizing epithelioid cell granuloma in myocardium (H&EX100), (d) Gross specimen of heart revealing multiple grey white areas in the left ventricular wall (thin black arrow), (e) & (f) Microphotograph from same case showing multiple epithelioid cell granulomas (H&EX100, H&EX200).

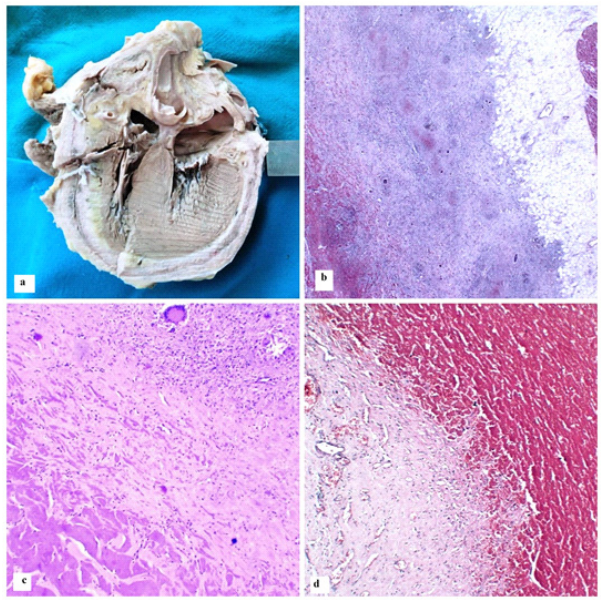

Figure 2 (a) Gross section of the heart revealing layers of pericardium thick and opaque, (b) & (c) Microsections from the heart revealing multiple epithelioid granulomas, giant cells and exudate in the pericardium(H&EX20, H&EX100), (d) Microsections revealing thick fibrinous exudate and fibrosis in pericardium (H&EX100).

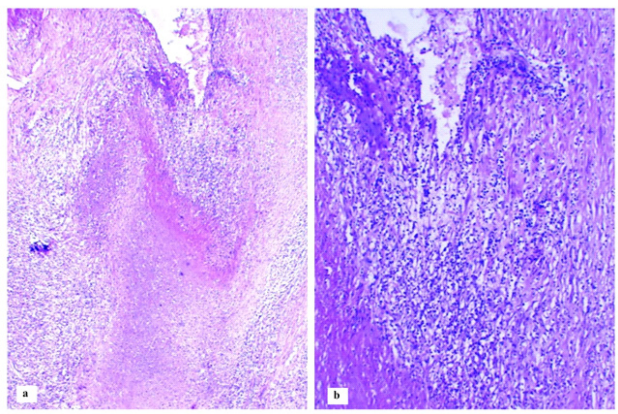

Figure 3 (a) & (b) Microsections from left coronary artery revealing caseous necrosis and epithelioid cell granulomas in the wall (H&EX40, H&EX100).

Table 1: Demographic and histomorphological findings of 11 cases of cardiac tuberculosis on autopsy.

S No.	Age (Yrs)	Sex	Cause of death (as mentioned in Post mortem papers)	Cardiac findings					Pulmonary findings	Extra pulmonary findings
				Area of heart involved	Weight of heart (gm)	Gross Features	Micros-copy	Diagnosis		
1	50	M	Chronic illness	Apex, IVS, LVW	324	Multiple grey white areas in apex and IVS	Multiple necrotizing granulo-matous inflamma-tion AFB - posi-tive	Tuberculous Myocarditis	-	-
2	35	M	Sudden death	Apex, IVS, LVW	338	Multiple grey white areas in LVW and IVS	Multiple epithelioid cell granu-lomas AFB -positive	Tuberculous Myocarditis	Multiple necrotizing epithelioid cell granu-lomas AFB -positive	Occasional granulomas in liver
3	30	M	Chronic illness	IVS	200	-	Few necrotizing epithelioid cell granu-lomas AFB - positive	Tuberculous Myocarditis	-	-
4	42	M	Sudden death	LVW	232	-	Occasional epithelioid cell granu-loma AFB-negative	Tuberculous Myocarditis	Multiple necrotizing epithelioid cell granu-lomas AFB-positive	-
5	24	M	TB	LVW	224	-	Few epithelioid cell granu-lomas AFB- nega-tive	Tuberculous Myocarditis	Multiple necrotizing epithelioid cell granu-lomas AFB- posi-tive	Multiple necrotizing epithelioid cell granulomas AFB-positive in Liver, kidney and spleen, Tubercular meningitis, AFB-positive
6	25	F	Sudden death	Apex	260	-	Ill formed epithelioid cell granu-lomas AFB-negative	Tuberculous Myocarditis	Multiple necrotizing epithelioid cell granu-lomas AFB- posi-tive	-

7	55	M	Sudden death	LVW, IVS and pericardium	620	Thick pericardium, occasional grey white areas in LVW and IVS	Few necrotizing epithelioid cell granulomas in myocardium with serofibrinous pericarditis AFB-positive	Tuberculous Myopericarditis	Multiple necrotizing epithelioid cell granulomas AFB- positive	Epithelioid cell granuloms in spleen
8	26	M	Chronic illness	LVW	276	Thick white pericardium	Few epithelioid cell granulomas in myocardium with fibrinous pericarditis AFB- negative	Tuberculous Myopericarditis	Multiple necrotizing epithelioid cell granulomas AFB- positive	-
9	35	M	Chronic illness	Pericardium	350	Thick grey white pericardium	Multiple necrotizing epithelioid cell granulomas, fibrinous exudate, fibrosis in pericardium AFB-positive	Tuberculous pericarditis	Multiple necrotizing epithelioid cell granulomas AFB- positive	-
10	65	M	TB	Pericardium	700	Thick grey white pericardium	Multiple necrotizing epithelioid cell granulomas, fibrinous exudate and fibrosis in pericardium AFB- negative	Tuberculous pericarditis	Multiple necrotizing epithelioid cell granulomas AFB – positive	Renal amyloidosis
11	43	M	Sudden death	Left coronary artery		Lumen of left coronary artery appear narrowed	Necrotizing arteritis with occasional epithelioid cell granuloma in left coronary artery AFB – positive	Tuberculous Coronary arteritis	-	-

Discussion

Tuberculosis stands top among infectious etiologies causing disease burden and death worldwide.[1] Laennec was the first to describe cardiac tuberculosis in 1826 and kept heart last in the list of organs involved by TB.[13] Tuberculous pericarditis or myopericarditis has been reported, however isolated myocarditis, tuberculoma, tuberculous endocarditis and arterial involvement are rarely reported.[10]

TB is believed to be one of the main causes of pericarditis in developing countries and its incidence is significantly rising in association with immunocompromised status like HIV.7,14 Four pathological stages of tuberculous pericarditis are recognized: (1) fibrinous exudation rich in neutrophils, early granuloma formation and abundant mycobacteria; (2) serosanguineous effusion with plenty of mononuclear cells; (3) absorption of effusion with multiple caseating granulomas and later on thickened pericardium and finally fibrosis; and (4) constrictive pericarditis due to fibrous scar around heart encasing it that reduces diastolic filling.

The first ever case of myocardial TB was reported in 1664 by Maurocadat and second by Morgagni in 1761.[10] Myocardium can contract the infection mostly through blood borne seedling and less frequently by retrograde lymphatic drainage from tuberculous mediastinal nodes or direct spread from infected structures in surrounding.[15]Three histological patterns of tuberculous myocarditis as describe by Horn and Saphirare are (i) nodular tubercles of the myocardium that varies from pea to egg size with central caseation, (ii) miliary tubercles of the myocardium complicating generalized miliary disease, and (iii) diffuse infiltration associated with tuberculous pericarditis where myocardium is infiltrated by granulation tissues containing giant cells, endothelial cells and lymphocytes.[16] Anatomical predilection of the wall of right atrium involvement has been described due of the frequent involvement of the right mediastinal lymph nodes by tuberculosis and subsequent spread to the adjoining myocardium.[17] Clinically tuberculous myocarditis can present as arrhythmias, conduction blocks, cardiogenic shock, ventricular aneurysm, right ventricular outflow obstruction or even sudden cardiac death,.[18]

Ante mortem diagnosis of this entity is challenging as many patients remain asymptomatic, rarely suspected clinically and obtaining sample for AFB staining or culture from heart is difficulty.[7]Thus, majority of the cases of cardiac tuberculosis were diagnosed incidentally on autopsy and accounts for <0.1% of TB-related deaths.[10,18]

In our study, preponderance of young individuals (below 45 years) and male gender for cardiac TB was observed. We had reported cases of pericarditis, myocarditis, myopericarditis and necrotizing arteritis caused by TB. Left ventricle was most frequently affected site with simultaneous presence of pulmonary TB was seen in 80% cases of myocarditis. In presence of caseating granulomas with or without AFB positivity, the diagnosis of TB is obvious. However, in case of occasional non caseating granulomas in heart, histological evidence of concomitant pulmonary tuberculosis is highly suggestive of cardiac TB.

Findings of our case series are similar to a systematic review of 16 cases by Michira et al. They observed that males were twice more frequently affected by tuberculous myocarditis than in females. Most of the reported cases of tuberculous myocarditis were predominantly in immunocompetent patients. Out of the reported sudden cardiac deaths, 81% occur in the 'young' patients (below 45 years). Left ventricle was commonly involved structure (68%) with concomitant pulmonary infection was reported in 56% of the cases. Concomitant pericarditis was recorded in 43% of the cases. Involvement of other extrapulmonary sites apart from the heart was recorded in 56% of the cases. Isolated cases of tuberculous myocarditis without involvement of any other organs were found in 25% of all reviewed cases.[19]

In a study conducted by Rose AG, myocardial tuberculosis was observed in 19 patients (0.14%) at autopsy over a 27-year period. Eight patients had miliary lesions and 11 had nodular lesions, most commonly observed in the ventricles. Out of the 19 cases, only in one patient diagnosis of myocardial TB was made ante mortem. Three patients developed left ventricular aneurysms.[10]

Differential diagnosis of cardiac TB includes granulomatous and giant cell rich lesions in heart.

Clinical history, radiological and serological investigations will always help in narrowing down the differentials. Differentials include sarcoidosis, fungal infections, giant cell myocarditis, systemic lupus erythematosus, syphilis, drug hypersensitivity, rheumatic fever and idiopathic granulomatous myocarditis.[20] Presence of confluent non caseating granulomas with peripheral fibrosis and asteroid bodies in giant cells may help in reaching the diagnosis of sarcoidosis. Necrotizing granulomas are seen in case of fungal carditis with Periodic Acid Schiff and Gomori Methamine Silver stain will identify the causative agent. In giant cell myocarditis, infiltration of myocardium by mixed chronic inflammatory infiltrate including lymphocytes, eosinophils, plasma cells, macrophages, many giant cells observed without any evidence of granulomas. SLE may lead to pancarditis, however pericarditis is more frequently observed than myocarditis. Diagnosis relies on presence of specific antibodies in serum with perivascular and interstitial mononuclear cell infiltrate with myocardial degeneration and fibrosis and Libman-sacks endocarditis of valves. In hypersensitivity myocarditis, poorly formed histiocytic lesions and numerous eosinophils infiltrating the cardiac muscle fibers and perivascular infiltrate are observed without any formation of giant cells or granuloma. In case of acute rheumatic fever, pancarditis may be present with aschoff nodules containing histiocytes with caterpillar like nuclear chromatin. Idiopathic granulomatous myocarditis is usually a diagnosis of inclusion and reveals non-caseating granulomas in heart without any evidence of similar lesions in any other organ of the body. As this study is based on autopsy findings of organs received, correlation with history and investigation findings is not possible.

To conclude, this case series emphasizes that although infrequent, tuberculosis can involve any cardiac structure. Histopathological spectrum of TB in heart may vary from diffusely infiltrating caseating granulomas to occasional non- caseating tubercles. Most of the cases in our series revealed presence of TB in extra cardiac organs which suggest that ante mortem diagnostic frequency can be increased by high index of suspicion in all patients presenting with cardiac symptoms with known case of TB of any organ, especially in TB endemic areas like in developing countries.

Conflict of Interest: None

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Ethical Clearance with Date & Reference no. - BPSGMCW/RC 736/ IEC /22, dated 08.02.2022.

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Original Research Article

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Estimation of Stature from Percutaneous Upper Limb Measurements in the North Indian Population

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Abstract

Background: In the field of forensic anthropology, stature estimation plays an important role in the identification of unknown dismembered bodies and skeletal remains. When forensic experts find body parts during a police investigation, their first task is to determine the age, sex, and height of the person. They assist law enforcement by using scientific methods in criminal cases.

Material and Methods: A cross-sectional study was carried out in the city. Measurements were taken on both the left and right sides of all males. The sample size was 563 individuals aged between 20 and 40 years. Accurate measurements of five upper extremities and stature were measured with the help of an Anthropometer and Sliding calliper.

Results: The correlation observed between stature and upper limb showed varying degrees of correlation, ranging from moderate to strong0.315 to 0.859. The precision of these equations was established by the obtained correlation value, where a greater correlation nearest to 1 indicated the highest significance.

Conclusion: This research addresses a critical gap by focusing on the upper extremities in a contemporary Central Indian population. Developing stature estimation models from specific body parts not only advances anthropological research but also aids forensic investigations, especially in warm climates like Uttar Pradesh.

Key words: Biological profile; Correlation; Forensic Anthropology; Regression; Stature; Upper limb

Introduction

In the present scenario, there are increasing instances of criminal incidents where the perpetrator cuts the victim's body into pieces and scatters the body parts in different locations to conceal their identity. When the police recover any of these body parts, identifying them becomes a formidable challenge for the police department. The role of forensic experts becomes crucial in unravelling the mystery of the dismembered body parts. In such criminal cases, one of the primary tasks of forensic experts is to estimate the stature of the victim.

In the specialized fields of forensic anthropology, the assessment of stature assumes particular significance, especially when dealing with dismembered body remains.In each situation,

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forensic anthropologists take into account a variety of variables and apply their knowledge to produce the most precise predictions[1,2].

The process of stature estimation in the context of forensic anthropology involves the prediction of an individual's height by measuring recovered dismembered remains with the flesh[3, 4]. Forensic anthropologists employ sophisticated techniques, including the use of regression equations derived from extensive population-specific studies. Stature represents a significant parameter in the identification process, contributing to the establishment of an individual's uniqueness[5]. It's widely recognized that there's a well-established connection between a person's height and different anatomical features, including the head, trunk, and the lengths of their upper and lower limbs. The assessment of an individual's height through measurements of distinct body parts has consistently captivated the attention of anatomists, anthropologists, and forensic experts[6].

In cases involving recovered dismembered remains with flesh, anthropometric measurements taken from these body parts can be utilized to estimate the individual's sex and stature[7, 4, 8, 3]. As height demonstrates a correlation with limb lengths[9], and considering the average differences in height and body proportions between males and females, statistical models can be applied to predict the sex and stature of an individual based on these recorded measurements[10].

A considerable body of international literature has been dedicated to height estimation based on skeleton and mutilated bodies focused on hand and foot dimensions [11]. However, the corresponding research focusing on the upper extremities is notably limited. The pace of decomposition of deceased bodies is accelerated by elevated temperatures. The speed at which this degradation occurs can have a major effect on the gathering and examination of forensic evidence[12]. This temperature zone's state of Uttar Pradesh serves as an example of the difficulties Indian forensic experts confront. Particularly, the scant literature on stature estimate in Uttar Pradesh reveals a deficiency in the application of scientific techniques to the particular forensic requirements of this area. A key component of forensic anthropology is stature estimation, which is used to identify people and piece together events connected to a crime[12].

Materials and Methods

A study of a cross-sectional nature was conducted in the city of Prayagraj, located in Uttar Pradesh, North India. A total of 588 male individuals participated in the data collection process during the time span of August 2019 to October 2023. Following data cleansing, 25 outliers were identified and removed. Consequently, the analysis was conducted on 563 cases. The ages of participants ranged from 20 to 40 years. Individuals with physical disabilities or any form of impairment affecting their extremities were excluded from the study.

To undertake this study, ethical approval was provided by the Institutional Ethics Review Board (IERB) with IERB ID: 2019-132 University of Allahabad, Prayagraj, Uttar Pradesh, India.

Measurements: In the present study, two instruments, namely the Anthropometer and Sliding calliper (manufactured by Jaico Electro Works, Western Ex. Highway Road, Malad East, Mumbai–400097). were employed for data collection. The Anthropometer was utilised to measure stature, upper arm, and forearm dimensions, while the Sliding calliper was utilized for assessing hand length and handbreadth. The least count of the anthropometer and sliding calliper was one millimetre.

To ensure comprehensive data, measurements were conducted on both the right and left sides of the upper extremities. Rigorous precautions were observed throughout the measurement process to maintain accuracy and consistency.

Stature: it measures the vertical distance from vertex to floor[13].

Total arm length: it measures the distance between acromion and dactylion, when the arm is hanging downwards[13].

Upper arm length: it measures the straight distance between acromion and radiale [13].

Forearm length: it measures the distance between radiale and stylion[13].

Hand length: it measures the distance between the mid-point of a line joining the two stylion and phalangion and dactylion of the middle finger [13].

Hand breadth: it measures the distance between 2nd metacarpal radialis and 5th metacarpal ulnare [13].

Statistical Analysis

To ensure the quality of our data, we first conducted a pilot study using a smaller sample. This helped us evaluate how precise and consistent our methods were for measuring stature and upper limbs. This initial analysis was then followed by a more in-depth analysis using IBM SPSS Statistics (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc.).

We summarised the measurements by calculating averages, standard deviations, and ranges (minimum and maximum), as well as discrepancies. Pearson correlation coefficients (r) were then calculated to determine the degree of correlation between stature and upper limb measurements. In statistics, regression is the process of determining a statistical relationship between two or more variables[5].

The accuracy of these equations was demonstrated by the obtained Standard Error of Estimate (SEE), where a lower SEE indicated greater precision. Using upper limb dimensions, both simple and multiple regression equations were developed for stature estimation. Significance was established $p<0.05$. The predictive performance of all equations was evaluated through comparison[14].

Result

The main aim of this study is to perform a thorough assessment of stature among the population of Prayagraj in Uttar Pradesh. To achieve this goal, ten specific body dimensions pertaining to the upper extremity were accurately measured. Through the careful analysis of these body dimensions, this study aims to contribute valuable information to the understanding of anthropometric characteristics within the specified population group.

Table 1 offers descriptive statistics for TAL, UAL, FAL, Hland HB, presented for both the left and right sides and stature. With noted positive correlations between stature and arm measurement dimensions, regression analysis was conducted to predict stature. Identification of the most appropriate regression equations for stature estimation relied on assessing the determination of coefficient and the standard error of estimated values. Table 2 displays the outcomes of the linear regression analysis. It is calculated that the TAL exhibits the highest correlation (r) with stature (0.859 for left arm, 0.850 for right arm) and HB exhibits the lowest (0.315 for left and 0.348 for right). The associations between the measured stature and the lengths of long bones exhibited a range of moderate to strong correlations, as indicated by Pearson's correlation coefficient (r) ranging from 0.315 to 0.859[15], as shown in Table 2.

Table 3 displays the outcomes of the stepwise regression analysis. The analysis indicates that the combination of upper arm length and forearm length yielded the highest prediction accuracy, accompanied by the lowest standard error of estimate (SEE) values in this male population. The statures estimated using upper arm length and forearm length demonstrated R^2 values of 0.536 for the left arm and 0.526 for the right side. The SEE was calculated at ± 3.292 for the left side and ± 3.326 for the right side[11].

Table 4 illustrated the comparison between estimated stature and actual stature. Through a tabular analysis, they ascertained that the differences between the predicted and actual statures, as determined by the regression model, were negligible. This suggests that their method demonstrated a high degree of accuracy with minimal margin for error. In this equation, it was determined that the largest measurement corresponds to TAL, while the smallest measurement corresponds to HB. With the increase in the parameter length, there is a reduction in the average disparity between the current stature and the predicted stature. Among these measurements, HB exhibits the highest mean difference at 3.6, while TAL demonstrates the lowest at 2.0.

Table 1: Routine statistical analysis of the parameters measured bilaterally - (in cm)

	Parameters	Mean	SD	Minimum	Maximum
1	TAL Left	75.25	2.68	68.20	82.00
2	TAL Right	75.28	2.68	68.80	81.60
3	UAL Left	31.89	1.56	27.40	34.80
4	UAL Right	31.90	1.55	27.90	34.90
5	FAL Left	25.69	1.27	23.10	29.10
6	FAL Right	25.67	1.25	22.70	29.00
7	HL Left	19.27	0.71	17.40	21.10
8	HL Right	19.27	0.73	17.10	21.30
9	HB Left	8.33	0.51	7.20	10.10
10	HB Right	8.35	0.50	7.10	10.00
11	Stature	167.0	4.83	155.8	183.2

TAL= Total Arm Length, UAL = Upper arm length, FAL= Forearm Length, HL= Hand Length, HB= Hand Breadth.

Table 2: Simple linear regression models of all parameters for stature estimation

SN		Regression Equation	r	r^2	SEE	p value
1	Left	S=50.814+1.545*TAL	0.859	0.737	2.474	0.000
2	Right	S=51.683+1.533*TAL	0.850	0.722	2.546	0.000
3	Left	S=95.412+2.247*UAL	0.726	0.527	3.321	0.000
4	Right	S=96.099+2.225*UAL	0.715	0.511	3.378	0.000
5	Left	S=118.835+1.878*FAL	0.496	0.246	4.195	0.000
6	Right	S=114.653+2.042*FAL	0.529	0.279	4.099	0.000
7	Left	S=97.402+3.616*HL	0.532	0.283	4.090	0.000
8	Right	S=97.355+3.618*HL	0.548	0.301	4.039	0.000
9	Left	S=142.157+2.991*HB	0.315	0.099	4.584	0.000
10	Right	S=139.138+3.345*HB	0.348	0.212	4.527	0.000

Table 3: Multiple regression models of all parameters for stature estimation

S. No.	Parameter	Left/ Right	Multilinear regression	r	r^2	SEE	Significance
1	UAL+FAL	Left	S=90.740+2.041*UAL+0.438*FAL	0.732	0.536	3.292	0.000
		Right	S=89.875+1.932*UAL+0.606*FAL	0.726	0.526	3.326	0.000
2	FAL+HL	Left	S=81.601+1.290*FAL+2.716*HL	0.617	0.381	3.803	0.000
		Right	S=78.370+1.445*FAL+2.678*HL	0.648	0.420	3.680	0.000
3	HL+HB	Left	S=94.109+3.285*HL+1.161*HB	0.543	0.295	4.058	0.000
		Right	S=93.427+3.219*HL+1.391*HB	0.564	0.318	3.992	0.000
4	FAL+HL +HB	Left	S=77.343+1.379*FAL+2.314*HL+ 1.350*HB	0.631	0.398	3.753	0.000
		Right	S=74.259+1.449*FAL+2.272*HL+ 1.418*HB	0.662	0.439	3.625	0.000

Table 4: Descriptive statistics of estimated stature comparison with present stature (in cm)

S. No.	Parameters	Left/Right	Present Stature	Estimated Stature	Mean Difference
1	Total Arm Length	Left	167.0	167.079	0.079
		Right	167.0	167.080	0.080
2	Upper Arm Length	Left	167.0	167.065	0.065
		Right	167.0	167.085	0.085
3	Forearm Length	Left	167.0	167.082	0.082
		Right	167.0	167.075	0.075
4	Hand Length	Left	167.0	167.076	0.076
		Right	167.0	167.075	0.075
5	Hand Breadth	Left	167.0	167.069	0.069
		Right	167.0	167.070	0.070

Discussion

The objective of this research was to develop novel stature prediction equations specifically tailored for the Indian male population, thereby enhancing the existing, constrained norms for stature estimation within Indian forensic anthropology. Recognising bilateral asymmetry in the measurements on the left side, adjustments were made for right-handedness in the presented data by formulating side-specific formulas[15].

Bilateral asymmetry, a well-known characteristic observed in human anatomy, carries important implications for stature estimation in forensic investigations[16]. This natural phenomenon has been extensively studied across various research endeavours examining human body proportions and skeletal structures[17]. Notably, a comprehensive study was conducted by Krishan[18] to shed light on the substantial bilateral asymmetry found in limb dimensions, emphasising its significant impact on stature estimation methodologies.

Regression formulas are an important component in forensic investigations involving partial or complete skeletal remains or body parts, particularly in determining stature, a crucial aspect of such inquiries. These formulas serve as indispensable tools when computing stature from bone measurements. Within the forensic domain, a regression formula embodies a meticulously crafted mathematical expression utilized to explain the intricate relationship between one or more independent variables typically skeletal dimensions and a dependent variable, such as stature.

The study revealed the strongest correlation with stature in the left total arm length and upper arm length (r=0.859, 0.726, respectively) and the right upper extremity length, total arm length, and upper arm length (r=0.850, r=726, respectively). Notably, our findings exhibited higher correlation values compared to the results reported in the study conducted North Indian population. However, our results aligned closely with those reported by Akhlaghi[19] for the right sides in the Iranian population[20].

All dimensions underwent assessment regarding their capability to predict stature through simple linear regression, considering Standard Error of Estimates (SEEs) and r^2 values. Among the hand dimensions, length consistently demonstrated the lowest SEEs and the highest R^2 values. This discovery aligns with the outcomes reported in studies by[21, 22].

By combining multiple measurements, such as body, arm, forearm, hand length, hand breadth, and second to fifth finger length inside the upper limb, Akhlaghi[19] was able to accurately determine the stature of an Iranian community. Upper limb length and hand length were found to be predictive variables for both male and female respondents in multiple linear regression analyses. Furthermore, hand length and breadth were found to be significant predictors irrespective of gender differentiation[11].

In the current study, a similarly robust correlation was observed for total arm length, with a high coefficient, similar to how stature was classified, the

15th and 85th percentiles served as the cut-off points. This underscores the significance of recognising and utilising specific anatomical measurements, even in cases where only isolated bones or body parts are available, to make accurate estimations of stature.

The significance of this study lies in its potential to provide more accurate and reliable stature estimation methods for North Indian males. This can have important implications in identifying human remains Table 5. In the present study, it has been found that total arm length and upper arm length demonstrate the most robust correlation with stature, surpassing similar correlations observed in different population groups.

Table 5: Comparison of Correlation Coefficient value of Upper extremity in different population groups.

Author	Population	TAL		UAL		FAL		HL		HB	
		L	R	L	R	L	R	L	R	L	R
Akhlaghi et al.[19] (2012)	Iran		0.635		0.602		0.354		0.696		0.310
Ahmed[5] (2013)	Sudan			0.698		0.725		0.602		0.358	
Chauhan et al.[23] (2017)	Lucknow			0.680	0.684						
Kaur et al.[24] (2016)	Haryana			0.660							
Yadav et al.[25] (2018)	Madhya Pradesh					0.837	0.835				
Howley et al.[26] (2018)	Australia					0.740	0.748	0.686	0.647	0.592	0.505
Uzun et al. (2019)	Turkey	0.716	0.675	0.534	0.497	0.473	0.486	0.350	0.339	0.231	0.248
Nandi et al.[27s] (2018)	Nigeria			0.80	0.79	0.75	0.72				
Present Study	North India	0.859	0.850	0.726	0.715	0.496	0.529	0.532	0.548	0.315	0.348

Conclusion

The findings of this study lead to the conclusion that the upper extremities can effectively serve as a means for estimating the stature of adults in forensic applications, benefiting law enforcement agencies and forensic scientists. Moreover, the study highlights the superiority of multiple regression equations over single linear regression equations for this purpose. Given the diverse racial, ethnic, and cultural composition in India, each population group necessitates a dedicated study in this context. Specifically, this study furnishes regression equations derived from hand and arm dimensions applicable for estimating the stature of adult males in Prayagraj City, North India. However, caution is advised against using these equations for other population groups.

Ethical Clearance: ethical approval was provided by the Institutional Ethics Review Board (IERB) with IERB ID: 2019-132 University of Allahabad, Prayagraj, Uttar Pradesh, India.

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Original Research Article

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Study of the Pattern of Craniofacial Injuries in Victims of Fatal Road Traffic Accident Cases Autopsied in Midnapore Medical College

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Abstract

Background: The objective of this study was to investigate the pattern of craniofacial injuries in victims of fatal road traffic accidents, observed through autopsies conducted at Midnapore Medical College, West Midnapore from January 2021 to December 2023.

Methods: It is a retrospective, cross-sectional observational study. Data were collected through a comprehensive analysis of post-mortem reports documenting injuries in alleged road traffic accident cases where victims sustained craniofacial injuries. The study covered a period of three years, from January 1, 2021, to December 31, 2023. The data were analysed using Microsoft Excel.

Conclusion: The study underscores the need for context-specific interventions to address the unique injury patterns observed in road traffic accidents in West Midnapore. Enhancing road infrastructure, increasing traffic safety awareness, and promoting the use of protective measures like seat belts and helmets can significantly reduce the incidence of severe craniofacial injuries. The high prevalence of maxillofacial fractures highlights the vulnerability of the face, with substantial long-term physical and psychological repercussions.Effective prevention strategies, including stringent traffic regulations and awareness campaigns about the dangers of distracted or impaired driving, are essential. Despite its limitations, this study offers valuable insights into the patterns of craniofacial injuries in fatal accidents, emphasizing the need for improved road safety measures, stricter traffic laws, and enhanced post-accident care. Interdisciplinary collaboration among healthcare professionals, law enforcement, and policymakers is crucial for developing comprehensive strategies to manage and prevent these injuries. By analysing regional injury characteristics and comparing them with findings from other studies, this research contributes to a broader understanding of craniofacial trauma. The findings have significant implications for improving road safety, trauma care, and forensic practices.

Keywords: Craniofacial injuries, road traffic accidents, autopsy, fissure fractures, depressed comminuted fractures.

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Introduction

Road Traffic Accidents constitute a leading cause of death and disability worldwide, particularly among young adults aged 15 to 29 years[1]; according to the World Health Organization (WHO), approximately 1.35 million people die each year due to RTAs, with an additional 20 to 50 million sustaining non-fatal injuries, many of which result in long-term disabilities (World Health Organization, 2018). The burden of RTAs is disproportionately borne by low- and middle-income countries, where inadequate infrastructure, lax enforcement of traffic regulations, and limited access to emergency medical services contribute to heightened risks.[1]Cranial and facial injuries are among the most severe and potentially life-threatening consequences of RTAs. The high-speed, blunt-force trauma characteristic of these accidents often leads to a diverse array of injuries, ranging from superficial lacerations to catastrophic intracranial haemorrhages. Autopsy examinations play a pivotal role in elucidating the precise nature and extent of these injuries, facilitating an accurate determination of cause and manner of death.[2]Cranial and facial injuries encountered in RTAs encompass a spectrum of traumatic lesions affecting the bones, soft tissues, and neurovascular structures of the head and face. Common injuries include skull fractures, intracranial haemorrhages, facial fractures, and soft tissue contusions. The severity and distribution of these injuries are influenced by various factors, including the velocity of the impact, the nature of the collision, and the use of protective equipment such as helmets and seat belts.[3]Understanding the pattern and characteristics of these injuries is crucial for implementing effective preventative measures and improving post-accident care. The present study titled "Study of Pattern of Craniofacial Injuries in Road Traffic Accident Cases Autopsied in Midnapore Medical College, from 2021 to 2023" aims to contribute to the existing body of research by providing insights into the specific pattern and characteristics of craniofacial injuries in fatal road traffic accidents, focusing on Autopsy findings, identify various contributing factors of fatal cranio-facial injuries and measures to prevent these types of injuries.

Materials and Methods

The study was conducted on victims of fatal road traffic accidents at the mortuary of Midnapore Medical College and Hospital. It encompassed a total of 863 cases from January 2021 to December 2023. The cases were systematically categorized based on factors such as age, gender, point of origin (PS) from where they were referred, and the specific patterns of craniofacial injuries and intracranial haemorrhage. Data were collected using a standardized format and analysed with Microsoft Excel.

Result and Discussion

Current study reveals that the majority of the victims were male, constituting 87%. The male-to-female ratio was found to be 7:1, which is supported by the study of World Health Organisations (WHO), though the ratio is somewhat lower than the present study, 3:1[4]. Study by Montazeri et al[5], Elvik et al[6], Bener et al[7] showing the similar pattern of male dominance. Young adults fell in the age group of 21 to 30 years, accounting for 22% of all cases, closely followed by the 31 to 40 years age group at 19.8%. The lowest incidence was observed in the age group of 0 to 10 years, with a mere 0.9%. Similar findings are reported by Reddy et al. (2021)[8]where young adults accounted for approximately 40% of RTA fatalities in their analysis of national data; though McGwin et al[9] found adults in the age group of 30-59 accounted for over 30% of RTA fatalities in their retrospective analysis.

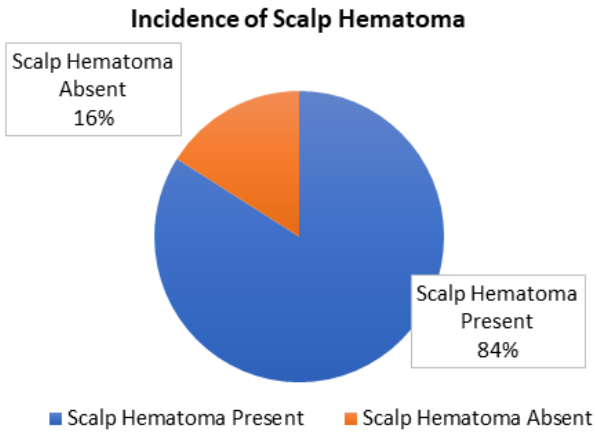

Figure No. 1

Pie chart 1 showing presence of scalp hematoma in 725 victims in current study, which accounts for

84% of the total.Horowitz R., et al.[10] depicted in their study that scalp hematoma is predominantly present in RTA cases subjected to cranio-facial injury, though they found the commonest area is the frontal region of the scalp[10].

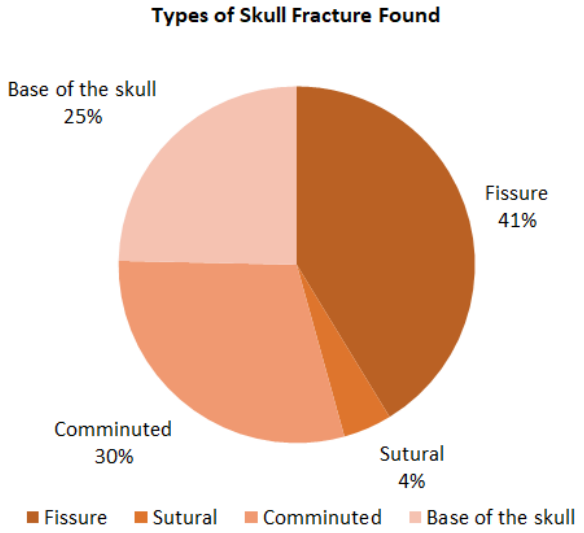

Figure No. 2

The current study reveals 38% of the victims were subjected to skull fracture, and among them the most prevalent skull fracture type was Fissure fracture also known as linear fractures, seen in 41% cases followed by Base of skull fracture and the least prevalent was sutural fracture, found in 4% cases (Pie Chart 2). A study by Nair et al.[11] found linear fractures to be prevalent in close to 60% of RTA fatalities examined during their investigation.Linear fractures are among the most common types of skull fractures observed in RTA fatalities. These fractures typically follow a linear trajectory along the cranial vault and may result from blunt force trauma to the head during the collision[12,13,14,15,16]. Barman et al. (2024) [17]documented basilar skull fractures in close to 25% of RTA fatalities included in their retrospective analysis.

Table 1: Prevalence of Base of Skull Fractures

Type of Base of the Skull Fracture found	Total number of cases seen
Type 1	82
Type 2	14
Type 3	10
Incomplete	17

As seen in Table 1, Base of the Skull fracture was seen in 123 victims, of which, most common Base of Skull fracture found was Type 1 and least common type was Incomplete Base of skull Fracture. Base of skull fractures in RTA victims often exhibit a characteristic pattern associated with the mechanism of injury. Studies by Johnson et al. (2022)[18] and Lee et al. (2021)[19] have reported that fractures commonly involve the anterior cranial fossa, middle cranial fossa, and posterior cranial fossa regions. Fractures may extend across multiple skull base compartments, resulting in complex patterns involving the petrous temporal bones, sphenoid bones, and occipital bones.

- Pattern of Fractures: Base of skull fractures in RTA victims often exhibit a characteristic pattern associated with the mechanism of injury. Studies by Johnson et al. (2022)[18] and Lee et al. (2021)[19] have reported that fractures commonly involve the anterior cranial fossa, middle cranial fossa, and posterior cranial fossa regions.
- Distribution by Location: Base of skull fractures in RTAs show a predilection for specific anatomical regions, influenced by the direction and severity of the impact forces. Research by Yang et al. (2020)[23] and Barman et al. (2024)[17] has indicated that fractures frequently occur at the skull base's weakest points, including the petrous temporal bone's thin squamous portion, the Sella turcica of the sphenoid bone, and the clivus of the occipital bone.
- Mechanisms of Injury: Base of skull fractures in RTAs typically result from blunt force trauma transmitted through the skull base during high-energy collisions. Acceleration-deceleration forces, combined with direct impacts or rotational forces, contribute to skull base fractures' severity and complexity. Studies by Garcia et al. (2019)[30] and Wiederholt WC et al. (2020)[20] have highlighted the role of head-on collisions, side impacts, and rollover events in producing skull base fractures, with differences in fracture patterns observed based on the vehicle's orientation and the occupants' positions.
- Association with Intracranial Injuries: Base of skull fractures in RTAs are frequently associated with intracranial injuries, including epidural hematomas, subdural hematomas, and intracerebral contusions. Research by Nair et al.[11] and Martinez

et al. (2021)[31] has shown that skull base fractures may serve as indicators of severe underlying brain injuries, particularly when accompanied with cerebrospinal fluid leaks or pneumocephalus.

- Prognostic Implications: The presence and severity of base of skull fractures in RTA victims have prognostic implications for outcomes and survival. Studies by Sharma et al. (2018)[26] and Lee et al. (2022)[19] have demonstrated an association between skull base fractures and increased mortality rates, particularly in cases involving extensive skull base involvement or associated intracranial injuries.

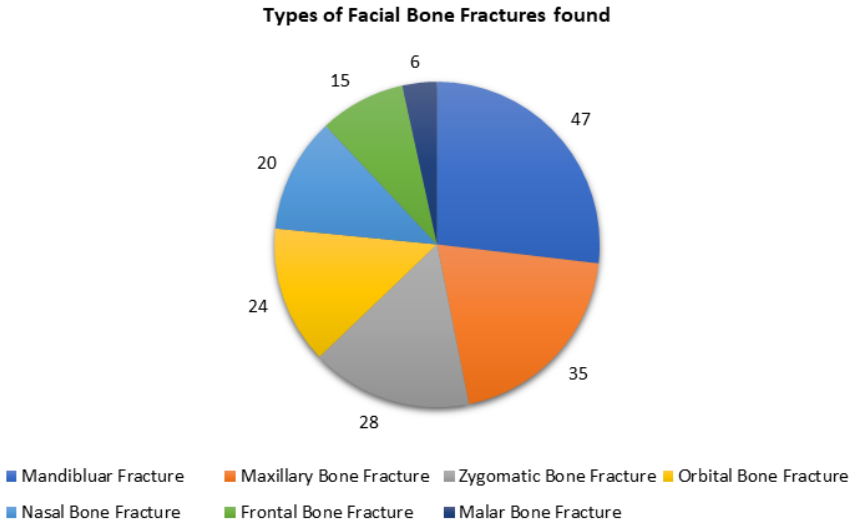

Figure No.3

In the present study, we found 20% of victims were subjected to facial bone fractures (n=175), mandible fracture (vide Pie Chart 3) being the most common type of facial bone to be fractured, and most of time it's also associated with other facial bones like maxilla, zygomatics. A comprehensive analysis by Barman et al.[17] found that facial fractures were present in nearly 65% of fatal cases studied. Correspondingly, a study conducted by Johnson and colleagues (2023)[18] reported a slightly lower but still substantial incidence of facial bone fractures, accounting for 58% of fatal road traffic accidents examined. Several scientific studies investigating facial fractures in fatal road traffic accidents consistently identify fractures of the mandible as the most common. Patel et al.[20], Kumar et al.[24], Sharma et al.[25], and Gupta et al.[26] conducted autopsy-based or retrospective analyses, confirming the predominance of mandibular fractures in such cases. These studies underscore the critical impact of facial trauma in fatal road incidents, emphasizing the importance of preventative measures and improved safety regulations in minimizing such injuries.

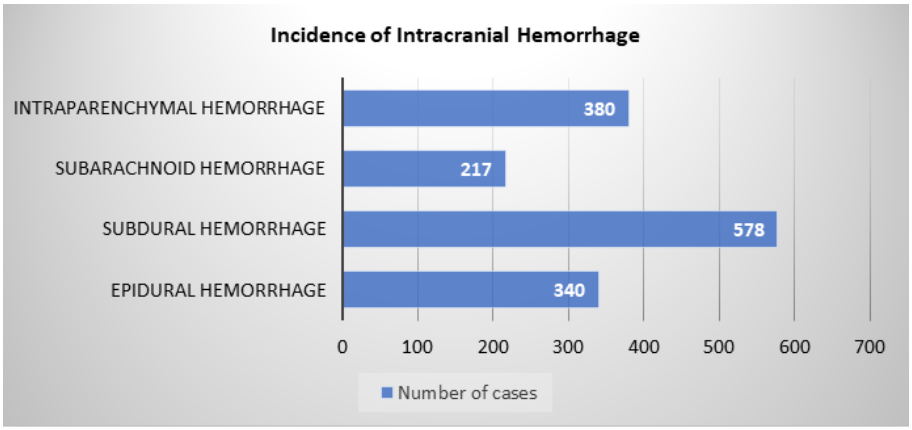

Figure No. 4

Total 688 cases of Intracranial haemorrhages were found in our study. A single individual often showed multiple types of intracranial haemorrhages. The most common type of intracranial haemorrhage seen in fatal road traffic accidents (RTAs) was subdural haemorrhage, seen in 578 cases. Many RTA-related intracranial haemorrhages exhibit multifocal distribution, involving several regions of the brain. This pattern reflects the diffuse nature of head trauma in RTAs, with widespread injury to various brain structures[20].A study by Barman et al.[17] revealed that ICH was present in 70% of fatal RTA cases, almost all located in the subdural and subarachnoid spaces. Similarly, Jones and colleagues[11] reported a higher incidence of ICH in traumatic brain injury cases associated with RTAs compared to other causes of head trauma. Studies by MG Rajkumar et al. (2023)[27], Chiu WT et al. (2000)[28] and Mekonnen D et al. (2012)[29] have arrived at similar conclusions regarding distribution of intracranial haemorrhages in victims of fatal road traffic accidents.

Prevalent Patterns:

The patterns of intracranial haemorrhages observed during autopsy examinations of RTA victims may vary depending on the mechanism and severity of the injury. However, certain prevalent patterns can be identified:

- Multifocal Haemorrhages: Many RTA-related intracranial haemorrhages exhibit multifocal distribution, involving multiple regions of the brain. This pattern reflects the diffuse nature of head trauma in RTAs, with widespread injury to various brain structures.
- Frontotemporal and Temporoparietal Haemorrhages: Haemorrhages involving the frontotemporal and temporoparietal regions of the brain are commonly observed in fatal RTAs, particularly in cases of lateral impacts or rotational injuries. These regions are susceptible to injury due to their proximity to the skull base and vulnerability to shearing forces.
- Haemorrhagic Contusions: Haemorrhagic contusions, characterized by areas of haemorrhage within the brain parenchyma, are prevalent in RTA-related head trauma. These contusions often occur at points of impact or deceleration, such as the cerebral cortex or deep white matter tracts, and may be associated with skull fractures or focal brain injuries[20].

Summary

This retrospective, cross-sectional observational study reviewed 863 cases of road traffic accidents with craniofacial injuries autopsied in the Department of Forensic Medicine and Toxicology at Midnapore Medical College and Hospital from 2021 to 2023. Most victims were male, aged between 21 and 40 years. The most common injury was scalp hematoma, observed in 84% of cases, followed by skull fractures, which were present in 38% of cases. The most frequent type of skull fracture was a fissured fracture. Many cases exhibited multiple concurrent fractures and scalp hematomas. Intracranial haemorrhage was reported in 80% of cases, with subdural haemorrhage being the most prevalent, accounting for 84% of all intracranial haemorrhages. Mandibular fractures were the most common type of facial bone fractures.

Conclusion

These variations in injury patterns emphasize the importance of context-specific interventions and preventative measures to address the specific challenges faced in the West Midnapore region. For instance, focusing on improving road infrastructure, increasing awareness about traffic safety, and encouraging the use of protective measures like seat belts and helmets can mitigate the risk of severe craniofacial injuries in road traffic accidents.

The observed prevalence of maxillofacial fractures in the present study highlights the vulnerability of the face to traumatic injuries. Maxillofacial fractures not only have immediate consequences but also impact long-term physical and psychological well-being. Therefore, interventions targeting the prevention of facial injuries, such as promoting compliance with traffic regulations and raising awareness about the risks associated with distracted driving or driving under the influence, are crucial to reduce the burden of craniofacial injuries sustained in road traffic accidents.

Despite the limitations of this study, it provides valuable insights into the pattern of craniofacial

injuries in fatal road traffic accidents in West Midnapore. The findings underscore the need for ongoing efforts to improve road safety awareness, strengthen traffic regulations, and enhance post-accident care services. Furthermore, the study highlights the importance of interdisciplinary collaborations between healthcare professionals, law enforcement agencies, and policymakers to develop and implement comprehensive strategies to prevent and manage craniofacial injuries sustained in road traffic accidents effectively.

In conclusion, the present study contributes to the existing literature by examining the pattern and characteristics of craniofacial injuries in fatal road traffic accidents in West Midnapore. The findings emphasize the significance of skull fractures, maxillofacial fractures, and intracranial haemorrhages and provide insights into the unique regional aspects of these injuries. Cross-referencing with previous studies conducted in India and other countries enhances our understanding of the variations in injury patterns. The study's outcomes have important implications for road safety interventions, trauma care protocols, and forensic investigations to reduce the burden of craniofacial injuries, mitigate their long-term consequences, and ultimately improve the overall well-being of road traffic accident victims.

Ethical Clearance: This is a retrospective non-interventional data based cross sectional observational study and thus ethical clearance was not required.

Source of Funding: Self

Conflict of Interest: Nil

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Original Research Article

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Epidemiological Study of Pediatric and Adolescent Poisoning Cases in a Rural Tertiary Care Centre in South India

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Abstract

Pediatricand adolescent poisoning covers the entire spectrum of cases from accidental ingestion in toddlers to intentional abuse in teenagers. Epidemiological surveillance of oral ingestion of poisonous substances in children and adolescents in a particular area is necessary to determine the extent and characteristics of the problem, according to which related preventive measures can be taken. This was a retrospective, observational study including all pediatric and adolescent poisoning patients (between the age of 0 to 19 years) received at the Trichy SRM Medical college & Research Centre, Irungalur, Trichy during the 2 year period from May 2021 to April 2023. A total of 52 cases were received in the casualty department of our hospital during the study period. Out of this, Male patients were predominant (53.85%). Most of the cases belonged to the age group between 16- 19 years. Most of the cases were fromthe Rural areas (82.69%). Accidental Poisoning (61.54%) is more common followed by suicidal poisoning (38.46%). The substances involved in Poisoning are Kerosene(20%),Drugs(18%), Insecticide Poisoning(10%) Rat Killer (10%), Oleander(8%), ant-killer (8%), among many others. Most of the time the poisoning happened inside Home(65%) followed by area surrounding home(17%). Oral route (88%) was the most common way of taking poison. Most cases took less than 4 hours (71%) to reach the hospital. Vomiting was the most common symptom in most of the cases. 23 cases (44%) were requiring intensive care of which only 8 cases (15%) needed more than 3 days of ICU care.

Key words: pediatric Poisoning, patients, ingestion, vomiting, hospitalization, complication,

Introduction

Poisoning is an important cause of morbidity and mortality in pediatric and adolescent age groups. Pediatric poisoning covers the entire spectrum of cases from accidental ingestion in toddlers to intentional abuse in teenagers. Most of the poisonings

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in children are accidental and most cases of accidental poisoning are preventable. According to "World Report on child Injury prevention" published by the World Health Organisation (WHO), 13% of total poisoning cases were reported among pediatric and adolescent age groups[1]. Poisoning accounts for 1-6% of bed occupancy in children's hospitals and 3.9% in Pediatric Intensive Care Units in India[2]. Poisoning in childhoodis accidental, particularly in children under five years old, but it might be increasingly self-inflicted in older adolescents[3].Epidemiological surveillance of oral ingestion of poisonous substances (household products, chemicals, drugs, pesticides, etc.) in children and adolescents in a particular area is necessary to determine the extent and characteristics of the problem, according to which related preventive measures can be taken.

Objective of the Study:

- To determine the epidemiology, Clinical Profile and outcome of pediatric and adolescent poisoning cases in a rural tertiary care hospital in South India.
- To know the pattern of common poisonous substances involved in pediatric and adolescent poisoning.

Materials and Methods

This was a retrospective, observational study including all pediatric and adolescent poisoning patients (between the age of 0 to 19 years) received at the Trichy SRM Medical college & Research Centre, Irungalur, Trichy during the 2 year period from May 2021 to April 2023. Children and adolescents who had food poisoning, toxic, or idiosyncratic reaction to the prescribed drugs were excluded from the study. General information like the age & sex of the victim, history part, type of poison, manner of exposure, treatment given and outcome of poisoning etc. of the cases will be collected from the case papers of respective cases from Medical Records Department.

Inclusion criteria: All Pediatric and adolescent poisoning cases between ages 0-19 years treated at Trichy SRM Medical College Hospital and Research Centre.

Exclusion criteria: Children and adolescents who had food poisoning, toxic or idiosyncratic reaction to the prescribed drugs and homicidal poisoning cases will be excluded from the study.

Observation

A total of 52 cases were received in the casualty department of our hospital during the study period. Out of this Male patients were predominant (53.85%) while the rest were females (46.15%). Most of the cases belonged to the age group between 16- 19 Years (Table :1). Most of the cases belonged to the Rural areas (82.69%) than Urban (17.31%). Accidental Poisoning (61.54%) is more common followed by suicidal poisoning (38.46%)(Table :2). The substances involved in Poisoning are Kerosene(20%),Drugs(18%), Insecticide Poisoning(10%) Rat Killer (10%), Oleander(8%), ant-killer (8%), among many others. (Table: 3)Most of the time the poisoning happened inside Home(65%) followed by area surrounding home(17%). Oral route (88%) was the most common way of taking poison. Most cases took less than 4 hours (71%) to reach the hospital(Table : 4).Vomiting was the most common symptom in most of the cases. 29 cases (56%) were not requiring intensive care of which only 8 cases (15%) needed more than 3 days of ICU care. Most cases (31%) required 2 to 3 days of hospitalization(Table: 5). 49 cases (94%) did not develop any complication and were discharged.

Table 1: Age Distribution

Age Category	Number of cases	Percentage
0-5 years	11	21.15%
6-10years	9	17.31%
11-15 years	9	17.31%
16 and above	23	44.23%
Total	52	100%

Table 2: Nature of Poisoning

Nature of Poisoning	Number of cases	Percentage
Accidental	32	61.54%
Suicidal	20	38.46%
Total	52	100%

Table 3: Type / Agent of Poisons

Insect bite	1	2%
Insecticide	5	10%
Kerosene poisoning	10	20%
Oleander	4	8%
Hydrocarbons	1	2%

Continue.....

Drugs	9	18%
Ant killer poisoning	4	8%
Rat killer poisoning	5	10%
Mosquito repellant	1	2%
Bleaching powder poisoning	1	2%
Scorpion sting	3	6%
Centipede sting	1	2%
Herbicide	1	2%
Camphor	2	4%
Isopropyl alcohol	1	2%
Bee sting	1	2%

Table 4: Time taken to reach the Hospital

Time taken to reach the hospital	Number of cases	Percentage
within 1 hour	11	21%
1-2 hours	9	17%
2-4 hours	15	33%
>4 hours	17	29%
Total	52	100%

Table 5: Duration of Hospitalisation

Duration of Hospitalisation	Number of cases	Percentage
<01 DAYS	10	19%
01-02 DAYS	16	31%
02-03 DAYS	8	15%
03-05 DAYS	5	10%
>5 DAYS	13	25%
Total	52	100%

Discussion

A total of 52 cases of age between 0 to 19 years were admitted in at the Trichy SRM Medical college & Research Centre, Irungalur, Trichy during the 2 year period from May 2021 to April 2023. Male patients have more common poisoning in this age group and is comparable with other studies[3,4,5]. As boys are more active and adventurous in nature, there is a more chance of them getting accidental poisoning. Majority of children belonged to the age group of 16-19 years as in study done by Sharma J et al[6] where the common age group was 11-18 years. Singh M et al[7] reported majority of cases in children above 5 years. Most of the pediatric poisoning studies have taken age limit upto 14 -15 years. So this study cannot be compared to most other studies. Most of the cases in our study were from rural areas as reported by V Kumar[8]. This is understandable as our Medical College Hospital which is a tertiary care center is located in rural area.

Kerosene was the most common poisonous substance ingested in our study. This is in accordance with studies done by, Kohli U et al ,Dutta AK et aland Sitaraman S et al [3,4,10],.Kerosene is still being used in rural areas for cooking as well as for fuel for machines in agricultural purposes. It is also enticing with its sparkling blue color for children who consume it accidentally. Other household substances like paracetamol, Rat killer poison, Oleander and Organophosphorus insecticides are also involved in poisoning in this rural area. Toxicity by drugs like Paracetamol is common in our country as these drugs are easily available to the child. Buch et al reported that the medicines are the commonest substance for pediatric poisoning[11].Most of the times the children and adolescents have consumed the poisons in their homes or in the areas surrounding the home. This is in accordance with the study done by Vasanthan Met al[12]. As most of the poisoning is accidental with household items, it is understandable that the children and adolescents have consumed them at home or nearby areas. Oral route remains the most common way of poisoning in our study. Most cases took less than 4 hours (71%) to reach the hospital. This indicates an acceptable level of awareness among general public to seek medical care quickly in such instances.

Vomiting was the most common symptom in our study as seen by Sharma J et al[6]. Vomiting itself has a beneficial effect in that it removes the offending agent quickly, especially in cases of Kerosene poisonings where gastric lavage is contraindicated. Few children and adolescents reported non- specific symptoms like epigastric pain, abdomen pain and abdominal distension. More than half of the poison cases did not require Intensive care. Only 8% of the Intensive care Unit admitted cases required more than 3 days of Intensive treatment. Overall, 1 in 4 cases required treatment for more than 5 days in our hospital. Only 3 cases developed complications during admission while the rest 49 cases did not have any major complications.

Conclusion

This study shows the gravity of pediatric and adolescent poisoning cases in the rural areas surrounding our medical college Hospital. The following are some of the preventive measures that can be followed in curbing poisoning in this age group.

1. **Safe Storage**:
    - **Store Medications Safely**: Keep all medications out of reach and sight of children. Use child-resistant containers and cabinets.
    - **Secure Household Chemicals**: Store cleaning products, pesticides, and other chemicals in locked cabinets.
    - **Separate Food and Chemicals**: Never store household chemicals near food to avoid accidental ingestion.
2. **Use of Child-Resistant Packaging**:
    - Ensure that all potentially dangerous substances are in child-resistant packaging and that these containers are securely closed after each use.
3. **Proper Disposal**:
    - Dispose of unused or expired medications and chemicals properly. Many communities offer drug take-back programs for safe disposal.
4. **Parental Awareness**:
    - Educate parents and caregivers about the dangers of common household substances.
    - Promote awareness of the Poison Control Center's contact information and the importance of having it readily accessible.
5. **Child Education**:
    - Teach children about the dangers of ingesting unknown substances and the importance of asking an adult before eating or drinking anything. Adolescents need to be
6. **Clear Labeling**:
    - Ensure that all containers are clearly labeled and that medications are kept in their original packaging to avoid confusion.
7. **First Aid Knowledge**:
    - Train parents and caregivers in basic first aid for poisoning, including the importance of not inducing vomiting unless advised by a professional.

Conflict of Interest: None

Ethical Clearance/Statement of Ethics: The study was commenced after obtaining Institutional Human Ethics Committee clearance (IHEC No.LVII-IRB-01/2024) on26.10.2023

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Original Research Article

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A Cross-Sectional Study on Profile and Working Conditions of Mortuary Workers at Victoria Hospital

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Abstract

Mortuary workers play a crucial role in ensuring the respectful, safe and dignified handling of human bodies. But despite of their irreplaceable role, there is prolonged neglect and under recognition of these mortuary staff in our country. It is in fact correct to say that mortuary workers were as important as nurses were to the Forensic Pathologists. The mortuary attendants assist in preparing bodies, specialized dissection and collecting specimens that were pertinent in performing meticulousautopsy techniques. Apart from this they also help in the examination of sexual offenders. These kind of diverse responsibilities makes them an integral part in the medicolegal system in India. There was only a few research done in regard to the mortuary staff. Understanding the work conditions and challenges faced by them will help in improving work environment. This will help in promoting the quality of work they offer and attract more eligible youth to take up this essential, yet risky profession.

Keywords: Mortuary, occupational hazards, autopsy, Forensic Pathologist.

Introduction

Mortuary is an important integral part of every Hospital.(2) In the field of health care, duty of a doctor doesn't end in caring the living but in proper disposal and after life care of the dead. Mortuary workers play a crucial role in providing after life care for the deceased. The presence of a mortuary in the vicinity of the hospital can affect the ailing patients who visits the Hospitals due to stigma attached to the procedure of autopsy. The Hospital and the concerned physicians treating the patients wouldn't prefer to highlight the morgue as well. Hence mortuary complex is set up in an obscure place where the dead bodies were preserved and the autopsies were performed.

For the bereaving relatives of the deceased, the handling and care of dead bodies holds a lot of sentimental values.(3) Mortuary staff takes care of the dead body from the moment of its arrival to the point it leaves the hospital .(4) Their services facilitate to acknowledge the deceased persons place as an individual in the society. Hence an adequately trained mortuary worker is vital in ensuring the dignified, respectful and safe storage, transfer and care of the dead bodies as well as in assisting the

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Forensic Doctors in ensuring justice to the dead when legal issues happens to be involved. In a Country like India where autopsy is done for every unnatural death,[5] it is important to know and analyze the working conditions and occupation associated hazards including psychological stress faced by mortuary workers, aimed at improving their quality of work and enable them to meet the demands of this unique kind of profession.[6]

Aims & Objectives of the study:

1. To analyse the working conditions, training requirements and occupational Hazards of mortuary staff involved in postmortem Examination.
2. To analyse the psychological impact of occupation over the mortuary workers.

Materials And Methods

Source of data:

Mortuary, Department of Forensic Medicine and Toxicology, Victoria hospital, Bangalore medical college and research institute, Bangalore.

Methods of Collection of Data:

A. Study design: Cross-sectional study.

B. Study period: 1 Month**.**

C. Place of study: Department of Forensic Medicine and Toxicology**,** VictoriaHospital, BMCRI.

D. Sampling Method: Convenience sampling**.**

E. Sample size: Approximately 10-12 Mortuary workers currently or had been previously employed in the mortuary of our institution

E. Inclusion Criteria:

Mortuary workers willing to give informed consent for participating in the study.

A person who is currently or had been previously employed in the mortuary of our institution.

F. Exclusion Criteria:

Mortuary workers not available at the time of interview.

Methodology

After obtaining the approval and clearance from Institutional Ethics Committee, date: 25/04/2024 , Ref No : BMCRI/EC/16/2024

The consent was taken from the participants of study on the consent form and data was collected as following:

1. Informed consent was taken from the participants
2. Non participatory observation: The direct observation of the day-to-day work and Occupational safety measures used**.**
3. Interviews: A validated semi structured questionnaire (Annexure-2) used in the study The permission for using the same has been taken from Principal Investigator.[7]

Assessment tools:

1. Semi structured questionnaire(Annexure-2)

ANALYSIS OF DATA

RESULTS:

Table 1: Sociodemographic characters and Occupational Hazards

Variable	Number of responses	Percentage
Gender		
Male	12	100
Female	0	-
Marital status		
Married	9	75
Unmarried	3	25
Educational status		
Till SSLC	7	58
Above or equal SSLC	5	42
Employment status		
Temporary	6	50
Permanent	6	50
Years of experience		
≥5 years	7	58
≤5 years	5	42

Occupational hazards		
Variables	**Number**	**Percentage**
Aware of Hepatits B?	9	75
Aware of Tetanus?	12	100
Tetanus vaccination status	10	83
Hepatitis B vaccination status	0 %	
Do you think your work can predispose you to TB and HIV?		
Yes	7	58
No	5	42
Ever experienced fluid splash on body ?		
Yes	12	100
No	0	
Frequency of splash		
≤3 / month	4	34
≥3 month	8	66
Hadyou ever inhaled chemicals ?		
Yes	5	42
No	7	58
Health issues faced due to use of chemicals at workplace.		
- Skin irritation	1	8
- Breathing difficulty	3	25
- Eye irritation	10	83
How often do you go for medical checkups ?		
Every yearly	2	17
Every two years	2	17
Never	8	66
Method of disposal of waste in mortuary		
-Dedicated dust bin	12	100
-Wash and reuse	0	0
How often do you use PPE?		
Masks		
Always	0	
Occasional	4	34
Never	8	66
Goggles		
Always	0	0
Occasional	2	17
Never	10	83
Gloves		
Always	12	100
Occasional	-	
Never	-	
Gown		
Always	12	100
Occasional	-	-
Never	-	-
Ever injured in workplace ?		
Yes	12	100
No		
Cause of injury:		
Needle pricks	12	100
Other Sharp instruments	9	75
Falls on damp floor	2	16
Action taken after sustaining injury.		
Reported to authority immediately	0	-
Continued work without reporting		
Reason for not reporting		
-Thought injury was minor	10	83
-Delayed response	2	17
-No response	-	-
Did you first-aidyourself?	12	100

Table 3: Working conditions of mortuary workers

Working Conditions		
What is your current salary		
N= ≤25000	6	50
N = ≤25000	6	50
Do you receive salary regularly?		
Yes	6	50
No	6	50
Were you satisfied with the remuneration ?		
Satisfied	4	34
Dissatisfied	5	41
Feeling ok	3	25
Do you receive incentives other than salary?		

Continue.....

Yes	-	-
No	12	100
Wereyou able to avail paid leaves ?		
Yes	6	50
No	6	50
How many hours do you work a day ?		
≤ 9 hours	10	83
More than 9 hours	2	17
Wereyou able to find time for lunch break?		
Yes	0	0
No	12	100
Do you hadproper restrooms and washrooms?		
Yes	0	-
No	12	100
How stable do you think your job is?		
Very stable	6	50
Can loose job anytime	3	25
Somewhat stable	3	25
Ever experienced any kind of ill-treatments?		
-Police personnel	5	42
-Other hospital staff	1	8
-Relatives of deceased	6	50
-Doctors	0	

Table 4: Psychological Aspects concerning Mortuary workers

PSYCHOLOGICAL ASPECTS		
Does your family support your career?		
Yes	12	100
No	-	
Do you face any kind of discrimination from society because of your job?		
Yes	10	83
No	2	17
Do you involve in any substance use? if yes		
Alcohol	12	100
Frequency of alcohol intake		
Daily after work	5	42
Occasionally	7	58
Daily During work	0	0
Cigarette smoking	6	50
Do you feel stressed about nature of your job?		
Yes	1	8
No	11	92
Wereyou able to manage work and family life ?		
Yes	10	83
No	2	17
How do you solve problems that arise among the worker?		
Approach authority for solution	4	34
Solve among each other	8	66

Among the 12 respondents, all were males which highlights the gender disparity. While three (25%) of them were unmarried, the rest nine (75%) were married. Seven (58%) of them had educational qualification till SSLC(10th standard), five (42%) of them were educated more than SSLC .50 %were temporary workers who work on a contract basis, while the rest 50% were permanent government employees. None of them had received any formal training prior to their joining of work. All the respondents had revealed that they learnt the post-mortem procedures by observing their senior workers and assisting them. Seven (58 %) hadmore than five years of experience as a mortuary worker.

The susceptible diseases that they were aware of include Hepatitis B (75%), Tetanus (100%), Tuberculosis and HIV (58%). Among them only 83% were vaccinated against tetanus. No worker has received vaccination for Hepatitis B. Among them eight (66%) workers didn't know that hepatitis B could be contracted through body fluids.

Among work place hazards, all of the twelve respondents reported that they had experienced fluid splash during their work, it happens more than three times per month as per four (34%) workers. According to them, it occurred while shifting the bodies as well as while opening the body cavities while conducting post-mortem examination. Five (42%) workers stated that they had accidentally inhaled chemicals which mostly included formalin used for embalming. Of the respondents one (8 %) has experienced skin irritation, three (25 %) had breathing difficulties, ten (83%) experienced eye irritation. The common chemicals involved include latex from gloves, formalin, hydrogen peroxide etc.

Only two (16 %) respondents had admitted that they did yearly medical check up. Among the

personal protective equipments, gloves and gowns were used by all the twelve (100 % respondents), goggles were used by two (17 %) of the workers only while doing autopsy of Covid cases. It was revealed and observed that there were dedicated colour coded dustbins for the proper waste management.

Needle prick injuries were sustained by all the respondents, out of which 75 % of them had sustained non severe injuries with other sharp autopsy instruments used for autopsy like Knife, Suturing needle etc.

The mortuary workers reported that they didn't reported the incidents of injuries to the concerned authorities, because the perceived that the injuries were only minor and had performed first aids by themselves.

During the interview it was also found that only the permanent workers received their salary regularly and only four of the respondents (34 %) were satisfied with the salary that they received. Only the permanent mortuary staff had felt they feel their career is stable. Six (50 %) of the respondents revealed that they had been illtreated by the relatives of the deceased whereas five (42%) had felt that they were treated badly by police personnels. Only the six (50%) respondents who were permanent employees could avail paid leaves.

There was no proper restrooms or washrooms available for the workers and there is no proper lunch break or tea break hours for them to had food regularly. While it was noted that family of the respondents had shown full support for their career, they had faced discriminations as well as snobbish comments and remarks from the members of society.

The respondents admitted that they consume alcohol. Five (42 %) of the respondents consume alcohol on a daily basis while the rest of the seven (58 %) respondents only drink occasionally. While asking about the work related stress, only one reported that he feels stressed about the workload, nevertheless all the twelve workers had clarified that they were completely at ease while handling the dead bodies. Ten workers (83 %) told that they were able to maintain a healthy balance between work life and family life. This finding is in contrary to that observed by Rose AL, Atkey SK, Goldberg JO [8] in which it was impossible for the workers to find any additional source of income due to continous duty hours. The 83% workers reported that they prefer to resolve the issues among themselves, if not solved then only they bring it to the notice of higher authorities of the department.

Discussion

On an average15 autopsies were conducted daily in Victoria Hospital mortuary. This workload makes the herculean task of managing large number of dead bodies at cold storage, shifting to autopsy room, performing PM examination etc. more difficult. However, this study envisages to analyse the working conditions, training requirements and occupational Hazards of mortuary staff involved in postmortem Examination. Also to analyse the psychological impact of occupation over the mortuary workers.

The mortuary is place with a heavy load of deadly micro organisms [9]

On contemplating the data related to the Demographics and Work Environment, we found it to be a male predominant workforce, which is consistent with the findings of Akinyemi et al. (2020) [10] where 95.1% of the participants were male. The educational status in our data shows that a significant portion of the workforce has education till SSLC, while the findings of Akinyemi et al. (2020), shows that 35% had no formal education. Regarding awareness of occupational hazards, our data shows high awareness of tetanus but low awareness of hepatitis B vaccination status, contrasting with Akinyemi et al. (2020), where awareness of hepatitis B was higher. Injuries in the workplace, especially needle pricks, were prevalent in our data, consistent with the findings of Desai et al. (2022).Use of personal protective equipment (PPE) varies, with gloves and gowns being used always by 100% of respondents, which is a positive finding compared to inconsistent use reported by Desai et al. (2022).[5]

On analysing the Psychological Aspects our data indicates a high prevalence of alcohol use among mortuary staff, consistent with the finding of Udita Srivastava et al. (2022), which attributed this to stress coping mechanisms. Stress levels seem relatively low in our data, with only 8% reporting feeling stressed

about the nature of their job, which contrasts with Mridula and K Ganesh's (2016) findings where monotony and long working hours were stressors. [6]As far as Health Risks and Safety Measures were concerned, exposure to chemicals and biological risks, as well as inadequate use of PPE, were highlighted in our data, which aligns with the findings of Desai et al. (2022).Lack of proper psychological training and support systems for coping with stressors were consistent with Udita Srivastava et al.'s (2022) findings.[5]

In summary, while some aspects like injury prevalence and PPE usage show positive findings compared to other studies, there were still significant concerns regarding occupational hazards, psychological support, and consistent use of safety measures. This study is aimed at understanding the demands and requirements needed for this particular job by keeping in mind the fact that the mortuary sector including funeral homes is a neglected area in regard to study of occupational factors as well as stressors effecting its employees [11] .Addressing these issues through improved training, support systems, and adherence to safety protocols could enhance the overall well-being and safety of mortuary workers.

Conclusion

The study revealed that mortuary workers were vulnerable to numerous hazards associated with their occupation. Factors such as limited education, inadequate training, and a lack of awareness significantly contribute to their exposure to avoidable mishaps. Addressing these underlying issues through targeted training programs and awareness campaigns is essential for improving workplace safety. Workers demonstrate a lack of seriousness regarding the risk of infection while handling the bodies of individuals with known cases of HIV and TB. This attitude further increases their susceptibility to contracting diseases. Additionally, they often administer first aid for injuries considering them to be minor without fully recognizing the potential severity of such wounds. Postmortem rooms were found to pose significant hazards, including the storage of dangerous chemicals without proper labelling in open racks. Safely storing these chemicals in secure locations can reduce the risk of unintended exposure and spills. Mortuary staff who were hesitant to wear goggles and masks need to be educated on the importance of these protective measures, and authorities should emphasize consistent usage.The absence of designated washrooms or areas for changing clothes during extended shifts significantly affects workers' well-being and productivity. A case was observed during the study, where a respondent was abruptly removed from his job without prior notice, exacerbates concerns about their job stability. Improving salaries of contractual workers performing the same duties as permanent workers is crucial for ensuring equal pay. Educating workers engaged in substance use on a daily basis is essential, as it can impact workplace safety and physical health. Additionally, fostering a culture of open communication and understanding among concerned authorities can encourage workers to seek help for the various unique challenges they face, ultimately promoting overall well-being within the mortuary environment.

Ethical Clearance: Institutional Ethics Committee, date: 25/04/2024, Ref No: BMCRI/EC/16/2024

Conflict of Interest: None to declare

Funding: None to declare.

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Original Research Article

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A Prospective Study of Histo-Pathological Changes in Lungs, Liver and Kidneys in Burns Cases Autopsied at A Tertiary Care Hospital

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Abstract

Introduction: Medico legal deaths including burns claim a substantial number of lives in central Karnataka. 'A prospective Study of Histo-Pathological changes in Lungs, Liver and Kidneys in Burns Cases' was carried out at the Department of Forensic Medicine & Toxicology, SS hospital, SSIMS & RC, Davangere.

Material & methods: The present study was carried out for the period of 3 years from January 2021 to December 2023. Totally 100 cases with burns and scalds injuries brought to the mortuary for autopsy was the material for study and collection of tissues for histopathological examination.

Observations & Results: In the present study, histopathological changes in lungs showed congestion, pulmonary edema, Diffuse alveolar damage or ARDS changes, bronchopneumonia, interstitial pneumonitis, anthracotic pigment, carbon laden macrophages, intravascular thrombi, septic emboli, interstitial & intra alveolar hemorrhage. Histopathological changes in liver showed congestion, fatty change, centrilobular necrosis, cloudy swelling, focal hemorrhage, necrosis, portal inflammation. Histopathological changes in kidneys showed ATN in majority of cases, cloudy degeneration, congestion, tubularcasts and acute pyelonephritis in rest of the cases.

Conclusion: The effect of burns on vital organs can be assessed through histopathological examination, which helps in determining the post burn complications and which aid in better treatment outcome of the burn's patients.

Keywords: Medico legal autopsy, Burns, Scalds, Histopathological examination.

Introduction

Burn is defined as a 'Damage to the skin or deeper tissues caused by hot liquids, fire, electricity or chemicals & the sun'. The degree of severity of most burns is based on the size and depth of the burn. Medico legal deaths including burns claim a substantial number of lives in Central Karnataka.

The circumstances of burns may be personal, domestic, occupational or social tragedy and dowry

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deaths. In all societies including the developed and developing countries, burns constitute not only a major medical and psychological problem, but have also resulted in social and economic consequences.[1]

A burn is an injury which is caused by application of heat or chemical substances tothe external or internal surfaces of the body which causes destruction of tissues.[2]

Thermal burns are becoming common incidents, which stands next to road traffic accidents in India. Mortality rate due to burns is much more than any other developed countries.[3]

The burn injury causes devitalization of the affected surface and produce sex tensive raw areas, which become moist due to exudation of plasma, forming a medium ideal for the colonization and proliferation of various types of microorganisms. The affected individual's immune system is depressed and this, compounded by the large cutaneous bacterial load and prolonged hospitalization contribute to sepsis.[4]. Hot or corrosive substances account for two-thirds of all burns, with fire and flame accounting for one-fourth of cases.[5]

The major cause of death in the burn patients includes multiple organ failure due to septicemia. This can be understood better with apathological study of the burn victim's organs.[6]

The present study is an effort to identify the histopathological changes occurring in the lungs, liver and kidneys of victims died due to burns with the help of routine H & E stain. The epidemiological profile, hospital data, police inquest and postmortem examination findings, the post-exposure duration of survival in burns victims is correlated with pathological findings of vital organs to find out the actual cause of death and mechanism of death at terminal events and their utility to predict prognosis and betterment of treatment modalities in future. As there are only few studies conducted in this regard till now, it will be of immense help in improving treatment of burns patients & throw a light on need of further research on this area.

Aims and Objectives:

1. To know the pattern of fatal thermal burns cases in relation to the age, sex & marital status.
2. To know the degree, cause & manner of death and their correlation with survival period.
3. To know the Histopathological changes in lungs, liver and kidneys in fatal burns casesin relation to duration of survival.

Methodology

All the cases of deaths due to burns & scalds brought to the mortuary, Department of Forensic Medicine, SSIMS & RC, Davangere for the period of 3 years from January 2021 to December 2023 was the material for the present study.

The specimens of lungs, liver and kidneys were collected and preserved in10% formalin solution. The specimens were sent to the department of pathology for histopathological examination. The reports were collected & analyzed.

The histopathological changes of each organ were noted and tabulated in MS XL. Statistical analysis is done using SPSS software.

Study Protocol:

- **Study design:** Prospective Observational Study.
- **Study period**: Three years from January 2021 to December 2023.
- **Sample size:** 100 cases of Medico Legal deaths due to Burns & Scalds.

Inclusion Criteria:

A total number 100 medico legal autopsies with the alleged history of burns & scalds, performed at the Department of Forensic Medicine, SS hospital, SSIMS & RC, Davangerefora period of 3 years from January 2021 to December 2023 were included in the study.

Exclusion Criteria:

- Cold injuries, electrical burns & Postmortem burns cases.
- Charred bodies, decomposed cases and unknown bodies

Results and Discussion

The present study was conducted in the department of Forensic Medicine and Toxicology with collaboration of the department of pathology

at SSIMS & RC, Davangere. The total of 100 burns & scalds cases were studied from January 2021 to December 2023.

Distribution of cases according to age & sex: In the present study, among 100 cases, 36 cases were seen in age group of 21 to 30 years (36%) followed by 26 cases in 11 to 20 years of age (26%) and 24 cases in 31 to 40 years (24%). Out of 100 cases, 74 (74%) were females and 26 (26%) were males. So, the overall Male: Female ratio was 1: 2.8.

Table 1: Distribution of cases according to age & sex

Age in yrs.	No. of cases		Total	Percentage%
	Males	Females		
0-10	04	02	06	06.00
11-20	06	20	26	26.00
21-30	02	34	36	36.00
31-40	10	14	24	24.00
41-50	04	02	06	06.00
51-60	00	02	02	02.00
>60	00	00	00	00.00
Total	26	74	100	100.00

(Chi-Square value = 6.09 df = 5 P = 0.01) Significant

Distribution of cases according to marital status: It was observed that 74% of victims were married and 26%victims were unmarried. (Fig-1)

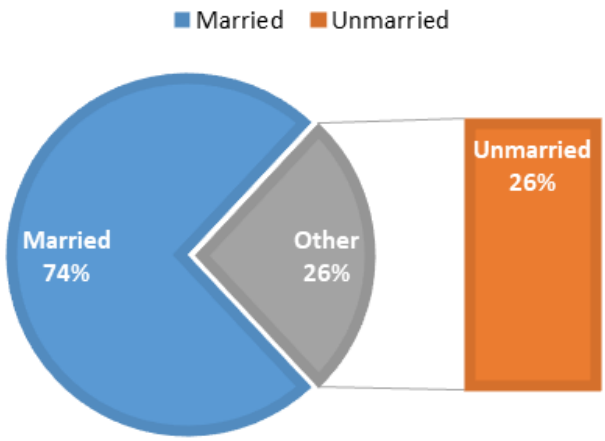

Fig 1: Distribution of cases according to marital status

Distribution of cases according to domicile status: Majority of the victims belong to rural area (68%) followed by urban area (32%).(Fig-2)

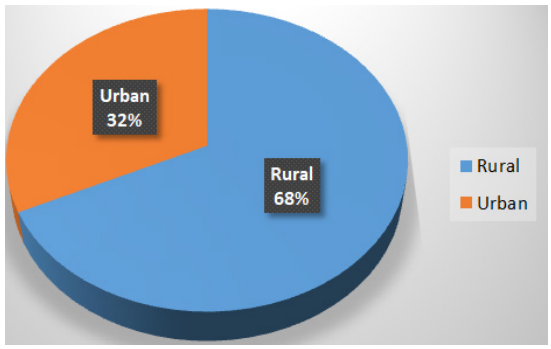

Fig 2: Distribution of cases according to domicile status

Distribution of cases according to type & depth of burns: Among100 cases;96 cases were flame burns & only 4 cases were scalds. Among 100 cases 60 cases had dermo-epidermal burns (60%) and in the remaining cases epidermal burns (24%) and deep burns (16%).

Table 2: Distribution of cases according to depth of burns

Depth of burns	No. of cases	Percentage%
Epidermal	24	24.00
Dermo-epidermal	60	60.00
Deep	16	16.00
Total	100	100.00

Distribution of cases according to total body surface area (TBSA) involved: All the victims of burns cases succumbed to death had more than 20% of burns. Majority of victims died with 91-100% of burns (26%) followed by 81-90% burns (20%). Two cases suffered 21-30% of burns.

Table 3: Distribution of cases according to total body surface area (TBSA %) involved

Percentage of TBSA	No. of cases	Percentage (%)
0-10%	00	00.00
11-20%	00	00.00
21-30%	02	02.00
31-40%	04	04.00
41-50%	12	12.00
51-60%	08	08.00
61-70%	16	16.00
71-80%	12	12.00
81-90%	20	20.00
91-100%	26	26.00
Total	100.00	100.00

Chi-Square value = 11.9 P = 0.04 Significant

Distribution of cases according to duration of survival: In our study, it was observed that 12% of cases survived for 1 day, 8% of cases survived for 2 days,14% of them survived for first 72 hours, 34% of cases survived for 3 to 5 days,17% of cases survived for 5 to 7 days and 15% of them survived for 8 days or more.

Table 4: Distribution of cases according to duration of survival

Duration of survival	No. of cases	Percentage%
0-24 hours	12	12.00
24-48 hours	08	08.00
48-72 hours	14	14.00
3 to 5 days	34	34.00
5 to 7 days	17	17.00
8 days and more	15	15.00
Total	100	100.00

Chi-Square value = 12.5 P = 0.03 Significant

Distribution of cases according to manner of death: In the present study, it was observed that the most common manner of death in burn injury was accidental (65%) followed by suicidal (32%) and homicidal (3%). (Fig-3)

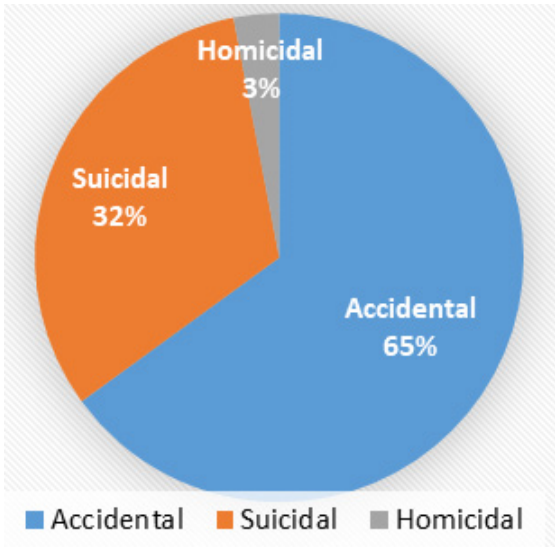

Fig 3: Distribution of cases according to manner of death

Distribution of cases according to cause of death &Correlation with duration of survival: The cause of death was septicemia in 46 cases (46%) followed by hypovolemic shock (22%), toxemia (20%) and neurogenic shock (12%).In the present study, 12% deaths occurred due to neurogenic shock within 24 hrs, 20 % due to toxemia within 3 – 5 days and 46% due to septicemia 3 days to 8 days & more.

Table 5: Distribution of cases according to cause of death &Correlation with duration of survival

Causes of death	Duration of survival					
	0-24 hours	24– 72 hours	3-5 days	5-7 days	8 days & more	Total
Neurogenic shock	12	00	00	00	00	12
Hypovolemic shock	00	22	00	00	00	22
Toxemia	00	00	20	00	00	20
Septicemia	00	00	14	17	15	46
Accidental injuries	00	00	00	00	00	00
Total (No. of cases)	12	22	34	17	15	100

HISTOPATHOLOGICAL CHANGES:

Histopathological changes in lungs: (Fig: 4 to 7)

In our study,22% of cases showed diffuse alveolar damage (ARDS), the alveolar walls lined with waxy hyaline membranes, consist of edema fluid mixed with the cytoplasmic and necrotic epithelial cells. Fatal cases often have superimposed bronchopneumonia (8%).Congestion was observed in 14 cases (14%), pulmonary edema in 16 cases (16%),emphysematous changes were observed in 10 cases (10%)and interstitial pneumonitis observed in 4 cases (4%). Anthracotic pigment and carbon laden macrophages observed in 14 cases (14%). Intravascular thrombi & septic emboli observed in 08 cases (8%), interstitial & intraalveolar hemorrhage observed in 4 cases (4%).

Wroblewsky P. et al found edema and necrosis of bronchial mucosa, inflammatory mediators and

obstruction of bronchial tract with the castscomposed of mucus, tissue debris, neutrophils and fibrin (ARDS) in 26 % of cases. The findings are is consistent with the present study.[7]

Toor AH et al (1990) observed diffuse alveolar damage in 16 (28.48%) patients andnecrotizing interstitial inflammation in seven (21.21%) patients. So, these findings areconsistent with the present study.[8]

Argamaso R V observed changes of pneumonitis in 6.66% of cases, pulmonary edema in 70% of cases and varying degrees of pulmonary infarction or necrosis in 23.33% of cases. So, these findings are in contrast with the present study. Different durations of post burn survival maybe the cause of this discrepancy.[9]

Shinde AB and Keoliya AN observed the histopathological changes in lungs, showed pulmonary oedema in 61(55.45%) cases, atelectasis in 16 cases (14.54%), interstitial haemorrhage in 42 cases (38.18%), intra alveolar hemorrhage in 39(35.45%), interstitial pneumonitis in 30 cases (27.27%), macrophages in 51cases (46.36%) and congestion in 81cases(73.63%),these findings are in contrast with the present study. Authors observed bronchopneumonia in 22 (20%) cases, emphysema in 19(17.27%) and ARDS in 32 % of cases, so these findings are consistent with present study.[10]

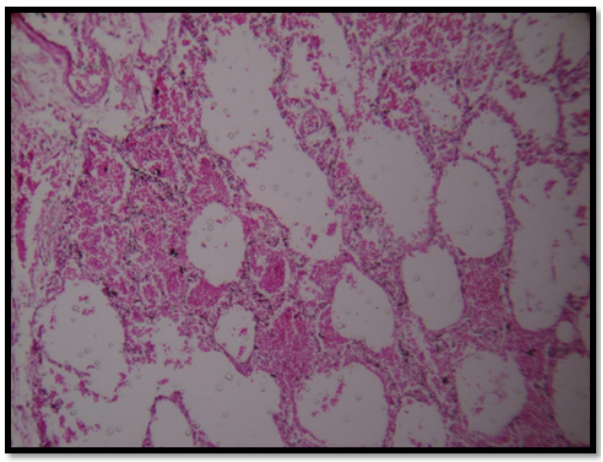

Fig 4: Histopathological slide showing pulmonary congestion.

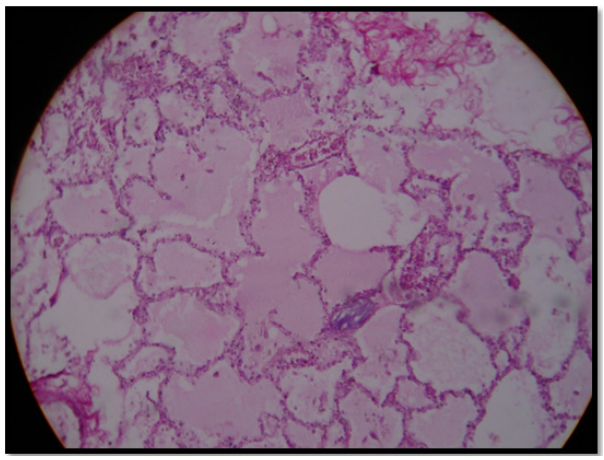

Fig 5: Histopathological slide showing pulmonary edema

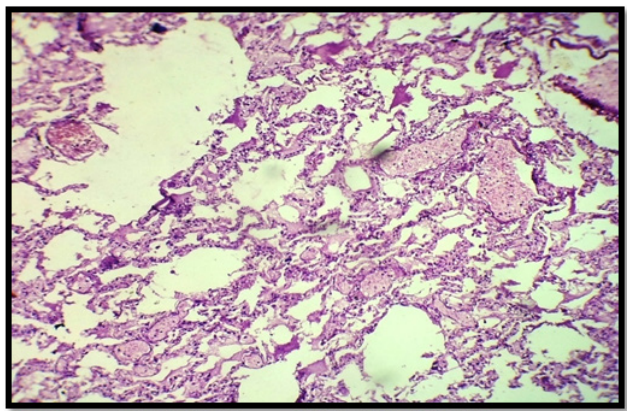

Fig 6: Histopathological slide showing of Diffuse Alveolar Damage in lungs (ARDS)

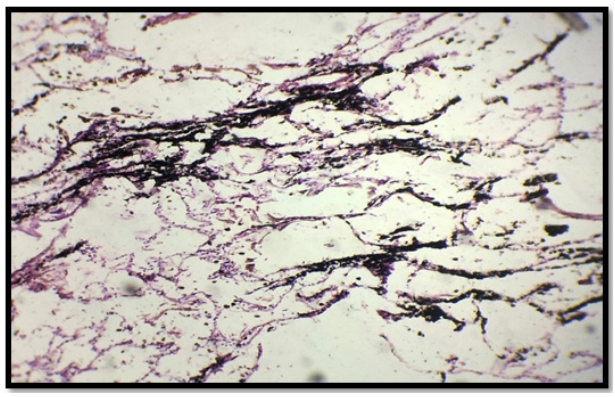

Fig 7: Histopathological slide showing anthracotic pigment in the lungs.

Histopathological changes in liver: (Fig: 8 to 11)

In our study, Congestion of the liver was observed in 40 cases (40%). It was observed that all cases showing changes of venous congestion had

aminimum duration of survival of 0-72 hours. Fatty changes in the liver were observed in 16 cases (16%). Cloudy swelling and loose cytoplasmic hepatic cells were observed in 08 cases (8%). Cases showing centrilobular necrosis had a minimum duration of survival of 0-72 hours. Cases showing changes of portal inflammation were distributed widely in correlation with duration of survival from 25-72 hours to 8 days and more.

Marc G. Jeschke (2011) observed changes of liver necrosis in 10-15% of thermally injured patients in his study. So, the findings are consistent with the present study.[11]

G. Watson James (1950) observed evidence of fatty infiltration (18 %), cloudys welling (11.5 %), increased pigments in the reticulo-endothelial cells and focal necrosis (6.5%) and congestion (45 %) in the liver substance. The observation in this study is in accordance with the observations made in our study.[12]

Lars H. Evers (2010) observed changes of large intrahepatocytic fat droplets (22 %), centrilobular necrosis (16 %) and congestion (38%) in most burn cases. These findings are in consistent with the present study.[13]

Shinde AB and Keoliya AN (2013) observed the histopathological changes in liver,64cases (58.18%) showed congestion of the liver. Fatty changes in the liver were observed in17 cases (15.45%). Cloudy swelling and loose cytoplasm were observed in hepatic cells. The findings are inconsistent with the present study.[10]

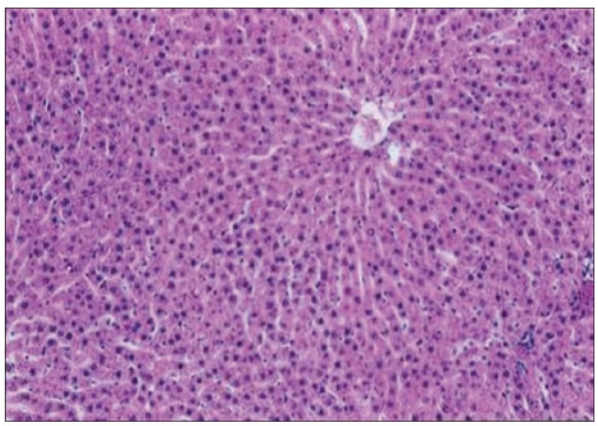

Fig 8: Histopathological slide showing liver congestion

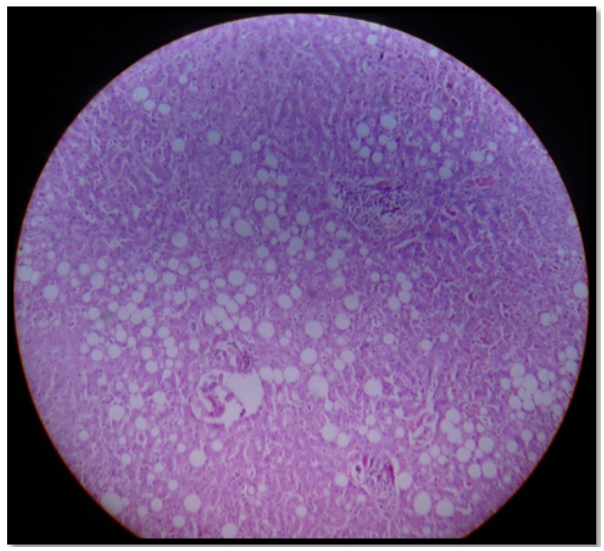

Fig 9: Histopathological slide showing Fatty change in the liver

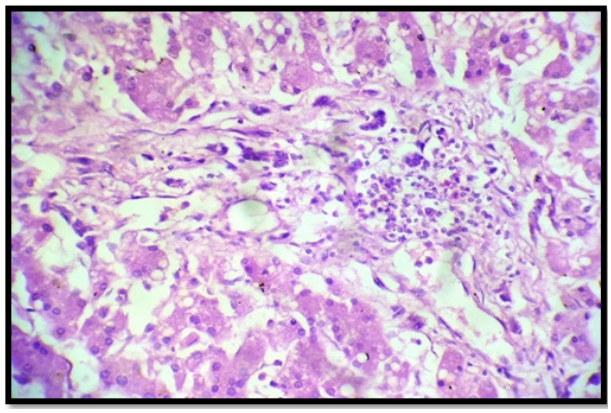

Fig 10: Histopathological slide showing portal inflammation in the liver

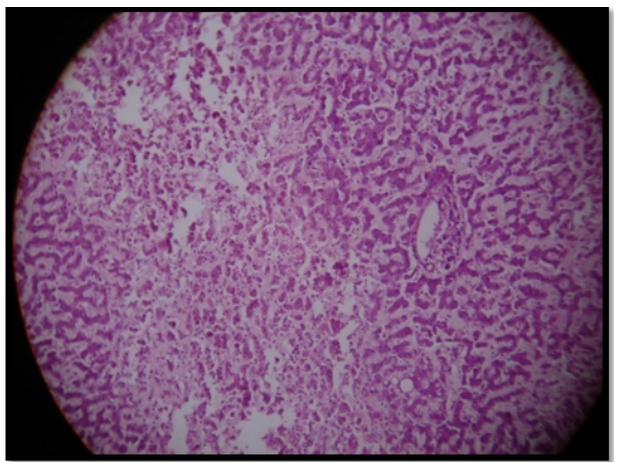

Fig 11: Histopathological slide showing Hepatic necrosis (centrilobular necrosis)

Histopathological changes in kidneys:(Fig: 12 to 15)

In the present study histopathological changes in kidneys showed acute tubular necrosis in 42 (42 %), cloudy degeneration in 20(20%) cases, congestion in 16(16%) cases, tubular casts in 14(14 %) and acute pyelonephritis in 08 (8%) cases.

Sevitt S observed changes of acute tubular necrosis in 59.30% cases and changes of cloudy swelling in 37.21% cases. Difference in the post burn duration of survival could be the reason for above observations.[14]

Dr Yan observed that the glomeruli morphologic changes and tubular casts in most of the burn patients. The above observation is in accordance with the present study.[15]

Argamaso R V observed changes of cloudy swelling in 10% cases whereas 33.33% cases had degenerative changes in the renal tubules. Results of our study is consistent with the present study.[9]

Cernea Daniela et al[16] and Palmieri T et al[17]HPE studies observations showed kidneys displayed tubular necrosis, fibrous micro-thrombi and infarct areas and in accordance with observations made in the present study.

Shinde AB and Keoliya AN observed cloudy degeneration of kidneys in17 (15.45%) cases, tubular casts in 35(31.81%), acute pyelonephritis in 10 (9.09%), regeneration of epithelium in 15 cases (13.63%) & acute tubular necrosis in 18 cases(16.36%), correlates with the present study findings.[10]

Coca SG et al observed acute kidney injury in 26.6% of burns. So, observation of this study is in contrast with the present study, could be due to variation in duration of survival.[18]

Steinwall I et al observed changes of acute kidney injury in 24% of burns. So, this study is contrast with the present study, which may be due to difference in the post burn duration of survival.[19]

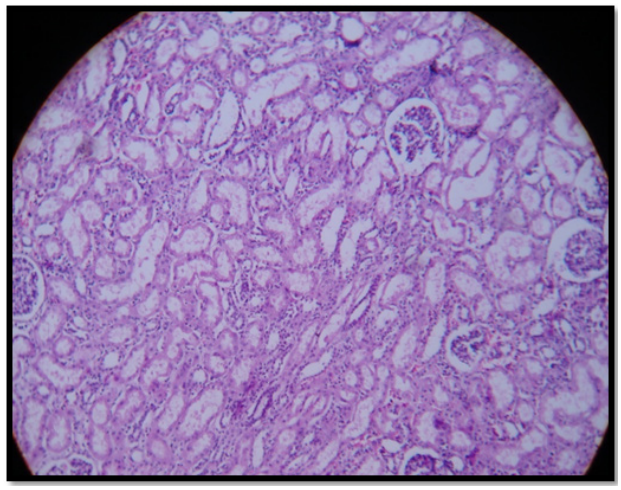

Fig 12: Histopathological slide showing degenerative changes in the kidney

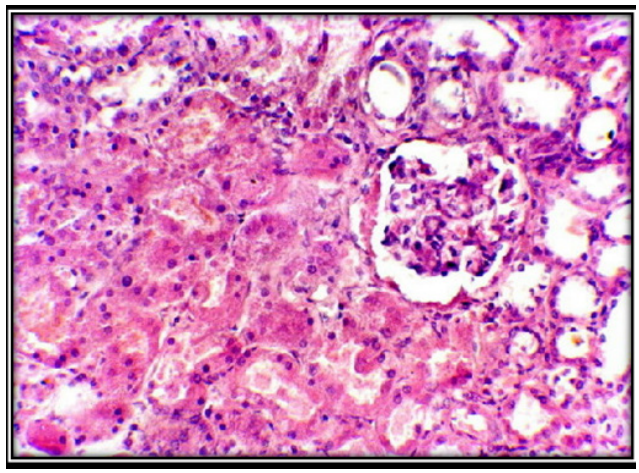

Fig 13: Histopathological slide showing cloudy degeneration in the kidney.

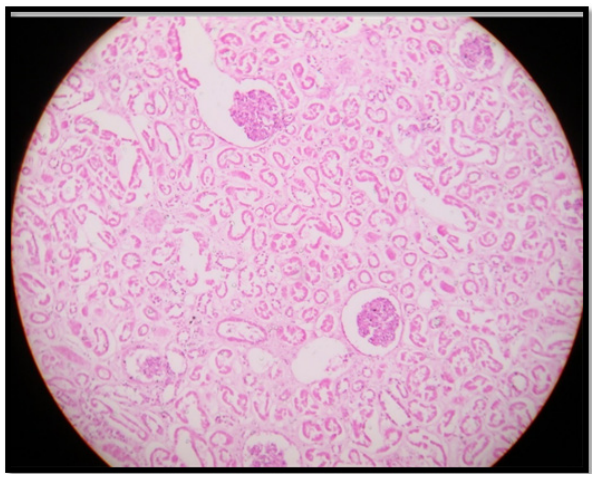

Fig 14: Histopathological slide showing acute tubular necrosis in kidney

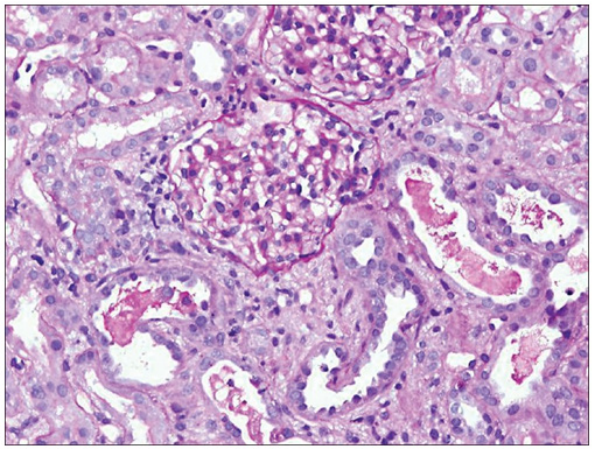

Fig 15: Histopathological slide showing acute tubular necrosis with tubular casts

Conclusion

The accidental deaths by flame burns are preventable by adequate safety measures and safety education. Deaths due to burns are more common in married women, which could be mainly due to indulging themselves in household works in cooking. Socio-economic factors like use of fire woods, kerosene stoves for cooking in rural areas, huts with thatched roofs, inadequate precautions, negligence and wearing of cloths made of polyester/sarees contribute to the high rate of accidental flame burns. The dowry deaths also contribute to the increased deaths among married women. Since scald injuries in children are very common, parents and care takers must always take necessary measures to avoid their children to not to come in contact with hot liquids.

Major cause of death in burn victims is septicemia as result of superadded infections due to their depressed immune mechanisms and loss of protective layer of the body (skin).

Usually, victims of burns die due to hypovolemic shock, toxemia or septicemia. As per the duration of survival of the victim, the changes that are noticed on histopathological examination of lungs, liver and kidneys will help in determining the final cause of death.

In our study majority of lung specimens showed diffuse alveolar damage as the major histopathological change which is due to the inhalation of incomplete products of combustion (inhalational injury) and septicemia. The liver showed changes of hepatic necrosis, cloudy swelling, fatty changes but they cannot be the sole causes of death in burn victims.

The kidneys showed acute tubular necrosis (ATN) in majority of specimens which is acommon pathology behind acute renal failure in burns patients. ARF isa well-known complication and dreadful consequence of burns as it may lead to anincrease in mortality about 80% as proved by many studies. Assessment of renal function in burns cases helps in early detection of acute renal failure and improve their treatment outcome.

Ethical Clearance: Ethical clearance is obtained from the Institutional Ethics Review Board, SSIMS & RC, Davangere, vide letter No: IERB/54/2021 dated 18/4/2021.

Source of Funding: Self.

Conflict of Interest: None.

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Original Research Article

DOI: https://doi.org/10.37506/zsdhtw52

Demographic Profile of Violent Asphyxial Deaths in JSS Medical College, Mysuru: Five Year Retrospective Study

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Abstract

The epidemiological risk factors for violent asphyxia deaths can contribute to construct a socioeconomic and demographic profile of victims of asphyxial deaths. This study is also very crucial in identifying the risk factors, triggers for common asphyxia deaths and especially suicidal asphyxial deaths like hanging based on the profile and data derived from this study.

This study was undertaken to analyse the different aspects of asphyxial deaths. Main focus is given to study the type of asphyxia, age, sex distribution and seasonal variation, also to know the pattern in work area, seasonal and demographic variations.

Among the asphyxial deaths hanging is the commonest which constituted 81% of the total asphyxia deaths and was predominant in males.

Drowning is the second most frequent type of asphyxia death followed by strangulation.

The incidence of hanging is highest during winter season. This suggests that seasonal factors and its resulting psychological fluctuations might aggravate depression and mood, which then might finally impact the victim's suicidal tendencies leading to increased incidences of hanging.

Key Words: Asphyxial deaths, Medico-legal case, demography, pattern, Autopsy, Tardieu's spots.

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Introduction

Asphyxial deaths are most commonly encountered in forensic practice and pose a considerable challenge in few circumstances. It can be mechanical, environmental or toxic. It Commonly include hanging, drowning and strangulation. This study was undertaken to analyse the different aspects of asphyxial deaths. Main focus is given to study the type of asphyxia, age, sex distribution and seasonal variation.

Asphyxia is a condition caused by interference with respiration, or due to lack of oxygen in respired air, due to which the organs and tissues are deprived of oxygen causing unconsciousness or death.[1]

Mechanical asphyxia: It is the mechanical interference to the passage of air into the respiratory tract by: closure of external respiratory orifices by closing the nose and the mouth eg. Smothering closure of the air passages by external pressure on the neck eg. Hanging, strangulation and throttling or impaction of foreign bodies eg. Gagging and choking Occlusion of the respiratory tract and lungs by fluid eg. Drowning Pressure on the chest in a stampede or collapse of a building eg. Traumatic-asphyxia.[2]

Suicidal hanging is defined as a form of asphyxia death produced by the body being self-suspended by a ligature material around the neck, with the body's weight serving as the compression force around the neck. Usually, rope or readily accessible clothing serves as the ligature material. The hanging may cause death by various processes that function separately or in combination. These include spinal cord injury, venous and arterial blockage, airway obstruction, carotid complex compression resulting in reflex cardiac arrest, and so on.[3]

In some instances, the 'cunning' suicide – perhaps with the intention to defraud an insurance company or to throw suspicion on an innocent person by way of revenge – may plan his death in a manner that suggests homicide.

Drowning is a form of asphyxia due to aspiration of fluid into air passages, caused by submersion in water or other fluid. Complete submersion is not necessary, for submersion of the nose and mouth alone for a sufficient period can cuase death from drowning. About 150,000 person die from drowning each year around the world[4].

The common Clinical effects of Asphyxia include cyanosis, congested viscera, Tardieu's spots.

Materials and Methods

It is a type of Retrospective demographic study of asphyxial deaths carried out from the year 2010 to 2014 at JSS Medical College, Mysuru. The information of demographic profile was collected from Postmortem register. This study profile includes information on age, gender, type of asphyxia and seasonal variation. Informed consent was not obtained for this study as it is an autopsy based retrospective study, all the data were obtained from post-mortem register and the details are anonymised. Later the information were analyzed using SPSS-18 software.

Results

During the five year period total 859 cases were autopsied out of which 221 cases were asphyxial deaths (26%).

Hanging is the commonest method of asphyxial death and was commonly seen in males, in 31-40 year age group and in winter season.

Drowning is the second most frequent type of asphyxia death followed by strangulation.

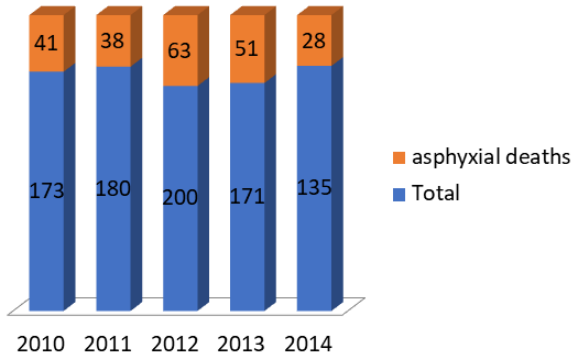

Fig 1: Total Cases in Each Year

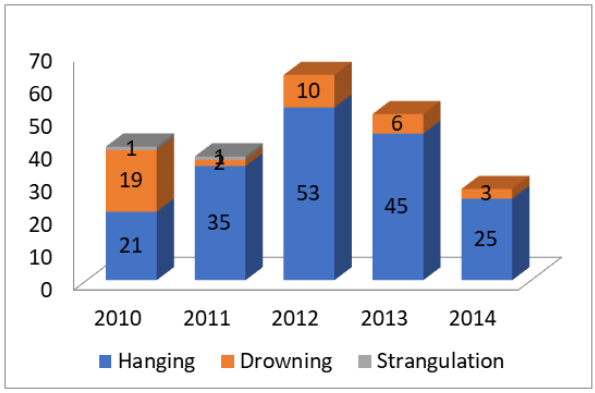

Fig 2: Type of Asphyxia

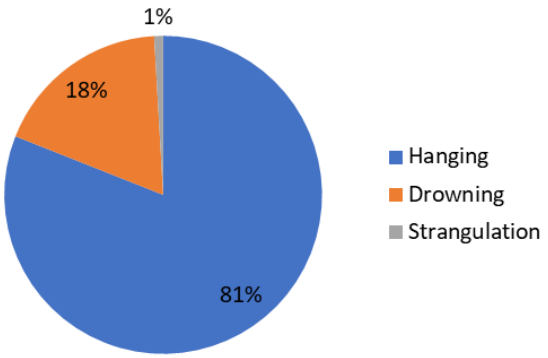

Fig 3: Total Distribution of Different Types of Asphyxial Deaths

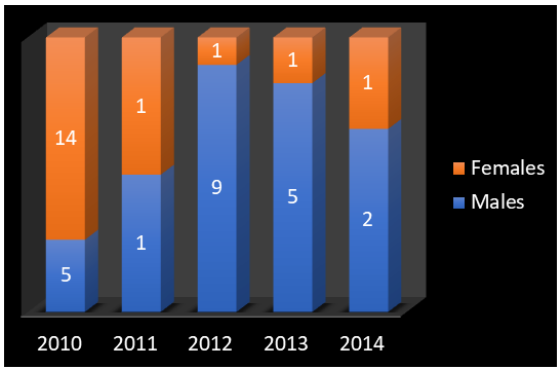

Fig 4: Hanging: Sex Distribution

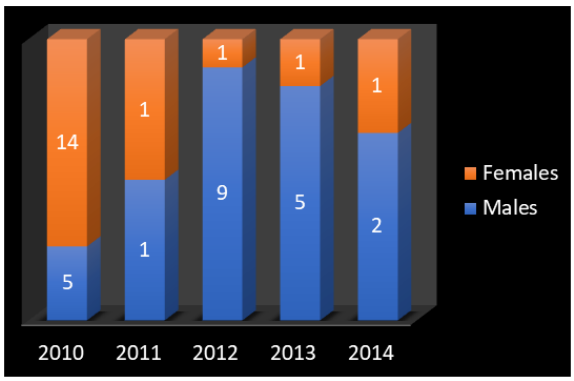

Fig 5: Drowning: Sex Distribution

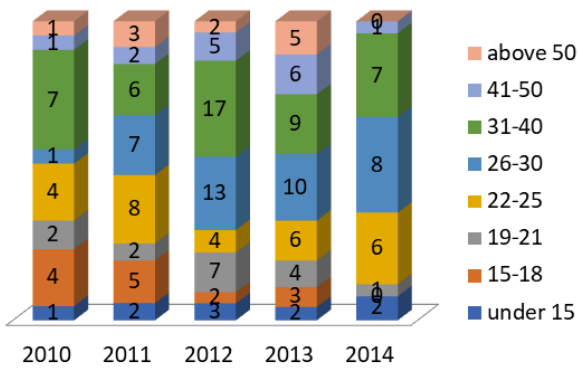

Fig 6: Hanging: Age Distribution

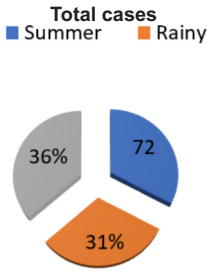

Fig 7: Asphyxial Deaths: Seasonal Distribution

Discussion

The incidence of asphyxial deaths in this study is higher when compared to other studies; Vikram Palimar et al[9] and Gupta Ved Prakash et al.[10]

In this study majority were male population age between ages 31 to 40 yrs. Similar findings were also observed in the studies by Sharma et al[11] and Jani et al[12]

The predominant sex is male which is in comparison with the study conducted by S Sharija et al[5] whereas it is in contrast with the study conducted by Dinesh Rao et al[6] where female preponderance is more when compared to males.

Majority of cases were in the age group: 31-40 years, which correlates with the study conducted by Bhausaheb N et al[7] and Elfawal MA[8],whereas it is in contrast with the studies done by Vikram P et al[9] and Gupta V P et al[10] where 21-30 years is the predominant age group.

The incidence of hanging is more among males than females, especially from 2012 to 2014.

Most of the cases were recorded during winter, it is in comparison with the study conducted by Meel BL[13] where the maximum cases encountered during November month, Whereas in the study done by Vikram P et al[9] and Kolpe et al [14] most cases were recorded during summer.

Hanging is the most common form among violent asphyxial deaths which was similar to the studies conducted by Sahoo et al. [15], Pradip et al. [16], and Mohanty et al. [17]

Conclusion

This study concluded that death as a result of hanging is the most common form among violent asphyxial deaths.

A well designed and comprehensive program is needed to identify the causative factors and prevention of asphyxial deaths.

The incidence of hanging is highest during winter season. This suggests that seasonal factors and its resulting psychological fluctuations might aggravate depression and mood, which then might finally impact the victim's suicidal tendencies leading to increased incidences of hanging.

A well designed and comprehensive program is needed to identify the causative factors and prevention of asphyxial deaths

This study emphasizes the importance for policymakers, mental health professionals, and medico-legal experts to develop targeted interventions. While personal problems may be triggers, societal and psychological factors are significant contributors. Early intervention strategies and broad mental health service implementation are crucial, particularly for young men with a history of mental illness.

Improved mental health services, along with social support and economic upliftment strategies, could significantly reduce the incidence rates. Informing public health policy with the factors leading to these suicides could revolutionize suicide prevention efforts.

Equipping primary care physicians to recognize and treat depression, coupled with youth education on depression and suicide prevention, and ongoing support for psychiatric patients, can significantly reduce suicidal behavior.

To create a comprehensive approach to suicide prevention, universal interventions encompass restricting access to lethal means, establishing media guidelines for responsible reporting, promoting help-seeking behavior, launching public awareness campaigns, providing accessible helplines, and actively reducing societal stigma surrounding mental health issues.

To effectively combat drowning, a multi-layered approach is essential. This includes engineering solutions that eliminate hazards, enacting legislation to enforce preventative measures and limit exposure, implementing educational programs to raise awareness and equip communities to respond, and prioritizing research and public health initiatives to better understand the global burden of drowning and develop even more effective prevention strategies

Conflict of interest: nil

Source of funding: self

Ethical clearance: Since this is a data-profile study and no interventions were performed on human subjects, ethical clearance was not required. The entire data in this study was obtained from Post-mortem register and personal details were not obtained; the data was anonymised.

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Original Research Article

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Lip Print Analysis: A Study on Patterns and Forensic Applications

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Abstract

Lip prints are lines, also known as grooves and fissures, on the skin that form at the junction of the labial mucosa and the lip's exterior surface. The study of these lip prints is known as chelioscopy. They are known to follow a pattern, which has been classified into multiple categories by various experts. Suzuki & Tsuchihashi's classification proved to be the most popular. They are also noted for having a few distinguishing characteristics that aid in determining a person's personality. The current study was conducted to examine quadrant-wise patterns and differences between males and females. In our study, the most prevalent lip print in males was type I (32.91%), followed by type 3 (22.50%). In females, type 1 was the most common (39.16%), followed by type 3 (20%). Study found significant variations between males and females in lower lip print patterns.

Key words: Lip print types; Chelioscopy; Suzuki and Tsuchihashi; Quadrant wise analysis

Introduction

Lip prints are typically intriguing due to the conspicuous appearance of lips on the face and their aesthetic value. We usually find latent or accidental imprints on smooth surfaces. Fingerprints, palms, footprints, lips, teeth, rugae, and other sources can all cause them.[1] These impressions necessitate a comparative investigation in situations of crimes. Lip prints are lines and/or fissures in the form of wrinkles and grooves. They form naturally in the transition zone between the inner labial mucosa and the outer surface of the human lip. Lip prints can be appreciated as early as the sixth intrauterine week.[2,3] Lip prints, like fingerprints, can be used to identify individuals. The creases along the vermilion border of the lips, as well as the raised reddish patches indicated by these creases, are similar to the furrows and ridges on the skin of the fingers.[4] Lip prints have been discovered to be invariable, unique, and permanent in nature. They are found to have no changes occurring during an individual's life. The prints also help to create a classification.[5,6] It has also been discovered that lip prints heal after changes such as herpes disease, trauma, and inflammation. The layout and shape of the furrows do not change with environmental conditions.[7,8] Although a specific hereditary pattern has not been found, there are some similarities between the lip prints of parents, offsprings, as well

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as those of siblings.[9] It has also been discovered that males and females exhibit different patterns, which can be utilized to determine sex of a person.[10]

Lipstick traces were discovered on human body parts, drinking glasses, cigarette buttocks, clothing, windows, doors, food items, and tissue papers. They are all useful as forensic evidence in investigations into crimes like sexual assault or homicide. [11] The expertise is also useful in lip repair procedures and other face pattern and esthetic treatments. [12]

Between 1970 and 1974, well-known Japanese doctors Suzuki and Tsuchihashi[7] carried out some of the most important Cheiloscopy studies. They presented six various types of groove patterns[7], as illustrated in image 1, which were used in our study.

Aims and objectives: The current study was conducted to understand different lip patterns, document common patterns, and determine variances by quadrant in the study participants. To determine any discrepancies in these patterns between male and female sexes. To investigate the potential use of lip prints in person identification. The study's findings will help forensic experts, police officers, and other law enforcement agencies identify suspects from crime scenes, like when performing autopsies on unidentified bodies or retrieving only mutilated or fragmentary head and face remains.

Material and Methods

The study was done between January and April 2024 on 120 people aged 18 to 25 who lived in the Srikakulam district of Andhra Pradesh. Persons having a congenital anomaly, malformation, trauma, mucocele, deformity, cicatrization, or surgical scars on their lips were excluded from the study. The study materials included white (A4 size) paper, disposable tissue papers, cellophane tape, a magnifying glass. Lip sticks utilized in this study are non-glossy, dark matty, or dark pink in color, depending on the study participants' choice.

The potential participants were explained about the study and technique, after which an informed consent was obtained. Participants were asked to apply lip stick on their clean, dry, slightly parted lips. The lipstick was applied uniformly. Cellophane tape was then softly applied from the right to the left, covering the entire length and width of the top and lower lips from the adhesive side. Care was taken that smudge traces do not emerge. Then cellophane tape was gently removed and was pasted on a white A4size paper sheet. Another piece of cellophane tape is again applied to obtain another copy of the print. Then the participant was let free to remove the lipstick with tissue paper or washing. This way, at least two prints were taken from each participant to account, and the print with the most significant characteristics was chosen for study. The collected lip prints were then carefully examined under bright light with a Magnifying Glass to determine the type of lip print.

The lip print was separated into four quadrants (each lip was divided into two), and each quadrant was examined separately to determine the type of grooves. This was done by drawing a perpendicular line through the midline to split each lip into left – right. The space between top and bottom lips is useful to separate it into upper and lower. This way, each lip print was separated into four areas: the right upper quadrant (RUQ), the left upper quadrant (LUQ), the right lower quadrant (RLQ), and the left lower quadrant (LLQ). The maximum number of groove types in a given quadrant determines the type of lip print in that quadrant. Various classification schemes have been proposed by researchers over time; however, the most widely accepted classification was developed by Suzuki and Tsuchihashi[7]was used in this study.

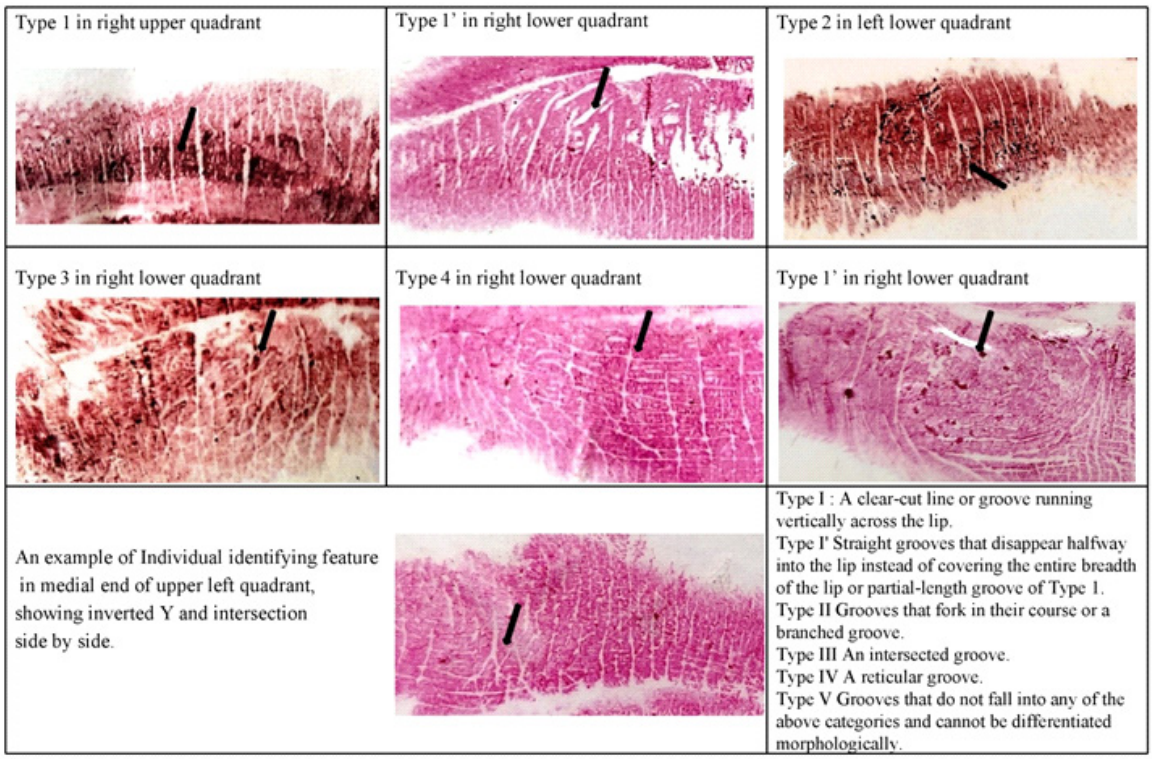
Results

Each lip print consisted of a variety of grooves rather than just one. This study found that type I is the most prevalent lip print in males (32.91%), followed by type 3 (22.50%). Type 1 was the most common among females (39.16%), followed by type 3 (20%). Further results for each quadrant are detailed in table number 1. There was no statistically significant difference ($P > 0.05$) between male and female lip prints in the right upper quadrant (RUQ) or left upper quadrant (LUQ). Lip prints of males and females showed a significant difference ($P < 0.05$) in the lower quadrants (right and left).

Table 1: showing the results obtained in our study showing lip print types distribution in different quadrants

	Males (n = 60)						Females (n=60)					
	RUQ	LUQ	RLQ	LLQ	Total /240	%	RUQ	LUQ	RLQ	LLQ	Total /240	%
Type 1	23	28	14	14	79	32.91%	27	21	22	24	94	39.16%
Type1′	10	6	4	5	25	10.42%	9	8	3	3	23	9.59%
Type 2	9	6	18	16	49	20.41%	3	4	8	11	26	10.84%
Type 3	12	11	16	15	54	22.50%	8	14	15	11	48	20%
Type 4	3	4	6	7	20	8.34%	11	9	8	6	34	14.16%
Type 5	3	5	2	3	13	5.42%	2	4	4	5	15	6.25%

Image 1: showing sample pictures from our study, one for each type of lip prints as per Suzuki and Tsuchihashi's classification



Discussion

Each person has a distinct lip print pattern, which differs depending on pattern kind, position, and number. In this study, type I was the most common (32.91% in men and 39.16% in women). Our study's findings are similar to a study by Peterson [13], in which the most prevalent lip print pattern was type I, as opposed to a study conducted by Sunil et al [14], which indicated type 1′ as the most common. Type III (32.3%) lip prints were discovered to be the predominant type in research by Tsuchihashi Y [7] and Sivapathasundharam et al [5]. Various studies in India have indicated variations in different populations. Sivapathasundharam et al[5] and Saraswati et al [15], discovered that Type III was the most frequent lip pattern in the Indo-Dravidian population. This variance in lip print occurrence across other researchers could be attributed to the fact that this study included a broad population, whereas other studies were limited to a certain region, or it could be due to regional diversity. The observed variance could also be due to a smaller sample size. So lip prints cannot be used to identify populations or races. Increase in the use of lip prints in forensic applications can be made by developing efficient technology and databases over time for lip print recognition, recording, and matching. Several factors

can influence lip print recording. The teeth position has an effect on lip prints as well. Habits like lip biting can cause repeated microtrauma to lips surface and alter the lip prints. Pathology and front tooth loss may produce deceptive results. The pressure, orientation, and method used to capture the imprint, inter observer bias may also have an impact on the appearance of the lip print. [16]

In addition to the patterns, the individual features of the grooves were analyzed, revealing that no two or more study participants had the same lip print. This is similar to a study by Sunil et al.[17], who found the individuality of lip prints in the their study on Delhi population. This has useful forensic applications in establishing the individuality of a person.

Comparison of lip print patterns in each quadrant of lips in both sexes:

Right upper quadrant (RUQ): In this study of lip prints in 60 males, and 60 females - in the right upper quadrant (RUQ): Type I was the most common (38.3%) in Males, followed by type 3 (20%). In cases of females, Type I lip print was seen in maximum numbers (45%), followed by type 4 (18.3%). It was similar to Ghimireet al.[18], who found that Type I pattern was seen in 62% of males and 32% of females in the right upper quadrant. In a study by Mathew SA et al. [19], females had predominant pattern as Type IV in the upper right quadrant, while the males showed a predominant Type I pattern in all four quadrants. This was in contrast to the findings of some authors' in previous studies. Among males, it was found that intersected pattern was most common in the right upper quadrant (42%) and females (38%) (Saraswathi TR et al.) [15] ; Type II pattern was most common in the right upper quadrant among females and males (DeepaJatti et al.)[20]

Left upper quadrant (LUQ): In this study: in males, Type I was seen in highest numbers (46.6%), followed by type 3 (18.3%). While in cases of females, type I lip print was seen in maximum numbers (35%), followed by type 3 (23.3%). In a study by (Peeran W et al.)[21], the Type I pattern was most prevalent in 43.24% of males and 56.71% of females. Some research found that males and females have different forms of lip prints in the left upper quadrant. Whereas in a study by (Mathew SA et al.) [18], Males in the left upper quadrant exhibited the highest prevalence of Type I lip print (48%), whereas females had Type IV lip print (44%).

Right lower quadrant (RLQ): In males, Type II was seen in maximum numbers (30%), closely followed by type 3 (26.6%). While in cases of females, Type I lip print was seen in maximum that is (36.6%), followed by type 3 (25%). Gender variations in outcomes were also observed by other authors where in the right lower quadrant, Type I pattern was seen in 54% of males, compared to 45% of females (Ghimire et al.)[18]. Mathew SA et al. [19]noted that in males Type I was present in the maximum population i.e., in 32% of total males while females had Type I lip print in 68% of female population.

Left lower quadrant (LLQ): In males, Type II was seen as the most frequent type (26.6%), closely followed by type 3 (25%). While in cases of females, Type I lip print was seen in a maximum that is (40%) of female population. Followed by type 2 and 3(each 18.33%). Some studies showed that there were no differences in lip print pattern in males and females in left lower quadrant. Type I pattern was seen in 57% of males, compared to 51% of females (Ghimire et al.).[18] Similarly, in another study (Mathew SA et al.)[19], in left lower quadrant, Type I was seen in 40% of total males and 46 % of total females.

Conclusion

This study revealed that the lip print did not have the same one type of pattern in all 4 quadrants of a lip. The most prevalent lip print pattern among the overall study participants is the Type I. In males, type I is the most common (32.91 %%) lip print, followed by type 3 (22.50%). In females, type 1 was the most common (39.16%), followed by type 3 (20%). The study showed significant difference in the predominant patterns between males and females in lower lip only. Larger and a more well defined studies will help to reduce inter observer bias. The study also demonstrated the uniqueness, indicating that no two lip prints are identical. Lip print analysis is a concise and affordable method, without much sophisticated equipment. Because of its uniqueness and ability to remain stable over time, lip print patterns may be utilized as a supplementary means of personal identification. Development of data

base and technological advancements can aid in the more precise forensic application in identification of persons.

Conflict of Interest /Source of Funding: Nil

Ethical Clearance: Obtained: IEC 25 / GMC & GGH/ SKLM/ 090124/11, Dated: 09-01-2024

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Original Research Article

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Correlation of Stature and Hand Dimension Among Medical Students of South Tamil Nadu, India

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Abstract

Background & Objectives: Estimation of stature from the incomplete skeletal remains have importance in personal identification in the events of murders, accidents or natural disasters and considered as one of the biggest challenges of forensic science.Objectives: To study the relationship of stature in relation with hand dimensions and to derive a mathematical model to predict the stature from hand dimensions.

Methods: This cross-sectional study was done among 50 medical students studying at a medical college in South Tamilnadu. Age, gender, hand dimensions and height of all the subjects were noted. Pearson correlation was done to find the correlation between hand dimensions and height. Linear regression was used to derive the equations to predict the stature of an individual using various dimensions of hands.

Results: The mean age of the study population was 20.06 ± 1.28 years. Regression equations were derived to predict the stature of an individual with length and breadth of right and left hand. There was statistically significant positive correlation between stature and dimensions of both right and left hand. Linear regression equations were derived to predict the stature of an individual with any of the hand dimensions.

Interpretation & Conclusion: Hand dimensions have statistically significant positive correlation with the stature. The length or breadth of the right or left hand can be used to predict the stature of an individual.

Keywords: Breadth of hand, Height, Identification, Length of hand, Linear regression, Prediction, Stature.

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Introduction

Estimation of stature from the incomplete skeletal remains or from mutilated, amputated limbs,parts of limbs or highly decomposed, fragmented human remains has obvious importance in personal identification in the events of murders, accidents or natural disasters are considered as one of the biggest aspects of forensic science. Anthropometric techniques have been used for stature and bone length estimation from unknown body parts and skeletal remains by anthropologists, medical scientists, and anatomists for over a hundred years[1-3].

Stature estimation is one of the four attributes of the biological profile. The hand and foot remain intact in mass disasters many a times and their anthropometric measurements help in estimation of stature. The hand and foot prints also provide valuable information in scene of crimes and contribute in identifying the criminal. The estimation of stature from long bones may not be feasible with fresh or decomposed mutilated remains. In such situations it can be done from hand length and prints or from foot length and prints[4]. Hand length has been documented as significant predictor of body surface area and body mass[5].

The dimensional relationship between body segments and stature has been the focus of scientist, anatomist, and anthropologist for many years[6]. For this purpose, many sets of regression equation have been developed, and the better known are Karl Pearson from Western countries and Singh and Sohal (1952) from India[7]. Previous studies have reported the effectiveness of using hand length and hand breadth in estimating stature[6,7]. However, estimation of stature from these formulae in all population are not appropriate; as climate, heredity, nutritional status of the population has been reported to influence stature.

To counter this problem, we must have regression equation of different bones from representatives of same populations. Many studies have been done for stature estimation using long bones[8], foot dimensions[9], hand measurements[10], Radius Ulna Bone measurements [11] and Head measurements[12].

In this paper, an attempt had been made to study the relationship of stature in relation with hand dimensions and to derive a mathematical model to predict the stature from hand dimensions in healthy adult individuals in the age group of 18-25 years in medical students of south Indian population of Kerala and Tamil Nadu. No specific ethnic group had been included in the study but combinations of variegated ethnic groups were considered. This information will be highly important to Forensic experts, human biologists, and physical anthropologists for determination of stature from the fragmentary remains of upper limb.

Material & Methods

Study Design: Cross-Sectional study

Study setting: Tertiary care teaching hospital in Kanyakumari District, Tamil Nadu.

Duration of study: 2 months (1/8/2019 to 30/9/2019)

Study participants:

a. Inclusion criteria: Medical students aged 18 to 25 years

b. Exclusion criteria: Those who did not give consent for the study, those with congenital abnormality, past history of injuries, fracture and surgeries of hand affecting the palm.

Sample size was calculated, using the formula $[(Z\alpha+Z\beta)/C]2 + 3$, based on the study by MS Supare, SV Pandit and AS Bagul, where the correlation coefficient was 0.45 for right hand breadth and stature in male[21]. With Zα, standard normal deviate for $\alpha = 1.96$;Zβ, the standard normal deviate for $\beta = 1.28$; $r = 0.45$ and $C = 0.5 \times \ln [(1+r)/(1-r)] = 0.485$.Calculated sample was 48 and a total of 50 subjects were studied. To have equal representation from all the batches, 10 students from each batch (I year MBBS to internship) were selected by simple random sampling technique. The students' list in the attendance register was used as the sampling frame.

Study procedure:

The study was commenced after obtaining Institutional Human Ethics Committee clearance (IHEC No.2/Protocol no.1/2019). Informed written consent was obtained from all the selected study subjects. Study variables included age, gender, bilateral hand length, bilateral hand breadth and

stature. Each participant was instructed to place their hands supine on a flat hard horizontal surface with fingers extended and adducted, with no adduction or abduction at wrist joint and forearm in line with the middle finger. Hand length was measured using a sliding vernier callipers with the sensitivity of 0.02mm. Later the subject was asked to place the hand prone on the flat hard table with the fingers together and the thumb out to the side, the breadth of the hand was measured at the level of the knuckles, with the vernier calliper. The hand breadth was measured as a distance between the radial side of 2nd metacarpophalangeal joint to the ulnar side of 5th metacarpophalangeal joint. The height of the participant was measured using stadiometer with sensitivity of 1mm. Weight was measured using a weighing scale with sensitivity of 500gm.

Data Management and Analysis

Data were coded and entered in MS Excel and analysed using SPSS v 20.0. Descriptive statistics such as mean and standard deviation were computed for height, hand breadth and hand length. Pearson correlation test was used to find the correlation between height and dimensions of hand. Linear regression model was used to derive the equations to predict the height using the dimensions of hand.

Results

The mean age of the study population was 20.06±1.28 years. Among the study population, 22 (44%) were males and 28 (56%) were females. Mean stature of the study participants was 163.6 ± 9.52 cm and mean weight was 62.5 ± 11.03 Kg. The mean dimensions of the hand were as follows; length of right hand was 17.73 ± 1.13 cm, breadth of right hand was 7.56 ± 0.65 cm, length of left hand was 17.65 ± 1.14 cm and breadth of left hand was 7.42 ± 0.70 cm.

1. **Correlation of hand dimensions with stature**

The Pearson Correlation Coefficient test was done to find the relationship between the stature of the individuals and various dimensions of hands such as length of right hand, breadth of right hand, length of left hand and breadth of left hand.

i. Correlation of length of right hand with stature

A positive correlation was found between the length of right hand and stature and it was found to be statistically significant (r value of 0.785 and p value of <0.001). The scatterplot portrays the result in the figure 1.

ii. Correlation of breadth of right hand with stature

There was a statistically significant positive correlation found between breadth of right hand and the stature of the individual with Pearson Correlation value 0.814 and p value <0.001. Figure 2 shows the scatterplot with this finding.

iii. Correlation of length of left hand with stature

The Pearson correlation test showed a statistically significant positive correlation between length of left hand and height, with Pearson Correlation value r = 0.782 and p value <0.001 and this result is shown in the figure 3.

iv. Correlation of breadth of left hand with stature

There was a statistically significant positive correlation between the stature and the breadth of left hand, with Pearson Correlation value 0.809 and p value <0.001 and shown in figure 4.

2. **Regression equations to predict the stature of an individual**

Linear regression model was used to derive equations predicting the stature of individuals using various dimensions of hands as follows.

i. Regression equation to predict the stature using the length and breadth of both hands: Stature = 50.629 + 2.012 (Length of right hand) + 1.139 (Length of left hand) + 5.262 (Breadth of right hand) + 2.348 (Breadth of left hand). The model had R2 value of 0.725, F value of 29.659 and p value <0.001.

ii. Regression equation to predict the stature using the length and breadth of right hand: Stature = 48.836 + 3.248(Length of right hand) +7.565 (Breadth of right hand). The model had R2 value of 0.721, F value of 60.777 and p value <0.001.

iii. Regression equation to predict the stature using the length and breadth of left hand: Stature = 56.147+3.177 (Length of left hand) + 6.927(Breadth of left hand). The model had R2 value of 0.710, F value of 57.461 and p value <0.001.

iv. Regression equation to predict the stature using the length of right hand: Stature = 46.285 + 6.616 (Length of right hand). The model had R2 value of 0.617, F value of 77.254 and p value <0.001.

v. Regression equation to predict the stature using the breadth of right hand: Stature = 73.073 + 11.979 (Breadth of right hand). The model had R2 value of 0.662, F value of 94.198 and p value <0.001.

vi. Regression equation to predict the stature using the length of left hand: Stature = 48.157 + 6.541 (Length of left hand). The model had R2 value of 0.611, F value of 75.45 and p value <0.001.

vii. Regression equation to predict the stature using the breadth of left hand: Stature = 82.064 + 10.99 (Breadth of left hand). The model had R2 value of 0.655, F value of 91.193 and p value <0.001.

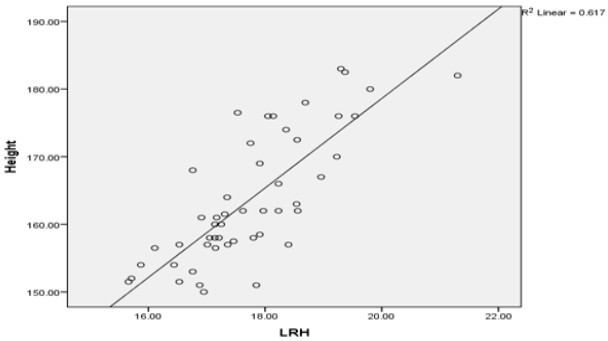

Figure 1: Scatterplot showing the Correlation between stature and length of right hand (LRH).

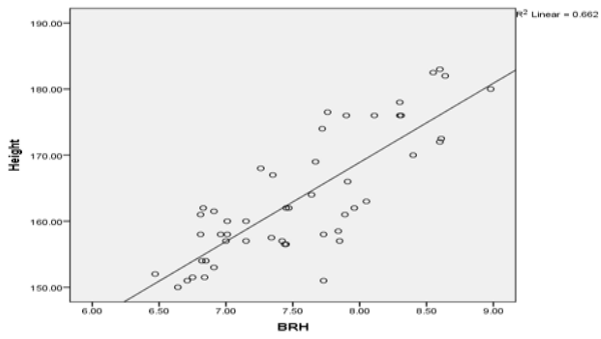

Figure 2: Scatterplot showing the Correlation between stature and breadth of right hand (BRH).

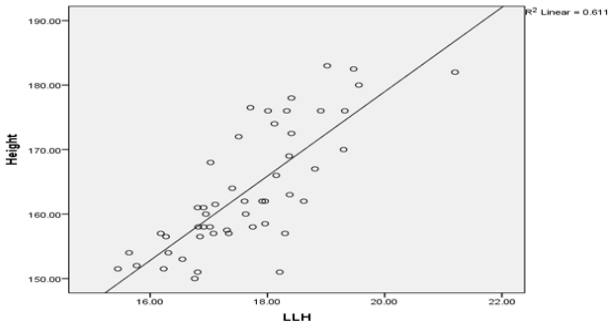

Figure 3: Scatterplot showing the Correlation between stature and length of left hand (LLH)

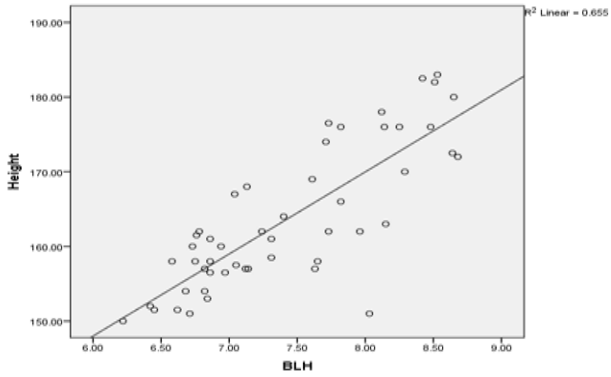

Figure 4: Scatterplot showing the correlation between stature and breadth of left hand (BLH).

Table 1: Comparison of regression equations from various studies to predict the stature using length of right hand

	REGRESSION EQUATION
Current Study	Height = 46.285 + 6.616 (Length of right hand)
Jasuja et al Male Female	 Height = 101.991 +3.767 (Length of right hand) Height = 133.961 +1.473 (Length of right hand)
Sunil et al Male Female	 Height = 86.93 + 4.25 (Length of right hand) Height = 72.42 + 4.56 (Length of right hand)

Continue.....

Vijeta et al Male Female	 Height = 79.23 +4.91 (Length of right hand) Height = 86.03 +4.11 (Length of right hand)
MS Supare et al Male Female	 Height = 68.69 +5.52 (Length of right hand) Height = 65.22 +5.46 (Length of right hand)
Sangeeta et al Male Female	 Height = 111.25 + 2.71 (Length of right hand) Height = 79.758 + 4.168 (Length of right hand)
Amitava et al	Height = 88.1 + 3.88 (Length of right hand)

Table 2 Comparison of regression equations from various studies to predict the stature using length of left hand

	REGRESSION EQUATION
Current Study	Height = 48.157 + 6.541 (Length of left hand)
Jasuja et al Male Female	 Height = 133.961 + 1.473 (Length of left hand) Height = 130.035 + 1.66 (Length of left hand)
Sunil et al Male Female	 Height = 85.84 + 4.32 (Length of left hand) Height = 80.94 + 4.4 (Length of left hand)
Vijeta et al Male Female	 Height = 169.73 + 0.36 (Length of left hand) Height = 88.20 + 3.97 (Length of left hand)
MS Supare et al Male Female	 Height = 69.09 + 5.51 (Length of left hand) Height = 66.90 + 5.37 (Length of left hand)
Sangeeta et al Male Female	 Height = 111.884 + 2.686 (Length of left hand) Height = 80.971 + 4.134 (Length of left hand)

Table 3: Comparison of regression equations from various studies to predict the stature using breadth of right hand

	REGRESSION EQUATION
Current Study	Height = 73.073 + 11.979 (Breadth of right hand)
Vijeta et al Male Female	 Height = 165.21 + 0.63 (Breadth of right hand) Height = 123.79 + 4.15 (Breadth of right hand)
MS Supare et al Male Female	 Height = 115.32 + 6.96 (Breadth of right hand) Height = 98.48 + 8.18 (Breadth of right hand)
Sangeeta et al Male Female	 Height = 122.273 + 5 (Breadth of right hand) Height = 85.545 + 8.852 (Breadth of right hand)

Table 4: Comparison of regression equations from various studies to predict the stature using breadth of left hand

	REGRESSION EQUATION
Current Study	Height = 82.064 + 10.99 (Breadth of left hand)

Continue.....

Vijeta et al Male Female	 Height = 139.85 + 3.67 (Breadth of left hand) Height = 117.23 + 5.2 (Breadth of left hand)
MS Supare et al Male Female	 Height = 115.92 + 6.90 (Breadth of left hand) Height = 100 + 7.99 (Breadth of left hand)
Sangeeta et al Male Female	 Height = 124.493 + 4.792 (Breadth of left hand) Height = 85.272 + 9.013 (Breadth of left hand)

Discussion

Most of the published studies to predict stature were done using length of hand and conducted among adult population. Similarly, there are dearth in studies to predict stature using breadth of hand. No such studies had been conducted among adolescent population in South India. To overcome such deficiency this cross-sectional study was planned among medical students in a rural area of South India.

In the present study, the mean age of the study population was 20.06 ± 1.28 years. There was almost equal representation from males (44%) and females (56%). The mean stature of the population was 163.6 ± 9.52 cm and weight 62.5 ± 11.03 Kg.

A positive correlation was found between various dimensions of hands and the stature in this study. The Pearson correlation was found to be statistically significant between stature and length of right hand. The studies done by, Supare et al (males r value 0.74 and females r value 0.75)[13], Jasuja O.P et al (males r value 0.502 and females r value 0.529)[14], Vijeta et al (males r value 0.554 and females r value 0.574)[15], Sangeeta Dey et al (males r value 0.54 and females r value 0.69)[16], Girish Shiv Shankar et al (r value 0.249)[17], Amitava et al (r value 0.683)[18]and Sunil et al (r value 0.7)[19]showed positive correlation between stature and length of right hand.

Current study showed a positive, statistically significant, correlation between breadth of right hand and stature. Similar correlation was found with studies by Supare et al males r value 0.45 and females r value 0.56)[13], Sangeeta Dey et al (males r value 0.35 and females r value 0.54)[16] and Amitava et al (r value 0.53)[18].

There was a statistically significant positive correlation between stature and length of left hand in this study. Results from studies by Sunil et al (males r value 0.6 and females r value 0.7)[19], Supare et al (males r value 0.75 and females r value 0.74)[13], Jasuja O.P et al (males r value 0.452 and females r value 0.557)[14] and Amitava et al (r value 0.682)[18] showed consistent result.

Breadth of left hand and stature was also found to have statistically significant positive correlation in our study. Similar finding was observed by Supare et al (males r value 0.46 and females r value 0.55)[13], Sangeeta Dey et al (males r value 0.33 and females r value 0.54)[16] and Amitava et al (r value 0.524)[18].

The regression equation derived to predict the stature using different hand dimensions in our study were compared with the regression equation derived from other studies in Table 1, Table 2, Table 3 and Table 4.

Conclusion

The length and breadth of both hands had statistically significant positive correlation with stature. In case of situations where only hand dimensions are available, the stature of an individual could be predicted with regression equation using length and breadth of both hands or any hand and length / breadth of any hand.

Ethical Clearance: The study was commenced after obtaining Institutional Human Ethics Committee clearance (IHEC No.2/Protocol no.1/2019) on 24.06.2019

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Conflicts of interest: No conflicts of interest

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Original Research Article

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A Cross-Sectional Study on Determination of Age from Third Molar Tooth Eruption in the Population of Telangana

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Abstract

Age has got significant role in Forensic medicine. It helps in identification and correlates various civil and criminal related issues. A cross sectional study on age determination from eruption of third molar tooth was conducted at Malla Reddy Institute of Medical sciences Hyderabad Telangana for a period of one year in the age group between 18 years to 25 years. A total of 160 medical students were participated in which 80 males and 80 females were participated in the study. Each individual was examined for physical dental examination in each quadrant of the jaw, mere appearance of crown of the third molar tooth was considered as erupted. A space between the second molar tooth and the ramus of the mandible without any evidence of the crown of the 3rd molar tooth was considered as not erupted.

Statistical results reveal 54.2% of the study population third molar teeth eruption was observed first in the lower left quadrant. 96.2% in male and 98.4% in female individuals third molar was erupted at 22 years of age and at 23 years third molar was completely erupted in all the quadrants of the jaw in both male and female population.

Key words: 3rd Molar tooth, Eruption, Age determination.

Introduction

Identification of a person by age is very significant in forensic medicine. Individuals are typically identified using a variety of identification data, including fingerprints, DNA fingerprints, footprints, race, religion, sex, age, and stature.[1]There are various methods to determine the age of a person which includes physical development, appearance of secondary sexual characters, ossification centers

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of long bones appearance and fusion, fusion of skull sutures and the eruption of both temporary and permanent teeth. Estimation of age from teeth eruption is equally reliable like any other methods. Ideally teeth can be preserved for a longerperiod hence it can be most appropriate sample for scientific evaluation of age estimation. Teeth are also useful for the collection of DNA, especially from unknown and mutilated bodies[1].

Developmentally there are two types of teeth, temporary teeth and Permanent teeth. Temporary teeth usuallyerupt at 6 months of age; there are 20 deciduous or milk teeth in each jaw, 4 incisors, 2 canines and 4 molars. Permanent teeth usually start erupting at the age of 6 years. Permanent teeth are 32 in number, 4 incisors, 2 canines, 4 premolars and 6 molars in each jaw[2]. The permanent teeth are further divided into successional teeth and superadded teeth. Permanent premolars are successional teeth whereas permanent molar are superadded teeth.As per physical examination the eruption of tooth is divided into 4 stages by modified Bengston's Classification[3]. Stage-1: The crown of the teeth is not visible. Stage-2: Upper surface of teeth just visible.Stage-3: tooth erupted into half way between the occlusal plane and alveolar surface. Stage-4: Complete crown of the tootherupted into occlusal plane.

3rd molar teeth are also known as wisdom teeth. The 3rd molars have a substantial variation in their morphology, anatomical position, developmental time and eruption compared to other dentitions. It has high ethnic variability in eruption, hence estimating the age by the emergence of 3rd molar teeth cannot be generalized to everyone[4]. In early human evolution the third molar teeth were used for chewing of plants and uncooked meat, similarly our ancestors had comparatively bigger jaws for chewing and mastication. In modern evolution the wisdom teeth are redundant in their use day by day due to changes in diet habits; as a result their eruption age is also delaying in comparison with the olden days. The eruptions of third molar teeth are not constant; many factors likegenetic, nutrition and environmental factors predominantly affect their eruption process.It erupts at 18 to 25 years of age in different population around the world[5].

The aim of this study is to determine the age of an individual from the 3rd molar teeth eruption in the study population of Telangana with an objectives to determine the age of male andfemale population. Observe in which quadrant of the jaw the molar teeth erupts early and to explain the stages of eruption of third molar teeth in different age and sex. This study will be highly useful for law enforcement agencies to determine the age of an individual from the eruption of 3rd molar teeth to resolve various medico legal cases more appropriately in the region of Telangana.

Materials and Method

A cross sectional and prospective study on age determination from eruption of third molar teeth in the population of Telangana was conducted in a medical college Malla Reddy Institute of Medical sciences, Hyderabad, from 1-9-2022 to 30-8-2023,for a period of one year in the age group between 18 years to 25 years. A total of 160 medical students participated in which80are males and 80 are female students. 20 individuals from each age including male and female students were considered. Informed consent was obtained from each participant before commencement of the study. The participant's chronological age was obtained from their birth records after verification.

Individuals who were in the age group of 18 to 25 years and not suffering from any disease and willing to participate in the study were included. Individuals who were not in the study age group or suffering from any congenital, developmental defects, nutritional or endocrine abnormalities and individuals who got their 3rd molar teeth already removed were excluded.

A clinical dental examination was conducted on each participant with proper care and hygiene. Each individual was examined for physical dental examination by using torchlight with careful inspection of 3rd molar tooth eruption in each quadrant of the jaw, during examination the investigator used disposable glove after thorough hand wash. Mere appearance of crown of the third molar tooth was considered as erupted. A space between the second molar tooth and the ramus of the mandible without any evidence of the crown of the 3rd molar tooth was considered as not erupted.

We categorize the eruption of the third molar tooth into three stages.

- Individuals were categorized as having no eruption (NE) status if the third molar not visible in any of the quadrants of the jaw.
- Incomplete eruption (IE) status, if any of the third molars have erupted but not in all four quadrants.
- Complete eruption status (CE), if the third molars have erupted in all four quadrants.

The collected data was taken into an excel sheet and statistical analysis was done by using SPSS software.

Results

A cross sectional prospective study on age determination from third molar tooth eruption was conducted in the age group of 18 to 25 years in Hyderabad Telangana reveal the following results. The study group consists of 160 members which include 80 male and 80 female individuals.

Table 1: Gender distribution of third molar tooth eruption in all quadrants of total study group.

Gender	Erupted	Not erupted
Male	72.2%	27.8%
Female	69.9%	30.1%
Total	71.05%	28.95%

Third molar tooth completely erupted in 71.05% of study group which including 72.2% in male and 69.9% in female individuals in all the quadrants of the jaw of above 18 years.

Table 2: Eruption status of third molar teeth in each quadrant of the jaw.

Quadrant of Jaw	Not erupted	Partially erupted	Fully erupted
Upper Right	37.5 %	11.2 %	51.3%
Upper Left	10.5%	37.5%	52%
Lower Right	10.8%	34%	53.2%
Lower Left	12.5%	33.3%	54.2%

54.2% of the study population showed third molar teeth eruption in the lower left quadrant, indicating higher rates compared to other quadrants.

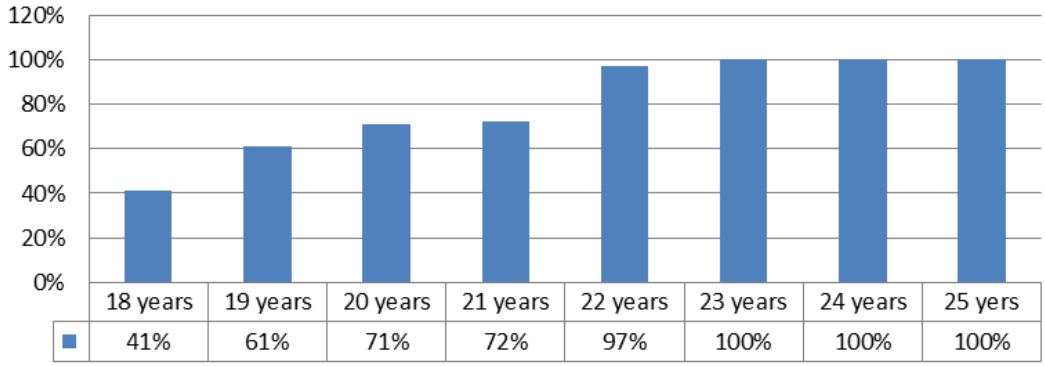

Figure 1: Age wise distribution of third molar tooth eruption in all quadrants of total study group.

Third molar teeth erupted in41% at 18 years of age from where the graph has an upward trend in the eruption process with increasing age. Notably by the age of 23 years a complete 100% third molar teeth eruption in all the quadrants of the jaw was observed.

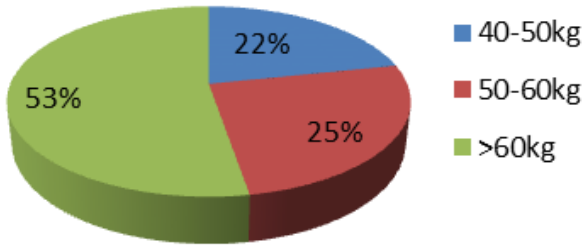

Figure 2: Eruption of third molar teeth in all quadrants in relation to their body weight.

Highest number of individuals weight more than 60 kg's were observed complete eruption of third molar teeth in all the four quadrant of the jaw.

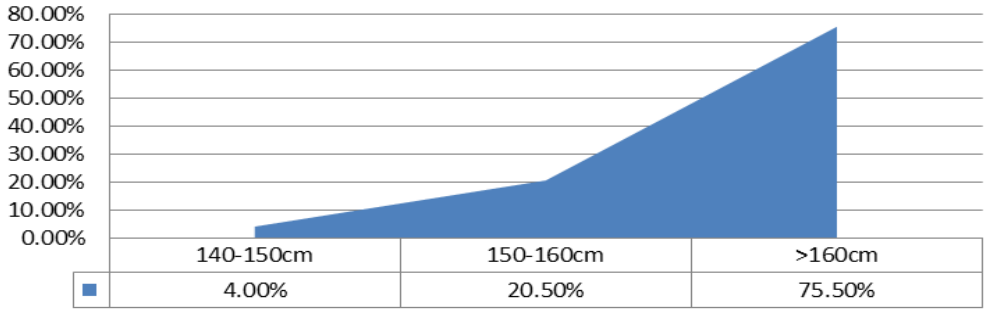

Figure 3: Eruption of third molar teeth in all quadrants in relation to their body height.

Increasing body height has proportional increase of complete eruption of third molar teeth in upper and lower jaw.

Discussion

A cross sectional and prospective study on age determination from third molar tooth eruption was conducted in the age group of 18 to 25 years, study group consists of 160 members which include 80 male and 80 female individuals from Hyderabad Telangana.

In relation to the gender wise distribution, eruption of third molar teeth highest percentage was observed 72.2% in male population, whereas in female population it was 69.9%, higher percentage were observed even in quadrant wise eruption of third molar teeth primarily in male population.

Eruption of third molar teeth was observed at 18 years of age in 41%, 61% in 19 years, 71% in 20 years, 72% in 21 years and 97% in 22 years. In Male individuals 96.2% and in female individuals 98.4% was observed at 22 years of age and by 23 years third molar was erupted in all the quadrants in both male and female population.

Majority of study population, height was more than 160cm. We found 75.5% of study population of more than 160 cm height got eruption of third molar teeth in all the four quadrants. In relation to the weight, highest number of study population was between 50 to 80 kg and less than 1 % was under weight and more than 11% were overweight, study revealed more than 6okg individuals got eruption of third molar teeth was 53%. Increased percentage of eruption of third molar teeth in all the quadrant of the jaw was increasing with height and weight was noticed in study group. We found a good correlation with nutrition of the individual with eruption of third molar teeth in our study.

Eruption of the teeth in quadrant wise revealed that left lower quadrant erupted primarily in majority of the individuals it was 54.25% next is lower right 53.2% and followed by upper left 52% and upper right 51.3%. Eruption was primarily on left side and in the lower jaw was observed.

A study conducted on Third molar eruption mechanisms and patterns by Winnie Zhang, University of Pittsburgh, School of Dental Medicine, Pittsburgh PA, USA[6] revealed that third molar teeth erupt at 19 years of age. In another study at Nigeria by O.D. Otuyemi[7] on Eruption times of third molars in young rural Nigerians found that the mean age of eruption of third molar was 16.5 years in males and 17.5 years in females. Our study results are different from their study; we found third molar eruption at 23 years of age.

Study conducted in India by Mahanta Putul[8] on Assessment of Age at the Stages of the Eruption of Third Molar Teeth among the People of North-Eastern India stated that the mean age of eruption of third molar teeth was 20.33(±2.566) and appeared primarily in the lower jaw. Study in south India on age estimation using development of third molar[9] by K Indra priyadarshini found that the results of mean age of third molar eruption in maxillary bone was 22.41 years in males and 23.81 years in females, in mandibular eruption of third molar in males 21.49

and in females 23.34, almost similar results were observed in our study.

Conclusion

Eruption of third molar tooth in relation with age in the population of Telangana shows 100% eruption of third molar tooth in all the quadrants of the jaw was observed in the study population at the age of 23 years, similar results were found in both male and female population. Quadrant wise eruption in study population, the left lower quadrant was erupted first. A positive Correlation of third molar teeth eruption with height and body weight was observed in our study. Almost similar results were found in other studies conducted in south India.

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Original Research Article

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Morphological Changes of the Heart in Sudden Death Psychiatric Patients

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Abstract

Although sudden cardiac death is often reported in epileptic or psychiatric patients, the etiologyis not fully understood. The aim of this study was to examine whether morphological changes of the heart contribute to sudden cardiac death in epileptic or psychiatric patients, compared with control decedents. Cases of sudden cardiac deaths due to fatal arrhythmia in patients with epilepsy or psychiatric disease were selected from forensic autopsies performed at the Shiga Prefecture from 2014 to 2021.As the control group, autopsied healthy decedents were selected. The heart weight to normal heart weight ratio, ventricular wall thickness, cardiomyocyte width, nuclear diameter and nuclear density of the left and right ventricle and interventricular septum were examined. The left and right ventricular wall thickness and cardiomyocyte to be smaller in epileptic patients, however, no significant differences were found. The nuclear diameter/body surface area of the left ventricle was significantly smaller in epileptic and psychiatric patients than in control patients. The smaller nuclei of cardiomyocytes in epileptic and psychiatric patients may relate to the etiology of sudden cardiac death.

Keywords: epilepsy, heart weight, psychiatric disease, sudden cardiac death

Introduction

Although sudden cardiac death has been reported in epileptic or psychiatric patients, the pathologic mechanisms remain poorly understood.[1,2] It is difficult to find the abnormalities by postmortem examination such as blood tests or computed tomography. Therefore, to correctly diagnose the cause of sudden death, autopsy and subsequent toxicologic and histopathologic examinations are required.

With autopsy, some sudden death cases are diagnosed as organic diseases such as cardiomyopathy or ischemic heart diseases. However, regardless of these detail examinations, in some cases, no marked abnormalities leading to death are found except for the findings associated with acute death. Generally,

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for these sudden deaths without specific findings (SDWO), cause of death was considered as functional abnormalities of the heart. Previously study revealed that cause of death was unknown even after autopsy in 65% of sudden death patients with psychiatric diseases. These unexplained deaths were speculated to be due to fatal arrhythmias.[3] In epileptic patients, this type of death is called sudden unexpected death in epilepsy (SUDEP). For the 'definite' SUDEP is used when competing causes of deaths are ruled out by autopsy or having directly observed /recorded the terminal event.[4] Therefore, SDWO includes SUDEP if a complete autopsy is performed.

There has been substantial interest in the morphological changes of the heart of psychiatric patients from approximately 100 years ago. Lewis examined the autopsied hearts of the psychiatric patients and concluded that 75.5 % of the patients with schizophrenia had smaller hearts(less than 300 g). This rate is much higher than that of patients with other psychoses.[5]

Fulstow compared the records of 540 autopsied psychiatric patients with those of 495 general hospital decedents. This study examined the heart weight in male and female patients separately. For schizophrenia patients, 49% of males and 66% of females had smaller hearts weighting less than 300 g, whereas for the general hospital decedents, 27% of males and 51% of females had smaller hearts.[6]

Similarly, Rupp and Wilson reported hypoplasia of the cardiovascular system in patients with functional psychoses.[7] In contrast, Coffman et al examined the left atrial, aortic root, end-diastolic left ventricular diameters and wall thickness by echocardiography in patients with chronic schizophrenia, mania and in normal volunteers. This study found no significant differences among the groups.[8]Therefore, the presence and implications of lower heart weight and histomorphological changes in patients with psychiatric diseases remain unclear.

The objectives of this study were: first to verify the heart size of epileptic and psychiatric patients suffering SDWO; and second, to examine the etiology of SDWO in epileptic and psychiatric patients by comparing microscopic findings of the heart to those of control decedents.

Materials and Methods

Cases of sudden cardiac death diagnosed as fatal arrhythmia without focal lesions were extracted from forensic autopsies performed at Shiga University of Medical Science in Shiga Prefecture in Japan from 2014 to 2021. Among these cases, previously diagnosed as epilepsy (Epi) and psychiatric disease (Psy) were selected. Cases of Psyincluded schizophrenia, bipolar disorder, depression and so on. We excluded decedents less than 20 years old and decedents whose cardiomyocytes could not be observed in detail because of postmortem changes. As the control group, age- and body stature-matched autopsied healthy decedents who died from unnatural death, asphyxia, drowning, cervical spinal cord injury, hemorrhagic shock, death from electricity and head injury without Epi or Psy were selected.

We examined basic patient information including sex, age, height, weight, body mass index (BMI), raw heart weight and heart weight to normal heart weight ratio (HWR). The normal heart weight was calculated by body surface area (BSA)according toa previously reported method.[9] As macroscopic findings, we measured the thickness of the left ventricular wall and right ventricular wall. Tissue specimens were preparedaccordingtostandardmethods.Myocardium was fixed in 10% formalin, processed, embedded in paraffin, sliced into 4-micrometer sections and stained with hematoxylin and eosin. Microscopically, cardiomyocyte width, nuclear diameter and nuclear density of the left ventricle (LV), right ventricle (RV) and interventricular septum (IVS) were measured at a magnification of 400.Cardiomyocyte width was measured using the shortest lateral diameter through the nucleus in the longitudinal section of the cardiomyocyte according to a previously reported method.[10,11] Only cardiomyocytes with a complete nucleus were included in the measurements. Nuclear diameters were measured in the longitudinal section of cardiomyocytes with a complete nucleus. We measured cardiomyocyte width and nuclear diameter at 50 points in each specimen and calculated the average values. Nuclear density was defined as the number of complete nuclei of cardiomyocyte observed in one field of view, counted at 10 points in each specimen and calculated the average values.

A Shapiro-Wilk test was performed to verify the normality of the data.One-way analysis of variance and Welch's test were used to compare normally distributed data between groups. Multiple comparisons were carried out with Bonferroni test and Games-Howell test. Kruskal-Wallis test was used to compare nonnormally distributed data. P-values <0.05 were considered statistically significant.

Results

This study includes 29 (23 male, 6 female) decedents with a mean age of 47.1 years. There were 7 decedents in the Epi group, 8 in the Psy group and 14 in the control group. Comparison of the backgrounds of the 3 groups is shown in Table 1. There were no significant differences between the 3 groups in age, body height, body weight, BMI or BSA. There was no difference in the male to female ratio between the 3 groups.

Table 1. Background of the 3 groups.

	Control	Epi.	Psy.	P-value
Age (years)	48.1±13.2	39.7±11.8	51.8±16.9	0.25
Body height (cm)	169.9±6.42	168.2±10.6	167.8±10.9	0.83
Body weight (kg)	65.6±12.2	69.2±16.2	63.1±11.9	0.67
BMI (kg/ m^2)	22.7±3.99	24.6±6.24	22.5±4.20	0.62
BSA (m^2)	1.77±0.16	1.79±0.23	1.72±0.19	0.78

BMI: body mass index, BSA: body surface area

The median values for raw heart weight in control, Epi and Psydecedents were 331.4, 359.1 and 339.4g, respectively. There was no significant difference inmedian values for raw heart weight and median HWR (Table 2). The ventricular wall thickness/BSA and cardiomyocyte width/BSA are shown in Table 2. Although there were no significant differences between the 3 groups, the thickness of the LV and RV wall/BSA tended to be smaller in Epi than those in control decedents. Cardiomyocyte width/BSA tended to be smaller in Epi than in control, however, no significant differences between the 3 groups were found.

Table 2: Morphological characteristics of the heart in the 3 groups.

	Control	Epi.	Psy.	P-value
Heart weight to normal heart weight ratio	0.89 (0.81,1.06)	0.92 (0.85,0.96)	1.06 (0.82,1.11)	0.69
Ventricular wall thickness (cm/m^2)				
LV/BSA	0.77 (0.71,0.83)	0.59 (0.52,0.72)	0.77 (0.71,0.95)	0.11
RV/BSA	0.18 (0.15,0.19)	0.14 (0.12,0.17)	0.21 (0.17,0.25)	0.06
Cardiomyocyte width (μm/m^2)				
LV/BSA	8.7 (7.7,9.4)	7.4 (6.6, 9.0)	8.6 (6.4,9.2)	0.33
RV/BSA	6.6 (5.9,7.3)	5.6 (5.1,8.1)	5.9 (5.2,8.9)	0.83
IVS/BSA	8.3 (7.7,8.8)	7.4 (6.7,8.5)	8.0 (6.8,8.2)	0.22

Values are represented as median (25^{th} percentile,75^{th} percentile)

LV: left ventricle, RV: right ventricle, IVS: interventricular septum, BSA: body surface area

The median LV nuclear diameter /BSA in Epi and Psydecedents was 3.3 and 3.2, respectively (Figure 1), significantly smaller than that of control (4.0), (P=0.007 and P=0.029, respectively). In the RV and IVS, the values were lower in Epi than control, but this did not reach significance. Nuclear density of the LV, RV and IVSare shown in Figure 2. There were no significant differences between the 3 groups in any region.

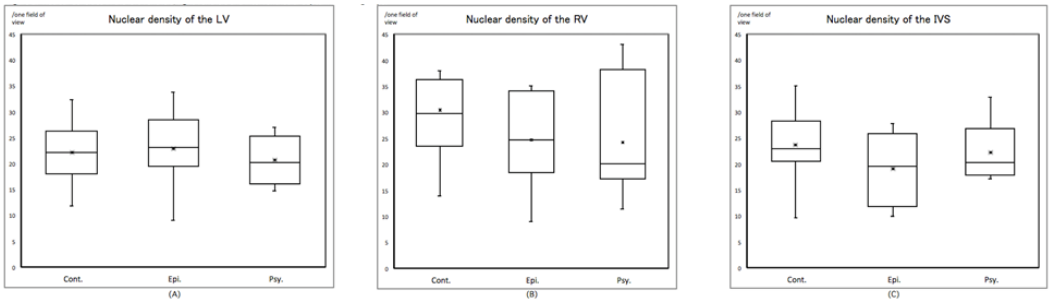

Figure 1. (A) Nuclear diameters in the left ventricle (LV) in the 3 groups. *P<0.05, **P<0.01. (B) Nuclear diameters in the right ventricle (RV) in the 3 groups. (C) Nuclear diameters in the interventricular septum (IVS) in the 3 groups.

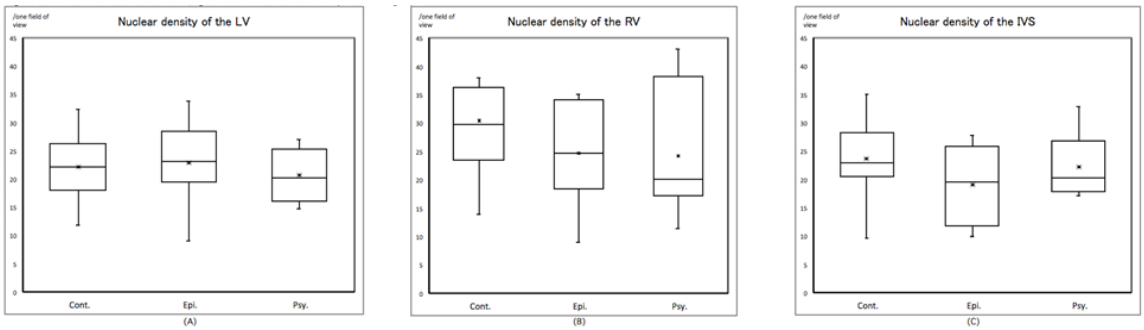

Figure 2. (A) Nuclear densities of the left ventricle (LV) in the 3 groups. (B) Nuclear densities of the right ventricle (RV)in the 3 groups. (C) Nuclear densities of the interventricular septum (IVS) in the 3 groups.

Discussion

Heart weight is a fundamental cardiac measurement obtained at autopsy. Heavier heart weight, described as cardiomegaly, is a marker of cardiac diseases such as cardiomyopathy orinfiltrative diseases. However, little attention has been paid to lower heart weight except for that caused by starvation or malnutrition. Heart weight is related to body size and we previously found that heart weight is well correlated with BSA in healthy persons.[9] Therefore, we evaluated HWR in the 3 groups.

We found that HWR of Epiand Psypatients was not lower than that of healthy persons. This result is similar to a previous report showing no significant differences in heart weight in cases of sudden unexplained nocturnal deaths, compared with that in non-cardiac sudden deaths.[12] Furthermore, a separate study found no significant differences in the heart weight of sudden death epileptic patients, compared with that of healthy persons dying from external causes.[13] However, our result was opposite to the results shown by Lewis and Fulstow. A notable reason for these conflicting results is the difference in methodology. They compared the raw heart weight, however, this is inadequate because heart weight depends on the body size. Another reason might be the differences in managements and treatment of psychiatric patients now and 100 years ago. Historically, psychiatric patients were often confined to a bed or a closed ward for a long time, which may lead to atrophic changes of the heart. Therefore, future studies should compare the heart weight of psychiatric patients who have stayed in a closed ward long-term with normal values.

Regarding the macroscopic and microscopic findings of the heart, we evaluated the ventricular wall thickness, cardiomyocyte width and nuclear diameter, indexed to BSA because morphological parameters depend on body size as shown in the heart weight. Previous studies have assessed the myocardial thickness, the size of cardiomyocyte and nucleus, however, no study has considered

these measurements according to body size.[8,14-16] Furthermore, some of the studies examining the microscopic morphological changes in patients with heart disease lacked a control group to compare the hearts of healthy persons[17] or had an insufficient control group as obtained at medical autopsy.[15,18-21] Generally, the decedents of medical autopsies were previously diagnosed with one or more diseases. Therefore, medical interventions or long-term hospitalization may influence the morphological changes of the heart in these decedents. In contrast, decedents undergoing forensic autopsies have typically died suddenly as a result of disease or external causes. In this study, we included a control group healthy decedents dying from unnatural death, providing accurate control data from persons who were normal prior to death. Therefore, our results are reliable.

In this study, the nuclear diameter in the LV was significantly smaller in Epi and Psy than in control. In the RV and IVS, the value was lower in Epi than in control, but the difference was not statistically significant. For the cardiomyocyte width in the LV, RV and IVS, no significant differences were found between the 3 groups. Because we found no significant differences in nuclear density of the LV, RV and IVS, only the nuclear size may influence the pathogenesis of SDWO in patients with Epi or Psy.

In response to various stresses, cardiomyocytes show morphological alternations. Increased load on the spared myocardium in the presence of cardiac failure and a decreased systolic stress may be the most important variables in the initiation of myocyte hypertrophy.[22] Phenotypic alternations in cardiomyocyte nuclei may also be involved.[23] Date from left ventricle biopsies heart function analysis in patients with cardiomyopathies and aortic valve diseases show that worsening of left ventricular function is associated with increased myocardial diameter and cardiomyocyte nuclear size.[21] A histological study of endomyocardial biopsies showed that both larger cardiomyocyte size and more nuclear hypertrophy were present inhypertrophic hearts with or without systolic dysfunction than in non-hypertrophic hearts.The study also suggested that nuclear hypertrophy reflected increased biosynthetic activities of DNA repair/synthesis, transcription and translation efficiency.[17] A study examining the nuclear size of cardiomyocytes in end-stage cardiomyopathies suggested that enlargement of the nuclear area was a complex process including simple nuclear hypertrophy, polyploidization and multinucleation.[19] A study examining the microscopic findings in hearts after myocardial infarction found the ventricular remodeling after myocardial infarction involved myocardial loss, cardiomyocyte nuclear polyploidization and hyperplasia.[20] A histological study of right ventricular endomyocardial biopsies found that cardiomyocyte diameter negatively correlated with cardiac function, however, doxorubicin-treated patients had significantly less cellular hypertrophy. Doxorubicin, an anti-cancer chemotherapeutic drug, intercalates DNA and interferes with protein production, it proceeded nuclear degeneration and inhibited myocardial cell growth.[16] Furthermore, implantation of a left ventricular assist device decreased both cardiomyocyte diameter and nuclear area in patients with end-stage dilated cardiomyopathy. These data suggest that the cardiomyocyte nuclei are in a dynamic state and nuclear polyploidization may be reversible phenomenon.[17] From these published studies, cardiomyocyte and nuclear diameter are considered to be indices of heart function. Enlargement of cardiomyocyte nuclei may induce cardiac hypertrophy.

Previous studies have observed hypertrophic nuclei in diseased hearts with hypertrophy or impaired function. However, to our knowledge, few studies have mentioned smaller sized nuclei and hypotrophic hearts. When the DNA synthesis is inhibited in cardiomyocyte nuclei, cardiomyocyte nuclei and cardiomyocyte growth is disturbed.[16,17] Therefore, the small nuclei seen in epileptic and psychiatric patients might related to the occurrence of SDWO. To further investigate the etiology of SDWO, more autopsy cases of sudden death in epileptic and psychiatric patients should be evaluated.

This study has some limitations. First, the sample size was small because autopsied cases of SDWO in epileptic or psychiatric patients are not common. However, in the Shiga Prefecture, the Council for Promoting Determination of Correct Cause of Death asks medical doctors and police to perform forensic autopsies in sudden unknown death cases. Therefore, we believe that we can collect valuable cases and provide the meaningful results. Second, our sample included both male and female decedents. Heart size also depends on sex.[9] However, there was no significant difference in the ratio of male to female decedents in our 3 groups. Furthermore, when considering HWR, we evaluated males and females separately. Therefore, we believed this issue did not influence our conclusion.

Conclusion

For the epileptic and psychiatric patients with SDWO, HWR did not differ significantly to that in control decedents. Although no significant differences were found in ventricular wall thickness, cardiomyocyte width or nuclear density, the epileptic and psychiatric patients with SDWO had significantly smaller cardiomyocyte nuclei in the LV than control decedents. The smaller cardiomyocyte nuclei may relate to the pathogenesis of SDWO.

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Conflict of Interest: Nil

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Original Research Article

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Trend of Medico-legal Cases at a Tertiary Care Teaching Hospital of U.P.

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Abstract

Background: Trend of medico legal cases is a fundamental part of the prevention of avoidable causalities in future and to study the crime rate in area. In present study an attempt is made to know the burden of medico legal cases. The aim of present study is to describe the profile, pattern and trend of medico-legal cases and identify errors in the medico-legal reports.

Method: This is a Retrospective, descriptive, non-interventional study, conducted in emergency department of Government Medical College and Hospital Jalaun during the period from 1st January 2023 to 31th December 2023. This is a tertiary care teaching hospital where patients are referred from most of private hospitals. Patients from district hospitals of the region are also admitted in this college.

Conclusions: In majority of places, duty of casualty medical officer is accomplished by MBBS doctor who is not expert in handling of medico legal cases. Therefore medico-legal work should be done under the direction of forensic medicine expert to avoid inaccuracy in giving the opinion. The present study showed that male out numbered female and maximum cases were of younger generation. Most common aetiology was of road traffic injuries. Such incidences can be prevented by giving awareness through proper education and training of safety standards by administrators through road safety programs.

Key words: Medico legal cases, Emergency department, Casualty medical officer, Road traffic injuries, Forensic medicine expert.

Introduction

The health care system of the modern world is certainly closely integrated with every sector of society, and the legal sector is no different. As a result of such integration, medical practitioners often deal with medical cases which have serious legal implications. Such cases are called medico-legal cases. Every doctor at some point in their life encounters

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medico-legal cases. Some of them are worried about having to deal with medico-legal cases as they imagine that they would be subpoenaed by the courts and the police. The anxiety of being intertwined in court leads them to avoid medico-legal cases or mis tag them. A medico-legal case is essentially a medical case with legal consequences. A medical case becomes a medico-legal case when the attending doctor clinically examines the patient and their history and forms the opinion that an investigation by law enforcement is required. A medical examination conducted for patients brought by the police or sent by the court also falls within this category.

Every doctor is bound by their duty to treat any patient. When doctors enter their profession, they make a pledge to perform their duties with utmost dignity and accordance with good medical practice. They cannot give any reason to refuse treatment, particularly for patients requiring emergency medical services. This was upheld in the landmark judgement of ***Parmananda Katara v. Union of India (1989)***[1], where the Supreme Court of India held that healthcare workers cannot decide whether or not to provide immediate medical assistance based on innocence or guilt of the patient. The right to seek medical assistance is an integral part of Article 21 of the Indian Constitution. In the case of ***Poonam Sharma v. Union of India (2002)***, the Delhi High Court repeated that doctors, as well as, police officers have a duty to ensure and provide medical aid to persons involved in medico-legal cases.

As per Section 39 of the Code of Criminal Procedure 1973, a person who becomes aware of the commission of an offence must provide the information to the police officer or nearest Magistrate. The similar shall apply to a doctor, who examining or treating a patient, forms an opinion that an offence was committed or attempted. Every doctor must collect necessary information and samples and properly record them while examining or treating a patient. This ensures that in case legal complications arise, the doctor will have sufficient evidence to provide for investigation. It is also to be noted that the disappearance of evidence is a punishable offence under Section 201 of the Indian Penal Code.

These medico-legal cases must be examined and determine the accountability regarding of an injury or medical condition. Incorrect or incomplete medico-legal reports may trigger obstacle and delay in legal proceedings and violated the patients' rights. Trend of medico legal cases is a fundamental part of the prevention of avoidable causalities in future and to study the crime rate in area. In present study an attempt is made to know the burden of medico legal cases. The aim of present study is to describe the profile, pattern and trend of medico-legal cases and identify errors in the medico-legal reports.

Material and Methods

This is a Retrospective, descriptive, non-interventional study, conducted in emergency department of Government Medical College and Hospital Jalaun during the period from 1st January 2023 to 31th December 2023. This is a tertiary care teaching hospital where patients are referred from most of private hospitals. Patients from district hospitals of the region are also admitted in this college as this college has got a state of art research canter & well qualified faculty. In the year 2023, total number of cases was 41388 & these include 16535 indoor cases. During this period 3021cases were registered as "medico-legal "was included in the study which comprised of information regarding various parameters obtained from medico legal register and hospital record of individual patient. The data thus obtained was analysed, observations were presented in tables & graphs, discussed and compared with other studies.

Results and Discussion

During the study period of one-year our hospital dealt with 41388 cases. These include 16535indoor cases. Out of the total number of cases given above 3021 cases (0.7%) were made medico legal.

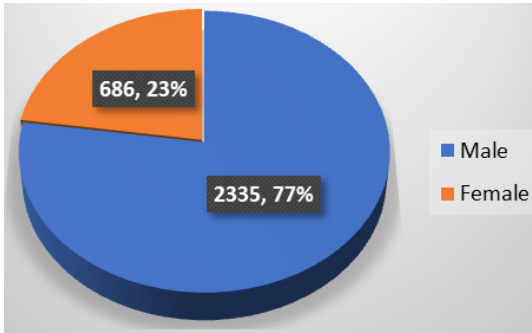

Figure 1: Gender wise distribution of cases

Gender	Number of cases
Male	2335
Female	686
Total	3021

As shown above in Figure-1 male cases were predominated over female cases which were 2335 (77%) and 686(23%) respectively. Male to female ratio was 3.4:1. In the present study males (77%) outnumbered females (23%) and male to female ratiowas 3.4:1. Studies done by various authors Brahmankar TR et al[2], Madadin M et al[3], Malik et al[4] Hussaini et al[5], Garg et al[6], Singh JP et al[7] and Siddappa S C et al[8]. also reported male predominance over female. Cause behind this may be that males are more exposed to outdoor activities.

Table 1: Age wise distribution of cases:

Age group in years	Number of cases	Percentage
<20	438	14.49
21-30	755	24.99
31-40	747	24.72
41-50	468	15.49
51-60	348	11.51
>60	265	8.77
Total	3021	100

Table-1shows that in the present study, maximum number of cases (24.99%) were from the age group of 21-30 years followed by (24.72%) from the age group of 31-40 years. Similar results were also obtained by Brahmankar TR et al[2], Madadin M et al[3], Malik Yogendra et al[4], Hussaini et al[5], Garg et al[6] Singh JP et al[7], Siddappa S C et al[8], Sangwan C et al [9], Result shows that the people of the most active and productive age group involve themselves in outdoor activities so they are more prone to accidents.

Table 2: Month wise Distribution of cases

Month	Number of cases
January	138
February	191
March	165
April	169
May	264
June	276
July	251
August	286
September	292
October	331
November	381
December	277
Total	3021

Table 2 shows that most of the cases were registered in the month of November (13%) and minimum in month of January (5%).

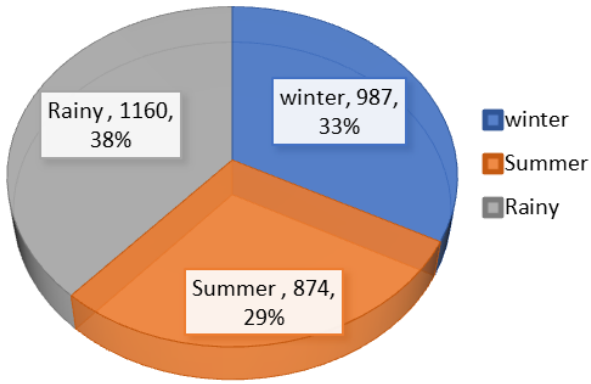

Figure 2: Sesonal variation of the cases

Season	Number of cases
Rainy	1160
Winter	987
Summer	874
Total	3021

The climate of India can be broadly as a tropical monsoon. The Indian climate designates three official seasons: Winter from November to February, Summer from March to June and Rainy from July to October. As shown above in Figure-2 that maximum cases occurred during rainy season (38%) followed by winter season (32%). Present study shows maximum number of medico legal cases reported during rainy season (38.39%). Similar findings reported by Hussaini et al [5], Garg et al[6], Siddappa S C et al[8], Trangadia MM et al[10], This could be mostly due to the increased farming activity and rainyseason. Ours is an agriculture-based country, hence major population depend upon farming activity, so it was true for Jalaun district also. Majority of farming activity like spraying of insecticide was done in monsoon season. So the chances of accidental as well as suicidal poisoning was increased. Incidence of bite by poisonous animals was also increased in rainy season.

Table 3: Characteristics of medico legal cases

Category	Number of cases	Percentages
Road traffic injuries	1760	58.25
Poisoning	493	16.31
Assault	172	5.69
Brought dead	171	5.66
Snake bite	167	5.52
Burns	71	2.35
Alcohol intoxication	68	2.25
Insect bite	64	2.11
Other accident	27	0.89
Firearm	13	0.43
Electrical injuries	10	0.33
Self-inflicted injuries	06	0.19
Total	3021	100

Table 3 shows characteristics of medico legal cases displays type of cases. Maximum number of cases were of Road traffic injuries (58.25%) followed by Poisoning (16.31%) and Assault (5.69%). The findings of our study are consistent with the studies conducted by Singh JP et al[7] Siddappa S C et al [8], Trangadia M et al[10], where road traffic accidents constituted majority of medico-legal cases. Poor road condition prevailing for a decade in both urban and rural areas, increasing population in the city day by day contributes maximum number of road traffic accidents. Malik et al[4], study shows poisoning case predominant followed by Road traffic injuries, Hussaini et al[5], study shows maximum number of the cases were of burns followed by assault and Yadav et al[11], study show that maximum number of cases were of poisoning followed by assault.

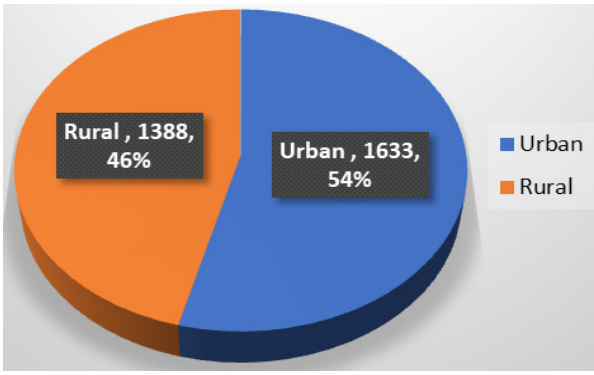

Figure 3: Distribution of cases according to demography

Demography	Number of cases
Rural	1388
Urban	1633
Total	3021

It was observed that urban victims constituted (54%) and the rural victims were (46%). Similar findings were also observed by Hussaini SN et al[5], Singh JP et al[7] Siddappa S C et al[8] The studies which were conducted in the rural areas differ from the present study. Increasing number of populations in the city and increase in the slum areas drastically within the last few years, lack of good roads and less safety measures among people, a greater number of falls due to industrial mishaps, construction works and fall from buildings constitute a greater number of medico-legal cases in urban areas.

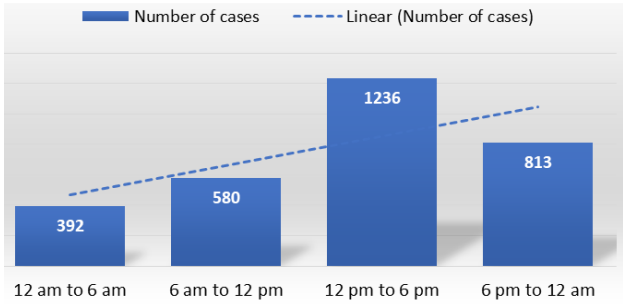

Figure 4: Distribution of cases according to time of reporting to emergency department

Time	Number of cases
12 am to 6 am	392
6 am to 12 pm	580
12 pm to 6 pm	1236
6 pm to 12 am	613
Total	3021

In the present study maximum incidence of medico-legal cases took place between 12 p.m. to 6 p.m. (40.91%) because in this time-of-day people engage themselves maximally into their activities. This is consistent with study conducted by Singh JP et al[7], Siddappa S C et al[8], Trangadia MM et al[10], Minimum incidences of medico-legal cases seen in between 12 a.m. to 6 a.m. because people usually remain asleep.

Table 4: Errors in Medico Legal Reports

Types of error	Number of cases	Percentage
No significant error present in medico legalreport	1881	62.26
Description of the injury was not complete	618	20.45
Address of the patient was not complete	208	6.88
Consciousness status was not written	118	3.90
Age of injury was not written	109	3.60
Date and time of examination was incomplete	87	2.87

With reference to the errors in medico legal reports, multiple errors were identified in the present study. Description of the injury was not complete in (20.45%) of the cases, address of the patient was not complete in (6.88%) of the cases, consciousness status was not written in (3.90%) of the cases, Age of injury was not written in (3.60%) of the cases and in (2.87%) of the cases date and time of examination was incomplete. However, in (62.26%) of the medico legal reports no significant error was seen. Study conducted by Madadin M et al. 2 shows the most common error was the lack of documentation of the size of the injury in (98.1%) of the cases, followed by incomplete description of the type of injury and lack of documentation of the age of injury in (41.9%) and (26.1%) of cases, respectively. Studies conducted by Aktas et al[12], and Turla et al[13]reported poor identification of external traumatic lesion in (62.4%) and (30.5%) cases.

Conclusion

Emergency department of a medical college receives all type of emergency cases including medico legal cases and in majority of places, duty of casualty medical officer is accomplished by MBBS doctor who is not expert in handling of medico legal cases. Expertise comes with experience but it is seen that MBBS doctor working as CMO lacks experience and hence have less knowledge and expertise. Poor opinion is no good than any opinion at all, as the later can mislead the case and may lead to administration of injustice. Therefore medico-legal work should be done under the direction of forensic expert to avoid inaccuracy in giving the opinion. The present study showed that male outnumbered female and maximum cases were of younger generation. Most common aetiology was of Road traffic injuries. Such incidences can be

prevented by giving awareness through proper education and training of safety standards by administrators through road safety programs.

Declarations

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee (Government Medical College, Jalaum (U.P) Ref no. 01/Ethics/ RMC Jalaun/2024 dated:5/06/24

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Original Research Article

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Pattern of Fatal Head Injury Due to Vehicular Accidents in Tertiary Care Centre

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Abstract

Head injury is an important cause of mortality worldwide. The present study was undertaken on 100 cases of vehicular accidents, which were autopsied at Thirunelveli Medical college over a period of one year from 2019-2020. Most of accidents has taken place during 8PM to 12 AM with a marked male preponderance of 83%. Vulnerable age group was found to be 21 to 40 years. Two wheeler occupants were commonly involved. Skull fractures were present in 65% of cases. Base of skull fractures found to be 23%, fracture of vault were found in 12%, linear fracture 50% .Among intra cranial hemorrhages, Subdural and sub arachnoid hemorrhage found to be 80.9%.

Key Words: Base of skull fracture, Subdural hemorrhage, subarachnoid hemorrhage, Linear fractures.

Introduction

Vehicular Accidents is an unplanned event occurring suddenly, unexpectedly and inadvertently in an unforeseen circumstance. About 90% of annual Disability Adjusted Life Years (DALY) lost because of vehicular accidents.

Head is the commonest site to get injured in vehicular accidents. As head is the most prominent vulnerable exposed part of the human body. Fatal vehicular accidents are a major concern all over the world. The outcome of injuries sustained in vehicular accidents depends on the impact site, vehicle type, nature of the roads and time of accidents.

Vehicular accidents is a result of interaction among different factors which include human factors like age, sex, education, mental condition, sudden illness, heart diseases, impaired vision, fatigue, psychological factors such as lack of experience, taking risk, impulsiveness, defective judgement, delay in decisions, aggressiveness, poor perception, family dysfunction, lack of body protection such as wearing helmets, safety belts etc. and environmental factors like defective narrow road, lack of signage in

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wanted points, speed breakers, lack of familiarity of route, excessive speed, large number of two and four wheelers, overloading buses, low driving standards, mechanical failure, old poorly maintained vehicles, bad weather, mixed traffic, slow and fast moving pedestrians and animals. Some precipitating factors are emotional tension, alcohol, drugs, social pressure, use of unaccustomed vehicle etc.

People are more important than the machines they make and use. It is the responsibility of all to contribute in reducing vehicular accidents. The preventable measures are properly planned roads, indexing of narrow roads, building of flyovers, underpass at required sites, well designed vehicle with newer technology, periodic maintenance of vehicle, trained driver, issuing driving license after strict tests, and medical fitness after strict vision test and knowledge of traffic rules.

According to NCRB, main reason for vehicular accidents in India is due to fault of driver (77.1%).

The study was conducted at Tirunelveli Medical College among 100 post- mortem cases of vehicular Accident deaths from 2019 to 2020.

Aims and Objectives

i. To study the pattern of head injuries in vehicular accidents.

ii. To study the death due to RTA in relation to age, sex, type of vehicle, time of occurrence and wearing of protective gadgets.

iii. To suggest steps to prevent the head injury and to decrease incidence of vehicular accidents.

Materials and Methods

Inclusion Criteria:

Cases with head injury with history of vehicular accident were included in the study.

Exclusion Criteria:

Cases with head injury with history other than vehicular accident and vehicular accident cases with head injury in varied stage of decomposition.

Sample Size: 100 cases

Study Design and Method

A Cross-Sectional study included 100 cases subjected for post mortem examination with head injury with history of vehicular accident at Department of Forensic Medicine and toxicology, Tirunelveli from November 2019 to June 2020. History and other details were obtained from Investigating authority. Pattern of injury in head, haemorrhage and brain injury were recorded & data was analysed using SPSS software.

Results

Table 1: Sex Distribution

Sex	No. of Cases	Percentage
Male	83	83%
Female	17	17%
Total	100	100%

Table 2: Age Distribution

Age	No. of Cases	Percentage
< 20	12	12%
21 to 40	33	33%
41 to 60	32	32%
61 to 80	21	21%
> 80	2	2%
Total	100	100%

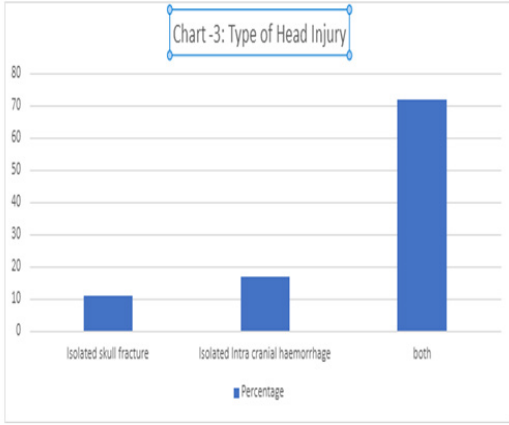

Figure 1: Type of Head Injury

Table 3: Type of Skull Fracture

Types of Skull Fracture	No. of Cases	Percentage
Cranial Vault	10	12%
Base of Skull	19	23%
Both	54	55%
Total	83	100%

Table 4: Type of Cranial Vault Fracture

Types of cranial vault fracture	No. of cases	Percentage
Linear fracture	32	50%
Depressed fracture	06	9.5%
Communited fracture	02	3.1%
Diastatic fracture	08	12.5%
Crush injury	11	17.1%
Ring fracture	01	1.5%
Combined fracture	04	6.3%
Total	64	100%

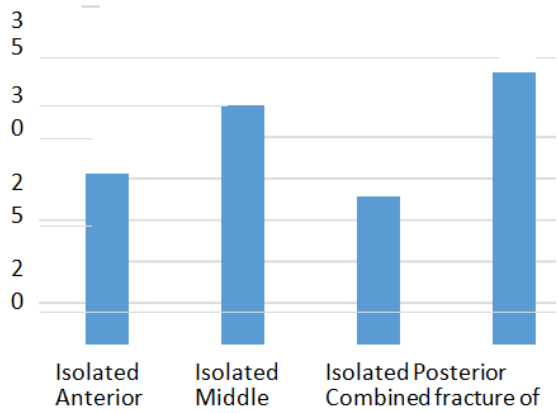

Figure 2: Type of Base of Skull Fracture

Table 5: Types of Intracranial Haemorrhage

Types of intracranial haemorrhage	No. of cases	Percentage
Extradural haemorrhage	1	1.1%
Subdural with subarachnoid haemorrhage	72	80.9%
Brain stem haemorrhage	1	1.1%
Combination of intracranial haemorrhage	4	4.5%
Crush injury (unclassifiable)	11	12.4%
Total	89	100%

Table 6: Time of Occurance

Time of occurrence	No. of cases	Percentage
12 am to 6am	5	5%
6am to 12pm	24	24%
12pm to 6pm	33	33%
6pm to 12 am	38	38%
Total	100	100%

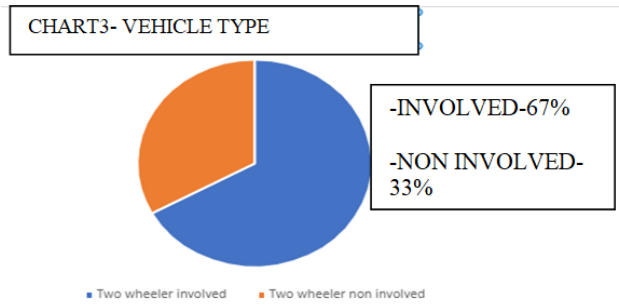

Figure 3: Type of Vehicle Involved

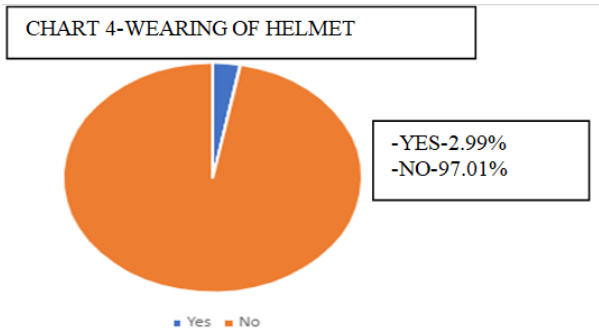

Figure 4: Wearing of Helmet

Discussion

In my study male preponderance was observed, 83 out of 100 cases. Similar observation was made in retrospective study by Goel S, Singh VB, Agarwal N, Niranjan A. head injury in road traffic accident and its presentation in emergency room were 63% of male preponderance observed[2].

In my study the maximum no of deaths occurred in the age group of 21-40 (33%) among the study group, which is similar to the study done by Mukesh & Goyal, Rajesh Verma, Shiv

R. Kochar, Shrikant A. Asawa where maximum number of deaths were in age group 21-30 yrs (27%) followed by 31-40yrs (18%)[8].

Regarding the time of occurrence, maximum number of deaths occurred during 6pm to 12 am which is about 38% followed by 12pm to 6pm which is about 33% which is near similar to study done by Anand Menon, Nagesh K.R, in their study observed that most of the accidentshad taken place between 12 pm to 6pm (39%) followed by 6 pm to 12 am (27%).[12]

Regarding type of skull fracture combination of both cranial vault fracture and base of the skull

fracture are more common in about 54(65%) out of 83 cases, similar findings noted in the study done by Anand Menon, Nagesh K.R were cranial vault fracture is 38% and base of skull is 34%.[12]

Regarding the type of cranial vault fracture linear fracture are common among cranial vault fracture are more common in about 32(50%) out of 64 cases, similar findings noted in the study done by Anand Menon, Nagesh K.R were 57% 0f cranial vault fractures were linear fracture.[12]

Regarding the type of base of skull fracture, combination of base of the skull fracture are more common of about 24(32.8%) out of 73 cases followed by isolated middle cranial fossa which is about 21 (28.8%) out of 73 cases, similar findings noted in the study done by Anand Menon, Nagesh K.R were combination of base of skull fracture constitute about 34% followed by middle cranial fossa 26%. Force caused by the impact over the side of head and face which radiates to the base causing base of skull fracture.[12]

Regarding the type of intracranial haemorrhage, subdural with subarachnoid haemorrhage are more common of about 72 (80.9%) out of 89 cases which is similar to retrospective study done by Goel S, Singh VB, Agarwal N, Niranjan A were 53% of intra cranial haemorrhage were subdural and subarachnoid haemorrhage which is higher among all type of intracranial haemorrhages.[2]

In the view of type of vehicle involved in the RTA, two wheelers are more common about 67(67%) out of 100 cases. According to the National Crime Record Bureau (NCRB 2017) statistics - one third of RTA involves Two wheelers. Since India being a developing country usage of two wheelers is exponential which leads to maximum number of RTA involving two wheelers. Measures need to be taken in reducing the unwanted usage of private vehicles by improving public transport infrastructure.

In the view of wearing of helmet, only 2 cases out of 67 cases wore helmet which is only about 2.99%. Remaining 65 cases (97.1%) sustained fatal head injury without helmet. This stresses the importance of wearing helmets.

Conclusion

Conclusion of my study regarding the pattern of head injury is Linear fracture is more common among cranial vault fracture.

Middle cranial fossa fracture is common among base of skull fracture.

Subdural Haemorrhage and Subarachnoid Haemorrhage are the most common Intracranial Haemorrhage in this study.

Source of Funding: NIL

Conflicts of Interest: NIL

Ethical Consideration: The study was conducted after obtaining institutional ethical committee clearance (Tirunelveli Medical college) Date: 20.11.2019 Reference No.: 1589/FM/2019

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Original Research Article

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Pattern of Medicolegal Cases Reported at Sri Madhusudan Sai Institute of Medical Sciences and Research

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Abstract

Introduction: A medico-legal case is a case of injury or illness where the attending doctor, after eliciting history and examining the patient, thinks that some investigation by law enforcement agencies is essential to establish and fix responsibility for the case in accordance with the law of the land. Medico-legal cases are an integral part of medical practice that is frequently encountered by medical officers working in emergency department.

Aims and Objectives: To analyze the pattern of medico-legal cases presented to the casualty at Sri Madhusudan Sai Institute of Medical Sciences and Research.

Materials and Methods: This is a retrospective study of medico-legal cases registered in a casualty of Sri Madhusudan Sai Institute of Medical Sciences and Research, Muddenahalli, chikkaballapura, Karnataka for a period of one year from1st Janaury2023 to 31st December 2023.

Results: Of the 218 cases, 171 were men and 47 were women with RTA constituting 66.05% (144 cases) of the cases and poisoning with 08.71% (19 cases) of the cases forming most of the case profile.

Conclusion: The Casualty of Sri Madhusudan Sai Institute of Medical Sciences and Research deals with a reasonable number of MLCs due to the large semi urban to rural population and easy accessibility from nearby areas. The clinical forensic medicine branch should be developed well to deal with MLC documentation for the administration of proper justice in the court of law at a later stage.

Keywords: Medicolegal cases, Clinical Forensic Medicine, Casualty

Introduction

Medico-legal case (MLC) can be defined as a case of injury or ailment, etc. in which investigations by the law enforcing agencies are essential to fix the responsibility regarding the causation of the said injury or ailment. In simple language it is a medical

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case with legal implications for the attending doctor where the attending doctor, after eliciting history and examining the patient, thinks that some investigation by law enforcement agencies is essential to establish and fix responsibility for the case in accordance with the law of the land.[1,2]. Medico-legal cases are an integral part of medical practice that is frequently encountered by medical officers working in emergency department. For such patients, not only treatment, but exhaustive documentation is also mandatory. The on-duty doctor in the casualty department must first stabilize the patient of any emergency. He is also duty bound to register a particular case as a medico-legal case whenever indicated and must examine the same. In the present study an attempt is made to know the workload of medico-legal cases and their pattern.

Aims and Objectives:

To analyze the pattern of medico-legal cases presented to the casualty at Sri Madhusudan Sai Institute of Medical Sciences and Research.

Materials and Methods

This is a retrospective study of medico-legal cases registered in a casualty of Sri Madhusudan Sai Institute of Medical Sciences and Research, Muddenahalli, chikkaballapura, Karnataka for a period of one year from1st Janaury2023 to 31st December 2023. During the study period a total of 218 medico-legal cases were registered. The collected data was analyzed and represented in the form of tables by mentioning various parameters and compared with other resembling studies. Individuals from both genders and all age groups were included and people with no medico legal perspective were excluded from study.

Results

Out of a total of 218 cases, males were found in 171 (78.44%) MLCs whereas females were found in 47 (21.56%) MLCs. Out of a total of 218 MLCs, victims of the age group 18–30 years (N = 77; 35.32%) form most of the cases followed by age groups 31–40 years (N = 59; 27.06%), and 41–50 years (N = 24; 11%), respectively. Out of 218 MLCs, RTA (N= 144; 66.05%) amounts to more than half followed by Poisoning (N = 19; 8.71%) and snake bite(N = 10; 4.56%) respectively. Among the 218 MLCs, the time of reporting was between 8 AM–2PM in the majority (N = 83; 37.07%) cases, followed by 2PM –8PM (N= 75; 34.40%) and 8PM–8AM (N = 60; 27.53%), respectively. Out of a total of 218 MLCs, in 152 (69.72%) cases, the stay of the victims in the hospital was less than 24 hours, followed by 43 (19.74%) cases, stay of the victims in the hospital was more than 4 days.

Table 1: Age wise distribution of cases

Si. No	Age	Numbers (N)	Percentage (%)
1.	< 18 Years	20	9.17
2.	18 – 30 Years	77	35.32
3.	31 – 40 Years	59	27.06
4.	41- 50 Years	24	11.00
5.	51- 60 Years	12	5.50
6.	> 60 Years	26	11.95
	Total	218	100

Table 2: Gender wise distribution of cases

Si. No	Gender	Number (N)	Percentage (%)
1.	Male	171	78.44
2.	Female	47	21.56
	Total	218	100

Table 3: Pattern of Medicolegal cases wise distribution

Si. No	MLC Pattern	Numbers (N)	Percentage %
1.	RTA (Road Traffic Accidents)	144	66.05
2.	Poisoning	19	8.71
3.	Self-Fall	16	7.33
4.	Snake Bite	10	4.56
5.	Assault	09	4.12
6.	Dog bite	08	3.65
7.	Monkey bite	07	3.21
8.	Brought Dead	03	1.37
9.	Electric Shock	01	0.45
10.	Attempted Hanging	01	0.45
	Total	218	100

Table 4: Distribution according to Time of hospitalization

Si. No	Time of Hospitalization	Numbers (N)	Percentage (%)
1.	8AM TO 2 PM	83	38.07
2.	2PM TO 8 PM	75	34.40
3.	8 PM TO 8 AM	60	27.53
	Total	218	100

Table 5: Distribution according to duration of hospitalization.

Si. No	Duration of Hospitalization	Numbers (N)	Percentage (%)
1.	< 24 hrs.	152	69.72
2.	1-2 days	11	5.04
3.	2-4 days	12	5.50
4.	> 4 days	43	19.74
	Total	218	100

Discussion

Out of a total of 218 cases, males were found in 171 (78.44%) MLCs whereas females were found in 47 (21.56%) MLCs. Our findings were similar to the studies reported by references. [3,4,5,6]

Out of a total of 218 MLCs, victims of the age group 18–30 years (N = 77; 35.32%) form most of the cases followed by age groups 31–40 years (N = 59; 27.06%), and 41–50 years (N = 24; 11%), respectively. Our findings were similar to the studies reported by references.[7,8,9,10]

Out of 218 MLCs, RTA (N= 144; 66.05%) amounts to more than half followed by Poisoning (N = 19; 8.71%) and snake bite(N = 10; 4.56%) respectively. Many studies have reported that Road Traffic Accidents were major causes of medico-legal cases presented to the hospitals, similar to our study.[11,12,13,14]

Among the 218 MLCs, the time of reporting was between 8 AM–2PM in the majority (N = 83; 37.07%) cases, followed by 2PM –8PM (N= 75; 34.40%) and 8PM–8AM (N = 60; 27.53%), respectively. Reference [4] reported that the peak time of reporting was between 12 PM to 6 PM Reference [9] reported that the majority (36.9%) of victims reported between 12 PM to 6 PM., followed by 35% between 6 PM. to 12 AM. Reference [15] has reported that majority (31.18%) of victims reported between 6 PM to 12 AM., followed by 30.59% between 12 PM. to 6 PM.

Out of a total of 218 MLCs, in 152 (69.72%) cases, the stay of the victims in the hospital was less than 24 hours, followed by 43 (19.74%) cases, stay of the victims in the hospital was more than 4 days. Reference [16] reported that the majority (90.89%) of the victims of MLCs were discharged from the hospital within 1 week of admission to the hospital.

Conclusion

The Casualty of Sri Madhusudan Sai Institute of Medical Sciences and Research deals with a reasonable number of MLCs due to the large semi urban to rural population and easy accessibility from nearby areas. As the busiest hours to deal with MLCs were found between 8AM and 02PM. hence, the concerned Orthopedics, Surgery, Medicine, and ENT departments should remain vigilant with well-trained manpower during those hours. The clinical forensic medicine branch should be developed well to deal with MLC documentation for the administration of proper justice in the court of law at a later stage.

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Conflict of Interest: None declared.

Ethical Clearance: Taken from the Institutional Ethics Committee. Ref. No: IEC/Certificate/12/23 dated 23/10/2023.

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Original Research Article

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Comparative Analysis of Drowning Index: Relevance in Drowning Deaths versus Non-Drowning Asphyxial Deaths

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Abstract

Drowning remains a significant cause of mortality worldwide, necessitating accurate diagnostic tools for forensic investigation. This paper conducts a comparative analysis of the Drowning Index (DI) to ascertain its relevance in distinguishing drowning deaths from non-drowning asphyxial deaths. Drowning deaths present a challenge for forensic pathologists, because the autopsy findings may occur in many non-drowning scenarios. Previous studies have attempted to identify patterns in organ weights that may be specific for drowning. The drowning index has been defined as the weight ratio of the lungs and pleural effusion fluid to the spleen. We compared the lung and pleural effusion weight, spleen weight, and DI from 124 autopsies of asphyxia deaths including both drowning deaths and non-drowning asphyxia deaths such as hanging, strangulation, suffocation and mechanical asphyxia at the department of Forensic Medicine and Toxicology at the Gandhi Medical College, Bhopal from September 2021 to August 2022. Findings highlight the potential utility of the DI as a valuable adjunctive tool in forensic investigations, providing insights into its comparative efficacy in differentiating drowning from other modes of asphyxial deaths. Such insights are critical for enhancing accuracy in forensic diagnoses and contributing to advancements in medicolegal death investigations.

Keyword: Drowning, drowning index, data, autopsy.

Introduction

Drowning is defined as a form of death by suffocation, in which atmosphericair is prevented from entering the lungs by submerging the body in water or another liquid medium.[1] Drowning is considered the leading cause of death in water and the third leading cause of accidental death worldwide. Drowning rates are highest indeveloping countries.[2] The World Health Organization (WHO)

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defines it as: "The process of experiencing respiratory distress as a result of immersion/immersion in a liquid".[3] Drowning is one of the 10 leading causes of death among people under the age of 25 and is most common in low- and middle-income countries.[4] Drowning is an important but often neglected public health problem. Drowning affects all age groups, but certain groups are particularly vulnerable. Most drowning deaths (almost 97%) occur in developing countries like ours.[5]

In forensic pathology, the diagnosis of drowning as a cause of death follows the exclusion of other causes and requires the completion of a full autopsy, in which body fluids are examined and all results interpreted along with all known examination data. In the absence of signs of drowning, it is acceptable to consider another cause of death other than natural. External findings in drowning deaths are variable and are both nonspecific and nondiagnostic.

Nishitani et al. reported a new concept in the diagnosis of drowning based on autopsy findings. They recommended the drowning index (DI), which isthe ratio of lung and pleural effusion to spleen mass, and the drowning indexis higher.[6] A lighter spleen weight with pulmonary findings is also useful to diagnose drowning. In this study, we investigated the significance of the DI for diagnosis, especially the diagnosis standard and its application limits.

Materials and Methods

The study has been carried out in the year 2021-22 after approval from ethical committee of Gandhi medical college, Bhopal. 62 cases were taken to study the drowning deaths, excluding bodies in advanced state of decomposition and head injury. Same number of non-drowning asphyxia related death of the sample size. The study was carried out over the period of September 2021 to August 2022. Amount of pleural fluid measured and all organs were weighed prior to dissection, and drowning index was calculated. Drowning index was calculated by weight ratio of the lungs and pleural effusion to the spleen. The study did not involve any removal of organs or mutilation of bodies, which is prohibited by the ICMR guidelines. The clearance for the study was obtained from the college ethical committee. (D. I = both lung Wt. + pleural effusion/ Wt. of spleen)

Observations and Results

A total number of 4590 autopsies were carried out at Gandhi Medical College Bhopal, over a period of 12 months and of which there were 83 cases of deaths due to drowning out of which 62 cases are included and rest excluded due to decomposition and head injuries, constituting 1.35% of all the unnatural deaths at the Gandhi Medical College Bhopal. The cases taken were 62 and the study includes, only the non-decomposed, unmutilated dead bodies which were retrieved from water sources and having history of drowning, brought for post mortem examination.

Observations were tabled and compared with equal number of representatives control groups and the mean organ weights observed in the drowning group are given in table.1 and fig. 1. The weight of all organs of the drowning group was larger than the control group, except for the liver and spleen, where the liver remained almost unchanged and the spleen lost weight.

Table 1: The Mean Organ Weights among Cases And Controls

Organ weights	Cases (±SD) n=62	Controls (±SD) n=62
Brain	1023.61 ± 188	1083.01 ± 99.22
Right Lung	502.52 ± 122.80	333.25 ± 73.32
Left Lung	479.03 ± 121.80	323.84 ± 73.66
Combined lung	981.55 ± 244.60	657.09 ± 146.98
Pleural effusion	233.06 ± 77.23	16.45 ± 8.48
Liver	1042.40±198.12	1145.73±157.82
Spleen	123.15 ± 11.92	131.21 ± 17.58
Right Kidney	155.24 ± 29.08	129.90 ± 14.66
Left Kidney	147.23 ± 28.92	126.74 ± 12.90
Combined kidney	302.23 ± 58	256.64 ± 27.56

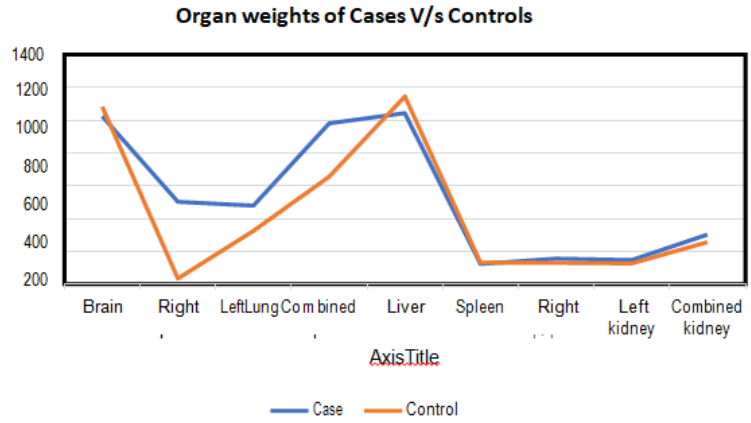

Fig 1: The mean organ weights among Cases and Controls

Comparative analysis of organ weights between cases (drowning deaths) and controls (non-drowning deaths) revealed significant differences. In cases, the mean brain weight was 1023.61 grams (±188), whereas controls exhibited a higher mean brain weight of 1083.01 grams (±99.22). Notably, both the right and left lung weights were markedly higher in cases compared to controls: right lung (502.52 grams ±122.80 vs. 333.25 grams ±73.32) and left lung (479.03 grams ±121.80 vs. 323.84 grams ±73.66). The combined lung weight was also substantially elevated in cases (981.55 grams ±244.60) compared to controls (657.09 grams ±146.98). Pleural effusion volume was significantly greater in cases (233.06 ml ±77.23) than in controls (16.45 ml ±8.48). Although the liver weight was slightly lower in cases (1042.40 grams ±198.12) compared to controls (1145.73 grams ±157.82), differences were not statistically significant. However, spleen weight showed a slight decrease in cases (123.15 grams ±11.92) compared to controls (131.21 grams ±17.58). Both right and left kidney weights were notably higher in cases than controls: right kidney (155.24 grams ±29.08 vs. 129.90 grams ±14.66) and left kidney (147.23 grams ±28.92 vs. 126.74 grams ±12.90). The combined kidney weight was significantly elevated in cases (302.23 grams ±58) compared to controls (256.64 grams ±27.56). These findings suggest distinct organ weight patterns between drowning and non-drowning asphyxial deaths, underscoring their potential diagnostic utility in forensic investigations.

The average organ weights observed in the drowning group were 1023.61 ± 188, 981.55 ± 244.60, 1042 ± 98.12, 123.15 ± 11.92, 302.23 ± 58, brain, combined lung, liver, spleen and combined kidney respectively and all organs of the drowning group were larger than the control group, except for liver and spleen, where the liver remained almost unchanged and the percentage increase was 49.32% for the mean combined lung weight, 17.97% for the combined kidney weight, and the spleen decreased of 6.14%, findings were in accordance with J.A. Hadley 82 study, lung and kidney weights increased by 47.8% and 14.7% respectively.[7]

In drowning cases, it has often been noted that the weight of the spleen falls and the weight of the lungs and pleural effusion increases; similarly, our study's results showed that the drowning index of cases is nearly twice that of the controls group, having p value of $p<0.00001$ which was found significant at $p <0.05$.

Table 3: Comparison of Drowning Parameters Among the Two Groups

Groups	Combined lugs weight	Pleural effusion	Spleen weight	Drowning Index
Cases	981.55 ± 244.60	233.06 ±77.23	123.15 ± 11.92	9.87 ± 2.30
Controls	657.09 ±146.98	16.45 ± 8.48	131.21 ± 17.58	5.13 ± 0.86

Comparison of drowning parameters between cases (drowning deaths) and controls (non-drowning deaths) revealed significant differences. In cases, the combined lung weight was substantially higher at 981.55 grams (±244.60) compared to controls at 657.09 grams (±146.98). Similarly, pleural effusion volume

was markedly elevated in cases (233.06 ml ±77.23) compared to controls (16.45 ml ±8.48). Conversely, spleen weight showed a slight decrease in cases (123.15 grams ±11.92) compared to controls (131.21 grams ±17.58). The Drowning Index was significantly higher in cases (9.87 ± 2.30) compared to controls (5.13 ± 0.86). These findings underscore the relevance of these parameters in distinguishing drowning deaths from non-drowning asphyxial deaths, emphasizing the potential diagnostic value of the Drowning Index in forensic investigations. Results clearly showed that the drowning index of cases is nearly twice that of the controls group and combined lugs weight, pleural effusion weight andspleen weight of cases are larger than the control group.(Table.3).

Table 4: Comparison of drowning index for significance Group Statistics

		N	Mean	Std. Deviation	Std. Error Mean
DI	Drowning cases	62	9.8706	1.16067	.14741
	Control cases	62	5.1305	.43522	.05527

Table 5. Independent Samples Test

DI	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variance assumed	28.120	.000	30.110	122	.000	4.74016	.15743	4.42852	5.05181
Equal variance not assumed			30.110	77.821	.000	4.74016	.15743	4.42674	5.05359

A comparison of the Drowning Index (DI) between drowning cases and control cases revealed significant differences. In drowning cases (n=62), the mean DI was 9.8706 (±1.16067), whereas in control cases (n=62), it was 5.1305 (±0.43522). Levene's test for equality of variances indicated unequal variances between the two groups (F=28.120, p<.001). Consequently, the t-test for equality of means, assuming unequal variances, showed a highly significant difference between the two groups (t=30.110, df=122, p<.001). The mean difference in DI between drowning cases and control cases was 4.74016, with a standard error difference of 0.15743. The 95% confidence interval for the difference in DI ranged from 4.42674 to 5.05359. These findings suggest a substantial and statistically significant variation in DI between drowning deaths and non-drowning asphyxial deaths, emphasizing its potential as a diagnostic tool in forensic investigations. Values are given as means ± standard deviation. Numbers show weight (g) except drowning index. Independent t test was applied in drowning index of case and control and observed that the drowning index mean of cases and control are 9.87 and 5.13 respectively, which shows a significant mean difference and highly statically significant. (P<0.00001) and 83.88% significant for differences between drowning and non-drowning cases. (Table.4 and 5).

Upon calculation of mean DI from 62 the cases in our study the mean was found 9.87. Of the 62 cases 50 cases were found to have DI higher than the mean value, which holds a percent of 83.88%, and we can assume that DI value 9.87 having the high significant for drowning deaths. This is compared to other studies such as Tomoko Sugimura[8] who reported to apply the drowning index (DI) for diagnosis, within 2 weeks post mortem, who propose DI "14.1" as the standard DI value (cut off value).

Conclusion

The results of our analysis provide compelling evidence of the significance of the Drowning Index (DI) in distinguishing between drowning deaths and non-drowning asphyxial deaths. Our findings indicate a substantial difference in DI values between the two groups, with drowning cases exhibiting significantly higher DI compared to control cases. This disparity underscores the utility of DI as a diagnostic tool in forensic investigations, particularly in cases where the cause of death may be ambiguous.

The observed variation in DI values highlights the importance of considering multiple factors, such as lung weight, pleural effusion volume, and spleen weight, in forensic examinations of drowning victims. The higher DI values in drowning cases likely reflect the physiological responses to submersion in water, including lung congestion and the accumulation of pleural effusion. In contrast, control cases, which represent non-drowning asphyxial deaths, exhibit lower DI values indicative of different underlying mechanisms of death.

These findings have significant implications for forensic pathology practice, providing forensic examiners with valuable insights into the diagnostic value of DI in distinguishing drowning from other modes of asphyxial deaths. By incorporating DI into routine forensic examinations, practitioners can enhance the accuracy and reliability of cause-of-death determinations in cases involving submersion incidents.

Overall, our study underscores the importance of incorporating DI as a complementary tool in forensic investigations of drowning deaths, contributing to improved forensic diagnostics and ultimately serving the interests of justice and public safety. Further research and validation studies are warranted to corroborate these findings and refine the utility of DI in forensic practice.

Ethical Clearance: The study has been carried out in the year 2021-22 after approval from ethical committee of Gandhi medical college, Bhopal. Vide letter no.: 26734/MC/IEC/2021, dated 24/08/2021.

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Original Research Article

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Attitude and Knowledge of Medical Negligence among General Populationattended Out Patient Department at Civil Hospital associated B. J. Medical College, Ahmedabad, Gujarat

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Abstract

Negligence is defined as doing something which reasonably competent people not suppose to do or not doing something which reasonably competent persons suppose to do.

Present cross sectional study was undertaken with aim to assess knowledge and awareness of general population visiting Out Patient Departments (OPD) of Civil Hospital associated B. J. Medical College, Ahmedabad towards medical negligence and legal proceeding regarding medical negligence. Total 350 people from general population were subjected to pre-tested and pre-validated questionnaire related to medical negligence after obtaining their informed written consent. Questionnaire contain 16 questions related to medical negligence and legal proceeding regarding medical negligence with responses based on Likert's scale varied from strongly disagree to strongly agree. Responses obtained were tabulated in MS Excel sheet and analyzed via SPSS software.

Out of 350 participants, 32.8% were between 31-40 years age group, 64% were male. Total 54% were agreed upon that failure to maintain a medical record by hospital is negligence. 65% were agreed that doctor can be liable for negligence. 67% were agreed upon that performing operation without informed written consent is negligence. 30% were agreed upon that treating a patient without his consent is negligence. 81% were strongly agreed upon that carelessly leaving an instrument in patient's body after operation is negligence. 49% were strongly agreed upon that refusing to attend patient in emergency is negligence. 57% were strongly agreed upon that death due to negligence is punishable by court. 44% were agreed upon that compensation for negligence can be claimed in consumer court. 53% were agreed about that wrong diagnosis followed by wrong treatment is considered as negligence. 50.5% of participants were agreed upon that postmortem is necessary in case of death due to medical negligence, while 34.8% were disagreed. All participants believed and agreed upon that threaten or attack on a doctor is punishable in court even if doctor is truly negligent.

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Present study reflected that general population has quite a good knowledge regarding medical negligence which may increase gradually over a period of time due to news papers, internet and other resources but less knowledge about legal proceedings regarding medical negligence. Training programs should be conducted for them to bring true knowledge and awareness regarding medical negligence which indeed helps to them as well as medical professionals.

Keywords: Attitude, Knowledge, Medical Negligence, General Population

Introduction

Negligence is defined as doing something which reasonably competent people not suppose to do or not doing something which reasonably competent persons suppose to do.[1] Professional negligence is defined as absence of reasonable care and skill or willful negligence by doctor during treatment of patient which may lead to physical injury or death of patient.[2]

Medical profession is considered as a most pious profession all over the world. A doctor is placed only second to Almighty God. He enjoys a position of an Angel. Patient feels a divine image in him. Its sole objective is improvement of the quality of the life of the people and mitigation of sickness and suffering. It is not a mathematical process but a service-oriented liberal profession having a self regulating code of ethics.[3]

The relationship between doctor and patient is based on trust and confidence but these trust, sacredness and confidence, has become the talk of olden days and now it sounds hollow. Lucky doctors of the past were treated like God and people revered and respected them. With commercialization spreading to all aspects of our lives, the medical profession and services rendered by hospitals and private clinics are going through dramatic changes. Some incidences cause suffering to the patients, forcing the legislature and the public to think twice about the credibility and authenticity of medical treatment given to the patients.[4]

Hence, now the doctor-patient relationship has deteriorated considerably and medical negligence is on the increase which is the act or omission by a practitioner and thus the treatment provided is below the accepted level and causes injury to the patient.

Indian society is experiencing a growing awareness regarding patient's rights. In India, the Consumer Protection Act (CPA) came into existence in 1986, which was enacted for better protection of the interests of consumers. The provisions of consumer protection act now covers deficiency of service by medical professionals in such cases to provide redresses to the patients.

Nowadays allegation and litigation regarding medical negligence is increasing day by day. Many of them may be false allegation and some may be true. But in current situation, attacks on doctors and hospitals in Indian cities are on the increase because of lack of knowledge about medical negligence and its legal proceedings. As medicine is a noble profession but there is also growing anxiety both within the medical profession and in the community regarding increasing trends of complaints and lawsuits against doctors.[5] Present study was carried out to know perspective and knowledge on medical negligence among general population attended Out Patient Departments (OPD) of Civil Hospital associated B. J. Medical College, Ahmedabad.

Material and Methods

This cross-sectional study was done from April to September 2023. General Population of Ahmedabad City was selected for the study. The study was done with the help of questionnaires specially prepared in vernacular language i.e. Gujarat for the study. After obtaining written informed consent of interested people, questionnaires were given to participants and responses were made anonymously. Incomplete filled forms were excluded from the study. After obtaining the response, some facts of medical negligence regarding the given questionnaires were acquainted and tried to clear their doubts, if any. A total of 350 peoples participated successfully in the study. The questionnaires consisted of perspective and knowledge of the Medical negligence and legal proceeding regarding medical negligence.

Observation

Questionnaires were distributed among a small group of the general population and obtained a response. A total of 350 respondents successfully participated & included in the study. The data regarding socio demographic characteristics of respondents,

response to questionnaire about medical negligence and its legal proceedings obtained, was tabulated and analyzed. The data obtained are shown in **Tables 1, 2 &3.**

Table 1: Socio-demographic characteristics of the respondents

Characteristics of the Respondents	Number	%
Sex		
Male	225	64.3%
Female	125	35.7%
Age		
21-30	85	24.2%
31-40	115	32.8%
40-50	96	27.4%
50-60	47	13.4%
60-70	07	2%
Education		
Below 10 standard	47	13.42%
Higher Secondary	103	29.42%
Graduate	136	38.85%
Post Graduate	64	18.28%
Occupation		
Laborer	34	9.71%
Farmers	51	14.57%
Housewife	37	10.57%
Students	45	12.85%
Employee	111	31.71%
Business	61	17.42%
Lawyer	11	3.14%

Table 2: Questionnaire about Medical Negligence

Sr No	Questions / Statements	Response In Numbers & (%)				
		SD	D	NS	A	SA
1	Doctor can liable for Professional Negligence	0 (0 %)	0 (0%)	5 (1.4%)	229 (65.4%)	116 (33.1%)
2	Nurse and other hospital staff or anyone can liable for Negligence	24 (6.8%)	103 (29.4%)	12 (3.4%)	167 (47.7%)	44 (12.5%)
3	Refusal to attend patient in emergency condition is Negligence	10 (2.8%)	13 (3.7%)	14 (4%)	141 (40.2%)	172 (49.1%)
4	Performing any procedure and Operation without inform consent is Negligence	12 (3.4%)	20 (5.7%)	11 (3.1%)	235 (67.1%)	72 (20.5%)
5	Leaving an instrument carelessly in patient's body after operation is negligence	0 (0%)	0 (0%)	0 (0%)	66 (18.8%)	284 (81.1%)
6	Doctor do not provide another doctor to treat patient during his absence is negligence	16 (4.5%)	63 (18%)	21 (6%)	151 (43.1%)	99 (28.2%)
7	If patient has side effect of prescribed treatment, It is negligence.	131 (37.4%)	117 (33.4%)	28 (8%)	51 (14.5%)	23 (6.5%)
8	Patient die during Operation, It is always due to negligence.	39 (11.1%)	133 (38%)	7 (2%)	107 (30.5%)	64 (18.2%)
9	Failure to maintain medical records by hospital is negligence	11 (3.14%)	13 (3.7%)	55 (15.7%)	189 (54%)	82 (23.4%)
10	Treating patient without his/her consent is negligence	33 (9.4%)	89 (25.4%)	95 (27.4%)	107 (30.5%)	26 (7.4%)
11	Wrong diagnosis followed by wrong treatment is considered as negligence	15 (4.2%)	45 (12.8%)	74 (21.1%)	186 (53.1%)	30 (8.5%)

(SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree)

Table 3: Questionnaire about Legal Proceeding regarding Medical Negligence

Sr. No	Questions / Statements	Response In Numbers & (%)				
		SD	D	NS	A	SA
1	In suspected case of negligence, you have to file complain in concerned police station.	0 (0%)	0 (0%)	4 (1.1%)	90 (25.7%)	256 (73.1%)
2	Postmortem is necessary in case of death due to medical negligence	49 (14%)	73 (20.8%)	51 (14.5%)	111 (31.7%)	66 (18.8%)
3	Death due to negligence is punishable in court	3 (0.8%)	5 (1.4%)	11 (3.1%)	129 (36.8%)	202 (57.7%)
4	Compensation may be given by consumer court for damage due to negligent act.	19 (5.4%)	53 (15.1%)	17 (4.8%)	155 (44.2%)	106 (30.2%)
5	Threaten or attack on a doctor is punishable in court even if doctor is truly negligent.	0 (0%)	0 (0%)	0 (0%)	205 (58.5%)	145 (41.4%)

(SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree)

Discussion

Medicine is a noble profession but there is also growing anxiety both within the medical profession and in the community regarding increasing trends of complaints and lawsuits against doctors. Negligence in the medical world has assumed great importance in relation to the medical malpractices suits in various countries in Asia, Europe, USA and more so in India.

There are good numbers of studies available about knowledge, awareness & attitude regarding medical negligence among health care professionals[4-10], but very few study available for general population. In the present study, a total of 350 peoples from Ahmedabad city participated, all were aged above 20 years with different educational levels and variable occupational status and quite capable of understanding the subject which we studied. We observed that the knowledge of medical negligence was found to be satisfactory, butthe knowledge was poor about legal proceeding regarding medical negligence, our findings are consistent with Parmar P et al[11]andSiddiqui M N[12]

(A) Knowledge about Medical Negligence

In the present study,98.5 % of respondents agreed upon that, Doctor can be liable for Professional Negligence. But only 60% of people agreed upon that, other hospital staff can also be liable for Negligence, 36.2% respondent disagreed with this.

We observed that 89.3% of people were agreed with that, refusal to admit patient requiring urgent hospitalization is Negligence. 87.6% respondents were agreed upon that performing any procedure and operation without inform consent is Negligence. It means the general population has sufficient knowledge about the duties of doctors and consent.

All participants were agreed upon that, leaving an instrument carelessly in patient's body after operation is negligence.71.3% of respondents knew that, if a doctor does not provide another doctor to a hospitalized patient during his absence is negligence.

In present study, 70.8% of respondents knew that if a patient has side effect of prescribed treatment, it is not negligence, but 21% of respondents were still believed that if a patient has a side effect of prescribed treatment, it is negligence. The general population is aware of medical maloccurrence, and there is not a 100% guarantee for a cure. But still some people don't think so; this type of attitude may be harmful to the medical profession.

We observed that 49.1% of respondents disagreed that, patient die during Operation, It is always due to negligence, but 48.7% were agreed with this. It means large numbers of people are not aware of the course of illness, risk of operation & anesthetic complications.

In present study, we observed that 77.4% of respondents agreed that, failure to maintain medical records by hospital is negligence while, 30.5% were

agreed and 27.4% were not sure upon that treating a patient without his consent is negligence.53.1% were agreed and 21.1% were not sure about that wrong diagnosis followed by wrong treatment is considered as negligence

(B) Knowledge of legal Proceeding regarding medical negligence

In the present study, 98.8% of respondents were aware that in suspected cases of negligence, you have to file complain in the concerned police station.

We observed that 50.5% of participants were agreed upon that postmortem is necessary in case of death due to medical negligence, while 34.8% were disagreed.

We observed that 94.5% of participants were agreed upon that death due to the negligence is punishable in court. Compensation may be given by consumer court for damage due to the negligent act, 74.4 % of participants were agreed with this statement. Still, 25.3% had no awareness about the consumer protection act. All participants believed and agreed upon that threaten or attack on a doctor is punishable in court even if doctor is truly negligent.

Overall knowledge about legal proceedings regarding medical negligence was not satisfactory. We have to arrange training sessions & seminars for the general population, lawyers and police.

Conclusion

Present study reflects that the knowledge of medical negligence in context to duties of doctors, consent, and gross absence of skill and due care is found to be satisfactory. We also conclude that knowledge is poor about legal proceedings regarding medical negligence. Medical professionals must obtain informed consent before any procedure and sensitize their patients about medical maloccurrence. We have to arrange seminars, awareness programs & training sessions regarding medical negligence & its legal proceedings for the practitioners, general population, lawyers and police.

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Original Research Article

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Acute Corrosive Acid Ingestion: A Case Series of Four Autopsies

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Abstract

Acute corrosive acid ingestion presents significant challenges in clinical and forensic pathology due to its severe and often fatal outcomes. This case series examines four autopsies involving fatal acid ingestion: three cases of hydrochloric acid (HCl) poisoning and one case of sulfuric acid (H_2SO_4) poisoning. Each case provides detailed autopsy findings, focusing on macroscopic and microscopic pathological changes. The first three cases of HCl poisoning revealed extensive tissue damage characterized by coagulative necrosis, particularly affecting the esophagus, stomach, and duodenum. Histological examination showed dense inflammatory infiltrate, submucosal edema, and significant hemorrhage, with patchy necrosis observed in the liver and kidneys. Pulmonary findings included alveolar edema and hemorrhage. The fourth case, involving H_2SO_4 ingestion, demonstrated more severe injuries with transmural necrosis and extensive hemorrhagic infiltration in the esophagus. The stomach exhibited full-thickness necrosis with a pronounced sulfurousodor, indicating severe chemical injury. Histopathological findings included extensive tissue dehydration and charring, with severe alveolar edema and hemorrhage in the lungs and extensive necrosis in the liver and kidneys. Comparative analysis of the histopathological changes highlighted the differences in tissue damage caused by these two acids. HCl primarily induced superficial necrosis with relatively preserved tissue architecture, while H_2SO_4 caused more extensive and deeper tissue damage due to its strong dehydrating and exothermic properties. Recognizing these differences is crucial for forensic pathologists in accurately diagnosing and differentiating cases of acid poisoning, ultimately enhancing diagnostic precision and clinical outcomes. This study underscores the severe and often fatal consequences of acute acid ingestion and aims to enhance the understanding of the pathological changes associated with such poisonings, thereby improving forensic and clinical evaluations.

Key words:

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Introduction

Corrosive acid ingestion, whether accidental or intentional, can cause significant morbidity and mortality. Corrosive acids, such as hydrochloric and sulfuric acid, are commonly encountered in household and industrial settings.[1] Their ingestion results in extensive tissue damage, leading to severe complications and often death. In India, acid ingestion is a notable cause of morbidity and mortality. The National Crime Records Bureau (NCRB) reported that in 2020, there were 833 deaths due to chemical poisoning in India, a category that includes acid ingestion (NCRB, 2021).[2] Hydrochloric acid (HCl) and sulfuric acid (H_2SO_4) are among the most common acids involved in these incidents due to their prevalent use in household cleaning products and industrial processes. These strong acids cause extensive tissue damage upon ingestion, leading to severe complications such as perforation of the gastrointestinal tract, peritonitis, and systemic toxicity. The pathological changes resulting from acid ingestion are profound, necessitating detailed forensic examinations to understand the extent of damage and the precise cause of death. This case series presents four autopsies to elucidate the pathological findings associated with fatal acid ingestion. The histopathological changes are discussed to offer insights into the mechanisms of injury and to aid forensic pathologists in identifying and differentiating between various types of acid poisoning.

Case Series:

Case 1: Hydrochloric Acid Poisoning

Patient Profile:

- **Age:** 45 years
- **Gender:** Male
- **Circumstances:** The deceased was found in his home with an open bottle of hydrochloric acid. A suicide note indicated intentional ingestion.

Autopsy Findings:

- **External Examination:** Severe corrosion and discoloration around the mouth and lips. Oral mucosa was extensively necrotic.
- **Internal Examination:**
  - **Esophagus:** Marked edema and necrosis with a distinct "yellow" discoloration extending down the esophageal tract.
  - **Stomach:** The gastric mucosa exhibited extensive black necrotic areas with perforation in the lower curvature. Gastric contents were dark brown with a pungent acidic smell.
  - **Duodenum:** The proximal part showed mild necrosis and ulceration.
  - **Lungs:** Edematous and congested, with areas of hemorrhage.
  - **Liver and Kidneys:** Congestion with focal necrosis.

Histopathological Findings:

- **Esophagus:** Coagulative necrosis with a dense inflammatory infiltrate.
- **Stomach:** Full-thickness necrosis of the mucosa with significant hemorrhage and ulceration. Granulocytic infiltration and thrombosed vessels were noted.
- **Duodenum:** Superficial necrosis with underlying inflammation.
- **Lungs:** Alveolar edema and hemorrhage.
- **Liver:** Centrilobular necrosis and congestion.

Case 2: Hydrochloric Acid Poisoning

Patient Profile:

- **Age:** 30 years
- **Gender:** Female
- **Circumstances:** Accidental ingestion while cleaning. Bottle labeled incorrectly.

Autopsy Findings:

- **External Examination:** Chemical burns around the lips and chin.
- **Internal Examination:**
  - **Esophagus:** Diffuse necrosis with areas of ulceration.
  - **Stomach:** Extensive blackening of the gastric mucosa with perforation.
  - **Duodenum:** Mild necrosis and edema.

- **Lungs:** Congestion and mild edema.
- **Liver and Kidneys:** Congested with no significant necrosis.

Histopathological Findings:

- **Esophagus:** Severe epithelial necrosis with submucosal edema and inflammation.
- **Stomach:** Necrotic mucosa with prominent hemorrhage and inflammatory cells.
- **Duodenum:** Surface necrosis with underlying edematous changes.
- **Lungs:** Mild alveolar edema and congestion.
- **Liver and Kidneys:** Mild congestion.

Case 3: Hydrochloric Acid Poisoning

Patient Profile:

- **Age:** 50 years
- **Gender:** Male
- **Circumstances:** Intentional ingestion following a family dispute.

Autopsy Findings:

- **External Examination:** Severe burns around the mouth, lips, and face.
- **Internal Examination:**
  - **Esophagus:** Transmural necrosis with hemorrhagic areas.
  - **Stomach:** Blackened mucosa with significant necrosis and perforation. Dark brown fluid in the gastric cavity.
  - **Duodenum:** Mild ulceration and necrosis.
  - **Lungs:** Severe congestion and focal hemorrhage.
  - **Liver and Kidneys:** Congestion and mild necrosis.

Histopathological Findings:

- **Esophagus:** Extensive necrosis with hemorrhage and inflammation.
- **Stomach:** Full-thickness necrosis, severe hemorrhage, and inflammatory cell infiltration.
- **Duodenum:** Surface necrosis and inflammatory changes.
- **Lungs:** Marked alveolar congestion and hemorrhage.
- **Liver and Kidneys:** Congestion and patchy necrosis.

Case 4: Sulfuric Acid Poisoning

Patient Profile:

- **Age:** 40 years
- **Gender:** Male
- **Circumstances:** Accidental ingestion at a workplace.

Autopsy Findings:

- **External Examination:** Extensive chemical burns on the face, neck, and chest.
- **Internal Examination:**
  - **Esophagus:** Severe necrosis and perforation.
  - **Stomach:** Blackened and perforated mucosa with a strong odor of sulfur. Gastric contents were dark brown and turbid.
  - **Duodenum:** Extensive necrosis and ulceration.
  - **Lungs:** Severe pulmonary edema and hemorrhage.
  - **Liver and Kidneys:** Severe congestion and extensive necrosis.

Histopathological Findings:

- **Esophagus:** Transmural necrosis with hemorrhagic infiltration.
- **Stomach:** Full-thickness necrosis, hemorrhage, and severe inflammation.
- **Duodenum:** Extensive necrosis and inflammatory infiltration.
- **Lungs:** Severe alveolar edema and hemorrhage.
- **Liver and Kidneys:** Severe congestion and extensive necrosis.

Comparative Analysis of Histopathological Findings:

Upon histological examination, the primary pathological changes observed in the cases of hydrochloric acid poisoning included:

- **Esophagus:** Coagulative necrosis, dense inflammatory infiltrate, submucosal edema.
- **Stomach:** Full-thickness mucosal necrosis, significant hemorrhage, inflammatory cell infiltration, thrombosed vessels.
- **Duodenum:** Mild to moderate necrosis, ulceration, edematous changes.
- **Lungs:** Alveolar edema and hemorrhage, with varying degrees of congestion.
- **Liver and Kidneys:** Congestion with focal necrosis.

In the case of sulfuric acid poisoning, the histopathological findings were more severe:

- **Esophagus:** Transmural necrosis with hemorrhagic infiltration.
- **Stomach:** Full-thickness necrosis, severe hemorrhage, strong inflammatory response, distinct sulfurousodor.
- **Duodenum:** Extensive necrosis and ulceration with a severe inflammatory response.
- **Lungs:** Severe alveolar edema and hemorrhage.
- **Liver and Kidneys:** Severe congestion and extensive necrosis.

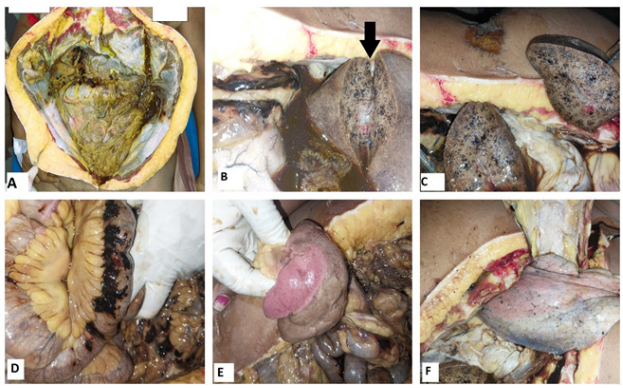

Figure 1: A. Gross appearance of the peritoneal cavity upon autopsy. B. Gross appearance of liver and fluid in the peritoneal cavity. C. Cut section of liver showing extensive necrosis. D. Extensive necrosis of the mesentery and intestine.E. Discoloration and necrosis of kidneys. F. Gross appearance of lungs.

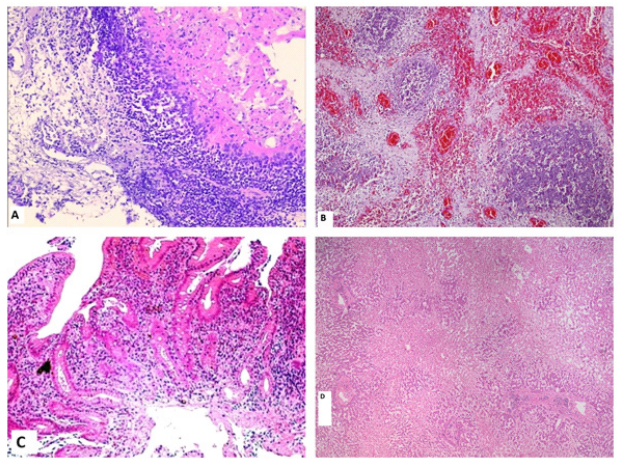

Figure 2: A. Esophagus showing coagulative necrosis with a dense inflammatory infiltrate. B. Stomach showing severe hemorrhage, inflammatory cell infiltration and necrosis. C. Duodenum showing surface necrosis and inflammatory changes. D. Liver showing extensive centrilobular necrosis and congestion.

Discussion

The pathological changes observed in acid ingestion cases primarily involve severe corrosive injury to the gastrointestinal tract, with subsequent systemic effects. Hydrochloric acid (HCl) typically causes coagulative necrosis, which preserves the basic tissue architecture while causing cellular destruction. This type of necrosis is characterized by the transformation of cells into a firm, opaque state due to protein denaturation. HCl is a strong acid with a high dissociation constant, leading to rapid proton release and subsequent damage to cellular proteins and membranes.[3]

In contrast, sulfuric acid (H_2SO_4) is a diprotic acid, meaning it can donate two protons, resulting in more extensive tissue damage. Sulfuric acid's corrosive properties are amplified by its strong dehydrating effect, which leads to severe tissue desiccation and charring. The dehydration caused by sulfuric acid exacerbates the necrotic process, leading to deeper and more extensive tissue destruction compared to HCl. Additionally, sulfuric acid's exothermic reaction when mixed with water can cause further thermal injury to tissues.[4]

The degree of necrosis and inflammation varies depending on the concentration and volume of acid

ingested, as well as the duration of exposure. Both acids cause significant damage to the esophagus and stomach, with potential for perforation leading to peritonitis. Secondary systemic effects, such as pulmonary edema and organ congestion, are common due to the systemic absorption of the acid and the resultant inflammatory response.[5]

When comparing the autopsy features of hydrochloric acid and sulfuric acid ingestion, several differences become apparent. In cases of hydrochloric acid ingestion, the external examination often reveals chemical burns around the mouth and lips, with the mucosal surfaces showing extensive necrosis. The esophagus typically exhibits coagulative necrosis with edema and a yellow discoloration. The stomach shows black necrotic areas with perforation, and the duodenum presents mild necrosis and ulceration. The lungs often show signs of edema and congestion, while the liver and kidneys display focal necrosis and congestion.[6]

Sulfuric acid ingestion, on the other hand, tends to produce more severe external and internal injuries. Externally, there are extensive chemical burns not only around the mouth but also potentially extending to the face, neck, and chest due to the acid's strong corrosive nature and potential for splashing. Internally, the esophagus shows severe transmural necrosis with hemorrhagic infiltration, indicating more extensive tissue penetration. The stomach displays full-thickness necrosis with a blackened and perforated mucosa and a strong sulfurousodor, a distinct feature of sulfuric acid. The duodenum also shows extensive necrosis and ulceration, reflecting the acid's potent corrosive effects. The lungs exhibit severe alveolar edema and hemorrhage, while the liver and kidneys present extensive congestion and necrosis.

The systemic effects observed in sulfuric acid cases are generally more pronounced due to the acid's higher propensity to cause extensive tissue dehydration and deeper necrotic damage. This leads to more significant systemic absorption and subsequent inflammatory response. Additionally, the thermal injury caused by the exothermic reaction of sulfuric acid with water adds another layer of complexity to the tissue damage, further differentiating it from hydrochloric acid poisoning.[7]

In summary, while both hydrochloric and sulfuric acids cause severe and often fatal injuries upon ingestion, the extent and nature of the tissue damage differ significantly. Hydrochloric acid primarily causes coagulative necrosis with superficial damage, while sulfuric acid results in more extensive and deeper tissue necrosis with severe dehydration effects. Recognizing these differences is crucial for forensic pathologists in accurately diagnosing and differentiating between these types of acid poisoning, ultimately enhancing forensic and clinical outcomes.

Conclusion

This case series underscores the severe and often fatal consequences of acute acid ingestion. Autopsy findings reveal distinct patterns of injury for hydrochloric and sulfuric acid, highlighting the importance of recognizing these differences in forensic medicine. Understanding the histopathological changes associated with acid ingestion can aid in the accurate diagnosis and differentiation of these cases, ultimately improving forensic and clinical outcomes.

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Authors' Contribution: All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Original Research Article

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Insights of Cardiac Changes in Sudden Deaths in Kalaburagi District: An Autopsy Study

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Abstract

Introduction: Sudden and unexpected death often arises as a complication of diverse cardiac ailments. The occurrence of sudden cardiac-related deaths is increasingly prevalent in both urban and rural settings. This surge presents a formidable challenge for forensic physicians tasked with conducting autopsies to ascertain the precise cause and manner of death, particularly in individuals previously considered healthy. Consequently, this study aims to shed light on infrequent lesions that may go unnoticed during the individual's lifetime, offering valuable insights into this phenomenon.

Aims and Objectives of the study: 1) To study the demographical profile of sudden cardiac death. 2) To study the histomorphological features of heart in sudden cardiac death. 3) To assess the histomorphology of atherosclerotic changes in aorta and coronary arteries of sudden cardiac death.

Materials and method: This is a retrospective study of 3 years from December 2020 to November 2023.The data of medicolegal autopsies was retrieved from the records of department of Pathology, Gulbarga Institute of Medical Sciences, Kalaburagi. A total of 371 medicolegal autopsy specimens were received in the department, of which the 114 cardiac specimens (sent with other organs) of sudden death were studied.

Results: Out of 114 cases of sudden death, 57% deaths occurred in outdoor location and remaining 43% occurred in hospitalized patients and homes. The commonest age group of sudden cardiac death was 31 to 40 years of age (27%). We found males were affected more commonly (84%) than females. The most common cause of sudden cardiac death is coronary artery disease (74.6%) followed by myocardial infarction (7.6%).

Conclusion: The most common cause of sudden cardiac death in young males (age group of 31-40 years) is coronary artery disease.

Keywords: Sudden cardiac death, Histomorphology, Atherosclerosis, Coronary artery disease.

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Introduction

Sudden death is defined by WHO as death within 24 hours from the onset of symptoms[1]. Although there may be both cardiac and extracardiac causes that contribute to sudden natural death (SND), most of the literature review revealed that the most common cause of sudden natural death is due to cardiovascular events resulting in Sudden Cardiac Death (SCD). The SCD is defined as instantaneous, electrically based cessation of cardiac output in individuals with otherwise uncompromised circulatory function[2].

Studies have shown that there is sudden surge in incidence and prevalence of sudden cardiac death all over the world in the last five decades. In India it is estimated that the prevalence rate of sudden cardiac death is 10.3% with increased prevalence in younger population[1]. Studies have shown that the most common cause of sudden cardiac death in India is due to unevaluated ischemic heart disease and increased prevalence of coronary risk factors associated with sudden cardiac death. Literature review roughly estimated that about 7 lakhs cases of sudden cardiac death occur in India annually[3].

Due to increased prevalence of sudden cardiac death cases, an attempt is made to study the cases of sudden cardiac death. Here autopsy plays an important role in documenting the etiology and to know the prevalence of sudden cardiac death cases. Hence it is essential to evaluate the cardiac specimens of sudden death in autopsy cases. The gross pathology alone cannot evaluate the cause of death. Hence the combined approach of gold standard histopathological examination with gross evaluation gives a conclusive opinion of cardiac pathology[4,5,6].

Hence giving importance to gross and histopathological examination of cardiac specimens in sudden deaths, the present study was undertaken to evaluate the prevalence of sudden cardiac death with following aims and objectives:

1. To study the demographical profile of sudden cardiac death.
2. To study the histomorphological features of heart in sudden cardiac death.
3. To assess the histomorphology of atherosclerotic changes in aorta and coronary arteries of sudden cardiac death.

Materials and methods

The present study is a retrospective cross-sectional study carried for a period of three years from December 2020 to November 2023 in the Department of Pathology, Gulbarga Institute of Medical Sciences, Kalaburagi. Institutional ethical clearance was taken for the study with clearance number- ECR/1410/Inst/KA/2020

Method of collection of samples:

The data of sudden death autopsies were retrieved from the institutional records. The gross and histopathological features of heart in sudden death cases were noted. All the heart specimens were weighed, inspected grossly and fixed in formalin. The heart was dissected initially by inflow-outflow method followed by short axis method. For histopathological examination, sections were taken from the right and left coronaries including two major branches left anterior descending and left circumflex artery of left coronary artery, right and left ventricular wall, atrioventricular junction, valves and aorta. Multiple sections of 3-4mm were cut, processed to paraffin blocks. Section of 4 microns thickness were cut and stained with hematoxylin and eosin for histomorphological evaluation.

Histopathological grading of coronary atherosclerosis was done using Modified American Heart Association Classification of Atherosclerotic Lesion[7].

Inclusion criteria:

Whole cardiac specimens of cases of sudden death received in the Pathology department, GIMS, Kalaburagi during the study period.

Exclusion criteria:

1. Core biopsy/portion/part of cardiac specimens of sudden death.
2. Cardiac specimens of other causes of death.
3. Autolyzed specimens.

Statistical analysis:

Data was entered in Microsoft Excel spreadsheet and analyzed using SPSS software version 16. Results are analyzed and expressed in the form of mean and percentage.

Results

A total of 371 autopsy specimens were received in our department. Out of which 114 cardiac specimens of sudden death were studied accounting to 30.7% of the total cases. Among the cases of sudden death, outdoor deaths accounted for 66 cases (57%) (Table 1). The most common age group involved was 31-40 years in 30 cases (27%) with male preponderance accounting for 96 cases (84%) (Table 2 & 3). Of 114 cases of sudden death, cardiac causes of sudden death accounted for 100 cases (87.7%) and the rest 14 cases showed normal morphology of the heart.

In the current study most common cause of sudden death due to cardiac pathology noted was atherosclerosis accounting to 74.6% of the cases(Figure 1, 2 &3) followed by myocardial infarction in 7.6% (Table 4). Majority of the cases showed three vessels involvement accounting for 77% of the cases (Table 5 & 6) with grade 1 as per Modified American Heart Association Classification of Atherosclerotic Lesion (Figure 4 & 5) accounting for 26.8% of the cases (Table 7). Other pathologies seen in the heart were cardiomyopathies(Figure 6), myocarditis and valvular disease.

Table 1: Deaths at different location

Location	No. of cases	Percentage
Outdoor	66	57%
Indoor	48	43%

Table 2: Age wise distribution

Age (yrs)	No.of cases	%
0-10	7	6%
11-20	16	14%
21-30	20	17%
31-40	30	27%
41-50	18	16%
51-60	18	4%
61-70	5	4%

Table 3: Gender wise distribution

Gender	No.of cases	Percentage
Males	96	84%
Females	18	16%

Table 4: Histopathological findings

Causes	No.of cases	Percentage
1)Atherosclerosis	97	74.6%
2)Cardiomyopathy	13	9.9%
a)Hypertrophic.	7	5.3%
b)Alcoholic	6	4.6%
3)Myocardial infacrtion	10	7.6%
4)Myocarditis	9	6.9%
5)Valvular disease	1	0.76%

Table 5: No. of coronaries involved

No. of vessels involved	No. of cases	Percentage
1)Three	49	77%
2)Two	9	14%
3)One	5	9%

Table 6: Distribution of atherosclerosis in coronary arteries.

Coronary arteries	No. of cases	Percentage
LCA	42	66.8%
LADA	16	25.3%
RCA	5	7.9%

Table 7: Modified American Heart Association Classification of Atherosclerotic Lesion

Grades	Microscopy	No. of cases	Percentage
Grade 1	Fatty streaks	26	26.8%
Grade 2	Fatty streaks with multiple foam cells	7	7.2%
Grade 3	Extracellular lipid pool	3	3.09%
Grade 4	Atheroma	21	21.6%
Grade 5	Fibroatheroma	17	17.5%
Grade 6	Complex plaques	9	9.27%
Grade 7	Calcified plaques	14	14.4%

Fig 1: Right coronary artery showing narrowing of lumen

Fig 2: Aorta showing fatty streaks

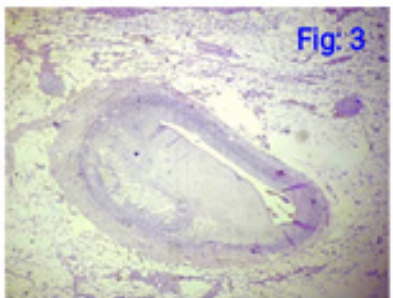

Fig 3: Right coronary artery showing atherosclerotic plaque (10x, H&E)

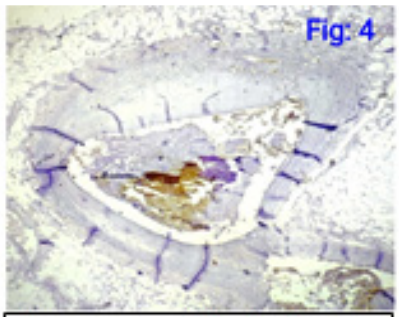

Fig 4: coronary artery showing thrombus (10x, H&E)

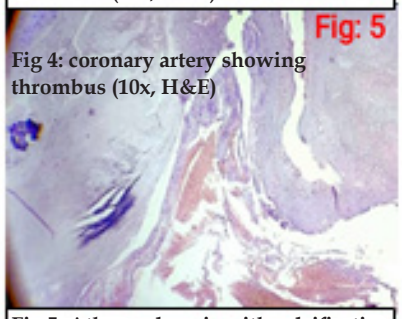

Fig 4: coronary artery showing thrombus (10x, H&E)

Fig 5: Atherosclerosis with calcification (20x, H&E)

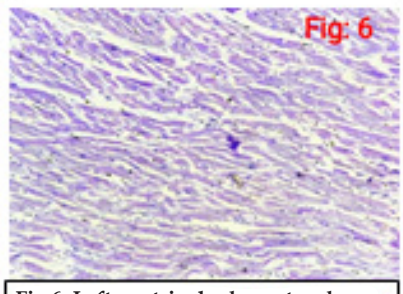

Fig 6: Left ventricular hypertrophy showing thick muscle fibres with enlarged dark nuclei. (40x, H&E)

Discussion

Sudden cardiac death is a catastrophic event that has huge adverse impact on health care system. It constitutes 5.6% of the total mortality and about 1/5th of all the cardiovascular deaths[3]. Literature review have shown that there are various causes of sudden cardiac death that include functional, structural, molecular and mechanical factors involved[2]. The recent literature search revealed that increased incidence of sudden cardiac death is among coronary artery diseases leading to unevaluated ischemic heart disease. It is roughly estimated that annually about 7 lakhs of sudden cardiac death cases occur in India[3].

In our study most of the cases of sudden cardiac death occurred in outdoor location accounting for 57% of the cases and our findings are consistent with studies done by Dinesh R[8] et al, Dinesh S R[9] et al and Mothakapalli J T[10] et al. In the present study majority of the cases of sudden cardiac death occurred among individuals between 31-40 years of age. Our findings showed younger age group predilection compared to studies done by Singal P[1] et al, Nisha M[11]et al and Patil A[12] et al, who showed higher predilection in decade later (40-50 years). Majority of the cases in our study of sudden cardiac death occurred in males and our findings are in concordance with studies done by Singal P[1] et al, Nisha M[11] et al, Patil A[12] et al and Joshi C[13] et al.

We observed that most common histomorphological findings is coronary artery disease showing atherosclerosis accounting for 74.6% of the cases. Similar findings were seen in studies by Nisha M[11] et al, Singal P[1] et al, Dinesh R[8] et al, Patil A[12] et al and Mothahapalli J T[10] et al. In majority of the cases the secondary changes in atherosclerosis observed was calcification accounting to 19% of the cases and our findings are in concordance with Nisha M[11], Signal P[1] et al and Patil A[12]et al study. In coronary atherosclerosis we observed three vessel involvement i.e. left anterior descending artery, left circumflex artery and right coronary artery accounting for 77% of the cases. Our findings are in concordance with Nisha M[11] et al study and Patil A[12] et al study in contrast to single vessel involvement in Signal P[1] et al study.

The next common histomorphological lesion observed in our study was cardiomyopathy accounting for 9.9% of the cases. Similar results were reported in studies done by Singal P et al, Ozdemir B[13] et al, Joshi C[14] et al and Karanfil R[15] et al. Other histomorphological findings in cardiac specimens were myocardial infarction followed by myocarditis and valvular diseases accounting for 7.6%, 6.9% and 0.76% respectively. Majority of the findings in our study could be attributed to various causes like severe left ventricular dysfunction, absence of reperfusion and revascularization or poor adherence to medications or due to lack of health awareness.

Burden of sudden cardiac death showed wide geographical heterogeneity with both clinical and nonclinical cases of coronary artery disease. As our study revealed cardiac diseases in younger population, they are the target groups to be focused for health care awareness. Our study has highlighted that most causes of sudden cardiac death was due to unevaluated ischemic heart diseases and with increased prevalence of coronary risk factors.

Conclusion

The present study revealed that sudden death due to cardiac causes is prevalent among young individuals, particularly in the age range of 31-40 years, and often occurs in outdoor locations. The most frequent histopathological lesion observed was atherosclerosis, frequently involving all three vessels, followed by cardiomyopathies and myocardial infarction. These findings signify the vulnerability of the young population to sudden cardiac events and emphasize the importance of targeting them for preventive measures and health awareness initiatives. By focusing on this high-risk group, efforts can be directed towards reducing the incidence and prevalence of sudden cardiac death through timely interventions, lifestyle modifications, and heightened awareness of cardiovascular health.

Limitations of this Study:

Our study has highlighted only non arrhythmic causes of sudden cardiac death and is lacking information regarding arrhythmic causes of sudden cardiac death. The arrhythmogenic causes of sudden cardiac death that include functional, mechanical and molecular causes were not evaluated in this classification of sudden cardiac deaths. Since our

study was retrospective, the above-mentioned limitations were beyond our control.

Conflict of interest: None

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Original Research Article

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To Evaluate the Histomorphological Changes of Postmortem Transthoracic Needle Biopsy/Autopsy Lung in COVID-19 Patients

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Abstract

Objective: To study the histomorphological changes in postmortem needle biopsy/autopsy lung in COVID-19 Patients.

Study Design: This was an observational study done at Shri Atal Bihari Vajpayee Medical College & Research Institute, Bengaluru, and Karnataka from March 2021 to May 2021.

Methodology: A total of 30 patients who died of Covid-19 were included and all of them were diagnosed to be Covid -19 positive by RT-PCR testing. Post-mortem transthoracic needle biopsy was done to obtain lung tissue by using B-Bard biopsy gun in midaxillary approach. The biopsy samples were grossed and processed after fixing for 48hrs. The slides obtained were stained by routine hematoxylin and eosin stain, studied for morphology of the lung tissue and findings were recorded.

Results: We obtained consent for post-mortem transthoracic needle biopsy/autopsy of lung in 30 deceased cases. All these cases were positive for SARS –COV2 on RT-PCR. The age of the cases was ranging from 26-72 years and median age is 53years, males (63.3%) were affected more than females (36.7%). Most deceased had comorbidities, among them diabetes mellitus (26.6%) and hypertension (26.6%) were most common.

Lung biopsy samples were taken from 30 deceased patients. Histomorphological feature of diffuse alveolar damage was seen in 90% (27 out of 30) cases. Other findings noted on microscopy were chronic interstitial inflammation in 6.7% cases, pulmonary edema (3.33%), intra alveolar haemorrhage (3.33%) and viral cytopathic changes (3.33%).

Conclusion: This study highlighted the pulmonary morphological changes which are most prominent in COVID-19 infections, but it was a difficult to ascertain that the findings are related to viral infection or due to associated coomorbidities.

Keywords: COVID-19, transthoracic needle biopsy, diffuse alveolar damage, viral cytopathic changes.

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Introduction

In December 2019, Covid -19 began in China in Wuhan district and then it expanded world wide as a pandemic disease. The first case of covid-19, caused by SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) was recorded on 30th January 2020 in our country[1]. SARS-CoV-2 is a single-stranded, enveloped RNA virus that belongs to the family of Coronaviridae and the order Nidovirales[2]. They cause respiratory illnesses in humans and other animals[3].

It primarily causes respiratory symptoms which vary from asymptomatic, mild influenza-like illness, severe pneumonia or to acute respiratory distress syndrome (ARDS) but occasionally neurologic, hepatic, and enteric symptoms have also been noticed that could be due to the involvement of other organs. The complications like arrhythmias, acute kidney injury and coagulopathy are also documented due to involvement of heart, kidneys and liver. This may be the cause for multiorgan failure and death[4] accounting to 7% case fatality[1]. The underlying pathology is still unclear.

Transthoracic needle biopsy is an acceptable and effective technique in alternative to autopsy. Studies done on this autopsy/needle biopsy finding in Covid-19 lung were diffuse alveolar damage, hyaline membrane formation, capillary congestion and platelet fibrin thrombi are the frequent findings noted[5]. This type of studies is helpful to understand in depth the pathogenesis and pathological changes. Hence this study is undertaken to understand and evaluate clinical and histomophological changes in lung of deceased patients due to SARS-CoV-2 infection.

Methodology

This was an observational study done at Shri Atal Bihari Vajpayee Medical College & Research Institute, Bengaluru, and Karnataka from March 2021 to May 2021. A total of 30 patients who died of Covid-19 were included and all of them were diagnosed to be Covid -19 positive by RT-PCR testing. Consent for the procedure tissue sampling (post mortem) was obtained from the next of kin as per guidelines. The study was approved by the Institutional Ethical Committee (Ref No: IEC/ APR/047/2021-2022).

Demographic data regarding age, sex, occupation, address and contact history were recorded. Relevant clinical data including chief complaints, physical examination findings, course in the hospital stay, laboratory and radiological investigations, treatment received in the hospital along with the probable cause of death were recorded.

Post-mortem transthoracic needle biopsy was done to obtain lung tissue by using B-Bard biopsy gun in midaxillary approach. The gun was introduced to obtain a 1-3cm sized tissue core/s. 3-4 biopsy specimens were collected by using the same site of insertion. The samples were transported to the lab by following Covid -19 guidelines on the same day at room temperature.

The biopsy samples were grossed after fixing for 48 hrs. Paraffin embedded blocks were prepared and slides obtained were stained by routine hematoxylin and eosin stain, studied by for morphology of the lung tissue and findings were recorded.

Results

We obtained consent for post-mortem transthoracic needle biopsy/autopsy of lung in 30 deceased cases. All these cases were positive for SARS –COV2 on RT-PCR. The age of the cases was ranging from 26-72 years and median age is 53years, males (63.3%) were affected more than females (36.7%). Most deceased had comorbidities, among them diabetes mellitus (26.6%) and hypertension (26.6%) were more common. (Table 1)

The deceased cases had presented with the symptoms of fever, cough, shortness of breath and diarrhea. 12 (40%) of the patients presented to hospital with severe acute respiratory illness (SARI) and all of them needed therapeutic oxygen at presentation (table 3). The mean duration of hospital stay was 10 days (ranged between 12hrs to 30 days), among them 36.67% of patients were on invasive ventilation.

On investigations, (table-2), anemia was seen in 82.14% of deceased cases, lymphopenia in 42.86%, thrombocytopenia in 32.14% and coagulopathy in 28.57% of them. Elevated inflammatory markers like C-reactive protein, IL-6, ferritin or D-dimer were seen in 84.6% of deceased patients. Typical findings of COVID-19 on chest radiograph were noted in

41.67%. As per the institutional covid-19 treatment protocol was followed for the patient management. All patients had one or more complications, and the most common were respiratory failure, Secondary infections, sepsis and coagulopathy.

Histopathology findings (Table 4):

Lung biopsy samples were taken from 30 deceased patients (Figure 2). Histomorphological feature of diffuse alveolar damage was seen in 90% (27 out of 30) cases.

In 66.7% of cases, exudative phase of diffuse alveolar disease was noted. It is characterized by interstitial edema with mild congestion, loss of type I pneumocytes and deposition of bright eosinophilic hyaline membrane in alveoli along the alveolar lining was seen in 17% of cases (05 out of 30). Sometimes fibrin balls with in the alveoli, hemorrhage, pulmonary edema bronchopneumonia and organizing pneumonia features were also coexisted in some cases (in 4 cases).

In proliferative phase of diffuse alveolar disease, 26.7% histopathological findings noted were like loose fibroblastic plugs and early interstitial fibrosis. Some cases showed reactive hyperplastic pneumocytes.

Other findings noted on microscopy were chronic interstitial inflammation characterised by lymphocytic infiltrate in 6.7% cases, pulmonary edema (3.33%), intra alveolar haemorrhage (3.33%) and viral cytopathic changes (3.33%).

Vascular changes like congested blood vessels were noted but none of the cases showed microthrombi even though the inflammatory markers like D-dimer levels are elevated.

Table 1: Clinical details at presentation to hospital

Sl no	Age	Sex	Comorbidity	Symptoms			Vitals		
				SARI	Respiratory symptoms (not SARI)	Non Respiratory symptoms	MAP <65mm/Hg	Hypoxemia SpO2<94%	RR ≥30/min
1	M	62	T2DM	+	-	-	+	+	+
2	M	70	Hypertension	+	-	-	+	+	+
3	F	31	-	-	+	-	-	-	+
4	M	58	-	-	+	-	-	-	+
5	M	65	T2DM	+	-	-	+	+	+
6	M	39	-	-	+	-	-	-	+
7	M	42	-	+	-	-	-	+	+
8	M	53	Hypertension	+	-	-	+	+	+
9	M	62	T2DM	-	+	-	-	+	+
10	F	72	T2DM, Hypertension	+	-	-	-	+	-
11	M	68	Alcoholic liver disease, T2DM	+	-	-	-	+	-
12	F	62	Post pulmonary Tuberculosis	-	+	-	-	+	+
13	M	70	Known Parkinsonism	-	+	-	-	+	+
14	M	46	-	-	-	+	-	+	+
15	F	55	T2DM, Hypertension	+	-	-	+	+	+
16	F	43	Hypothyroidism	-	+	-	+	+	-
17	M	45	-	-	+	-	-	+	-

Continue.....

18	F	38	-	-	-	+	+	+	+
19	F	65	Hypertension	-	+	-	+	-	-
20	M	58	-	-	-	+	-	+	-
21	M	54	T2DM, Hypertension	+	-	-	+	+	-
22	M	55	-	-	-	+	-	+	-
23	M	50	Hypertension	-	+	-	-	+	+
24	F	48	Hypothyroidism	-	-	+	-	+	-
25	M	49	Alcoholic liver disease	+	-	-	-	+	+
26	M	70	Hypertension, Chronic kidney disease	+	-	-	+	+	+
27	F	26	-	-	-	+	-	+	-
28	F	65	T2DM	+	-	-	-	+	+
29	F	45	-	-	+	-	-	+	-
30	M	43	-	-	+	-	+	+	+

Table 2: Laboratory findings in deceased cases

Laboratory parameters:	
Anaemia	23/28 (82.14%)
Lymphopenia (ALC<1000)	12/28(42.86%)
Thrombocytopenia (<100,000mm^3)	09/28 (32.14%)
Coagulopathy	8/28 (28.57%)
Renal dysfunction	11/28 (39.28%)
Hyperbilirubinemia	5/28(17.86%)
Metabolic acidosis	2/12(16.67%)
Elevated inflammatory markers (C-reactive protein, IL-6, ferritin or D-dimer)	22/26 (84.6%)
Chest Radiograph:	
Abnormal Chest radiograph	20/24 (83.3%)
Typical COVID findings (peripheral-predominant lower lobe opacities)	10/24 (41.67%)
Area involved >50%	10/24 (41.67%)

Table 3: Management given at admission

Management (given at admission)	
Supplemental oxygen	12/30 (43.3%)
Non-invasive ventilation	5/30 (16.67%)
Mechanical ventilation	11/30 (36.67%)

Table 4: Clinical and histomorphological diagnosis in transthoracic needle lung biopsies.

Sl no	Age	Sex	Comorbidity	Clinical diagnosis	Histomorphological diagnosis on lung
1	62	M	T2DM	Acute Respiratory distress syndrome with Pneumonia	DAD (exudative phase)
2	M	70	Hypertension	Acute Respiratory distress syndrome	Chronic interstitial inflammation
3	F	31	-	Acute Respiratory distress syndrome with Type I respiratory failure	Chronic interstitial inflammation
4	M	58	-	Acute Respiratory distress Syndrome	DAD (exudative phase)
5	M	65	T2DM	Acute Respiratory distress syndrome	DAD (exudative phase)
6	M	39	-	Acute Respiratory distress syndrome with pneumonia	DAD (exudative phase)
7	M	42	-	Acute Respiratory distress syndrome	DAD (exudative phase)
8	M	53	Hypertension	Acute Respiratory distress syndrome	DAD (exudative phase)
9	M	62	T2DM	Acute Respiratory distress syndrome, Acute kidney injury	DAD (exudative phase)
10	F	72	T2DM, Hypertension	Acute respiratory distress syndrome	DAD (proliferative phase)
11	M	68	Chronic liver disease, T2DM	Acute respiratory distress syndrome	DAD (exudative phase)
12	F	62	Post pulmonary Tuberculosis	Acute respiratory distress syndrome	DAD (proliferative phase)
13	M	70	Known Parkinsonism	Acute respiratory distress syndrome with pneumonia	DAD (proliferative phase) with organizing pneumonia
14	M	46	-	Acute respiratory distress syndrome	DAD (exudative phase) with hyaline membrane
15	F	55	T2DM, Hypertension	Acute respiratory distress syndrome, lower respiratory tract infection	Lung: DAD (proliferative phase)

Continue.....

16	F	43	Hypothyroidism	Lower respiratory tract infection with sepsis and septic shock.	DAD (exudative phase) with hyaline membrane.
17	M	45	-	lower respiratory tract infection, acute kidney injury	DAD in exudative phase with hyaline membrane
18	F	38	-	Acute respiratory distress syndrome	DAD in proliferative phase
19	F	65	Hypertension	Acute respiratory distress syndrome	DAD (proliferative phase)
20	M	58	-	Acute respiratory distress syndrome	DAD in exudative phase with hyaline membrane
21	M	54	T2DM, Hypertension	Acute respiratory distress syndrome with pneumonia and ventricular arrhythmias	DAD (exudative phase) with acute bronchopneumonia
22	M	55	-	Acute respiratory distress syndrome and ventricular arrhythmias	DAD in exudative phase
23	M	50	Hypertension	Acute respiratory distress syndrome	DAD in proliferative phase with organizing pneumonia
24	F	48	Hypothyroidism	Acute respiratory distress syndrome with type II respiratory failure	DAD in exudative phase with hyaline membrane
25	M	49	Alcoholic liver disease	Acute respiratory distress syndrome	DAD in exudative phase
26	M	70	Hypertension, Chronic kidney disease	Acute respiratory distress syndrome	DAD in exudative phase with pulmonary oedema
27	F	26	-	Acute respiratory distress syndrome	Acute organising pneumonia with alveolar haemorrhage
28	F	65	T2DM, chronic kidney disease	Hypertension, Diabetes, Chronic kidney disease on maintenance haemodialysis	DAD in exudative phase
29	F	45	-	Acute respiratory distress syndrome	DAD in exudative phase with Acute organising Pneumonia
30	M	43	-	Lower respiratory tract infection, Acute bacterial meningitis, sepsis with septic shock, acute kidney injury	DAD in proliferative phase

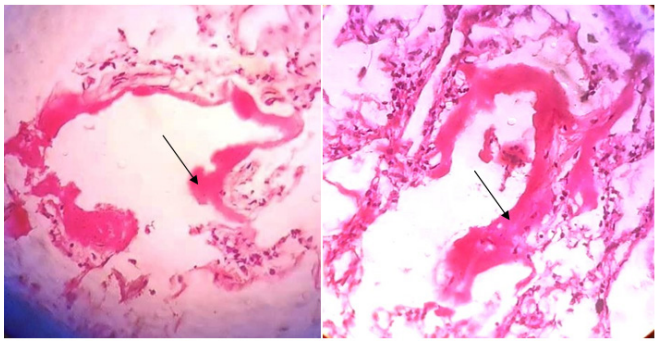

Fig 1: shows pink eosinophilic hyaline membrane formation (arrow)

Discussion

Minimally invasive technique like postmortem transthoracic needle biopsy/autopsy is a simple method of performing postmortem sampling. It is a more acceptable and less time consuming effective autopsy procedure [6,7,8]. In order to prevent risks associated COVID-19, this method was followed to study the morphological changes in COVID-19 infection.

In our study, transthoracic post-mortem biopsy samples from lung of 30 deceased patients were obtained to study the morbid pathological changes in COVID-19 patients.

The typical histopathological findings noted in Covid-19 biopsy are epithelial/alveolar [3,9], vascular [3,9], fibrotic [10] and ultrastructural changes [9].

The common epithelial/alveolar changes described are diffuse alveolar damage, hyaline membrane formation, pneumocytes hyperplasia, presence of syncytial giant cells and prominent nucleoli characteristic of viral cytopathic-like changes [5,9].

The vascular changes described include capillary congestion, alveolar hemorrhage [3], thrombosis of micro-vessels [9] and peri or intravascular inflammatory infiltrates [3].

In the present study also noted intra-alveolar hemorrhage and capillary congestion, but no thrombi identified in microvasculature.

In our study, similar findings were noted, but among them Diffuse Alveolar Damage in the acute exudative phase and organizing phase were common.

The fibrotic changes like interstitial fibrosis and microcystic honeycombing [3] were noted. Other changes like interstitial and intra-alveolar inflammatory infiltrate[3] predominantly of lymphocytes and monocytes and increased stromal cells[9]. In our series, the common changes seen were predominantly interstitial edema and congestion. Others findings noted are like loose fibroblastic plugs, interstitial fibrosis and chronic interstitial inflammation.

In our study ultrastructural changes were not studied.

In patients with ARDS, the characteristic pathological findings noted in the lungs were different with time and described as acute, subacute and chronic phases. In the early phase, i.e. before 6 days of onset, Diffuse Alveolar Damage (exudative) changes are common followed by progresses to subacute phase, (i.e. between 7-14 days) where the lung changes transits to organizing phase.

In our study most of the patients hospital stay before death was less than 14 days, this explains the predominance of Diffuse Alveolar Damage features.

In some cases, bronchopneumonia was noted but no bacterial colonies/neutrophilic infiltrate noted. This could be due to viral infection itself.

The vascular changes like congestion was noted but none of the cases showed microthrombi, when compared to other cases reported [13, 1]. This could be due to early and regular initiation of anticoagulants as a part of national policy [14] or due to genetic variation [15] or due to error during sampling.

Conclusion

This study highlighted the pulmonary morphological changes which are most prominent in COVID-19 infections, but it was a difficult to ascertain that the findings are related to viral infection or due to associated coomorbidities. However, like previous studies this study also demonstrated that the diffuse alveolar disease is a most common cause for the death of COVID-19 infected patients.

Ethical Clearance: The study was approved by the Institutional Ethical Committee (Ref No: IEC/APR/047/2021-2022).

Conflict of Interest: We have no conflicts of interest to disclose.

All authors declare that they have no conflicts of interest.

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Original Research Article

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Pattern and Distribution of Gross Atherosclerotic changes in the Cerebral Arteries, Coronary Arteries, and Aorta in Persons above the Age of 30 years in North Kerala: An Autopsy-Based Study

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Abstract

Background: Cardiovascular disease (CVD) has emerged as a pervasive source of illness and a prominent factor in death rates throughout the majority of nations. Atherosclerosis has been identified as the primary cause of this global health concern.

Methods: 150 cases older than 30 years were subjected to medicolegal autopsy in the Department of Forensic Medicine, Government Medical College, Kannur. During a medicolegal autopsy, while dissecting the aorta, coronary arteries and cerebral arteries; gross macroscopic changes brought on by atherosclerosis were examined and documented.

Results: The study group consisted primarily of males (62.7%) with an average age of 46.90±16.34 years. Nearly half of them were in their fourth and fifth decades of life. A total of 67 instances were diagnosed with atherosclerosis, with 22 of them falling within the age range of 40 to 49 years. 79 percent of these incidents involved males.

Conclusion: Atherosclerosis is becoming increasingly recognized as the primary cause of around one-third of all fatalities in India. Conducting a study on atherosclerosis in living individuals is challenging, as it requires invasive and costly procedures. This is particularly true in underdeveloped nations. Therefore, autopsies are crucial for documenting the occurrence of atherosclerosis in the population. This study will assist doctors in evaluating the overall arterial health of patients and developing therapeutic protocols and courses of treatment. Additionally, it will aid forensic pathologists in determining the cause of death in cases of sudden death.

Key words: autopsy, atherosclerosis, aorta, coronary artery, cerebral artery, occlusion.

Introduction

Cardiovascular disease is a leading cause of mortality worldwide. In 2019, around 17.9 million individuals succumbed to cardiovascular illnesses, accounting for approximately 32 percent of global mortality. Approximately 85% of these deaths were

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attributed to myocardial infarction and stroke. More than 75% of deaths related to cardiovascular diseases occur in low- and middle-income nations, such as India. Early identification of cardiovascular disorders is crucial for preventing severe health complications [1].

Coronary atherosclerosis is the primary factor responsible for ischemic heart disease. Atherosclerosis mostly impacts the elastic, big, and medium-sized muscle arteries. The fundamental abnormality that defines atherosclerosis is the presence of an atheroma or fibrofatty plaque. Atheroma causes blockage of blood flow in small blood vessels, leading to ischemic damage to organs such as the heart (for example, myocardial infarction). Unlike the small arteries, atheroma weakens the walls of larger arteries and leads to the destruction of their walls, which can result in catastrophic occurrences such as aneurysms, ruptures, and thrombosis [2].

Coronary atherosclerosis can advance clinically in an asymptomatic manner. An abrupt arrhythmia that may lead to sudden death is often the first sign of ischemic heart disease. Coronary atherosclerosis is the most prevalent underlying disease associated with sudden mortality [3].

Furthermore, it is said that 50% of patients who experience sudden death from ischemic heart disease are unaware of their underlying cardiovascular condition. The quantitative data of this nature underscores the significance of prioritizing prevention over treatment of established diseases in order to achieve substantial reductions in mortality [4].

In the Framingham study, the ratio of males to females in the age category of 35–44 years was 6.8 to 1. However, in the age group of 75–84, the frequency was equal between both sexes. Although the condition is less common in females, once it appears, it tends to progress more aggressively [5].

Individuals who have experienced a stroke are at a heightened risk of experiencing another stroke, myocardial infarction, or death [6]. An autopsy is a valuable tool for evaluating pathologies that are challenging to assess in living individuals [7]. Studying atherosclerosis in living humans is difficult due to the need for invasive and expensive procedures. This is especially accurate in less developed nations. Autopsies have a vital role in identifying the prevalence of atherosclerosis in the population [8]. Prior to this, only a limited number of studies had been undertaken to assess the pattern and distribution of gross atherosclerotic changes in the coronary arteries, cerebral arteries, and aorta during autopsy. Considering these facts, this study evaluating the pattern and distribution of gross atherosclerotic changes in coronary arteries, cerebral arteries, and aorta will help clinicians in assessing the general arterial health of the patients and also in formulating the treatment protocol and course of treatment. It will also help forensic pathologists arrive at the cause of death in sudden death cases.

OBJECTIVE

To evaluate the pattern and distribution of gross atherosclerotic changes in the cerebral arteries, coronary arteries and aorta in persons above the age of 30 years in north Kerala, based on autopsy findings.

Materials and Methods

One hundred and fifty random cases above 30 years old brought for medico-legal autopsy in the mortuary of the Department of Forensic Medicine, Govt. Medical College, Kannur, from june 2022 to april 2023, were included in the study.

The study received ethical approval from the Institute's Ethics Committee.

Inclusion criteria

1. Age more than 30 years, including both sexes.
2. Permanent residents in the Kannur and Kasaragod districts of Kerala.

Exclusion criteria

1. Decomposed bodies.
2. Mutilated bodies.

Procedure

This study comprised cases that met the selection criteria and were brought in for medicolegal autopsy. Demographic information, such as age, gender, and occupation, is documented. Additionally, measurements of length, weight, and the apparent cause of death were recorded. Subsequently, a medicolegal autopsy was conducted utilizing the M. Letulle Technique.

The aorta, coronary arteries, and cerebral arteries (as represented by the circle of willis) were grossly examined. The aorta was assessed for wall thickness, the existence and characteristics of atheromatous lesions, such as fatty streaks, and the presence and extent of calcification. The walls of the coronary arteries, specifically the Left Main Stem (LMCA), Left Anterior Descending (LAD), Left Circumflex (LCx), and Right Coronary Artery (RCA), were assessed for the presence of wall thickening. Both the anterior and posterior surfaces of the heart were thoroughly investigated to do these tasks. The coronary arteries and cerebral arteries are examined by cross-sectioning followed by lengthwise opening.

During the medicolegal autopsy, during the longitudinal dissection of the aorta, the extent of atherosclerosis in the aorta was assessed by visually estimating the proportion of the specimen's surface that was impacted by any kind of atherosclerosis. Subsequently, the extent of atherosclerosis involvement in the various types of atherosclerotic lesions (lipid streak and fatty plaque; fibrous plaque; complex lesions; calcification) was assessed individually. The grading system utilized four categories: "none," "some but less than 1/3," "1/3 to 2/3," and "more than 2/3".

During the evaluation of coronary and cerebral arteries (as represented by the circle of willis), the extent of atherosclerosis in each specimen was determined visually by analyzing the proportion of sections where any form of atherosclerosis was observed. The assessment was based on three categories: "none or some to less than 1/3," "1/3 to 2/3," and "more than 2/3." The extent of narrowing was assessed in the segment displaying the most severe narrowing in each sample. A standard diagram was referenced. The units were categorized as follows: "no narrowing," "some but less than 1/2 occlusion," "1/2 or more but less than pinhole," "pinhole," "occlusion by thrombus," and "occlusion not by thrombus." The categorization of constrictions in each artery was classified as follows: "absent" for no narrowing, "solitary" if observed in only one portion, and "multiple or prolonged" if observed in more than one region. The data will be tabulated and analyzed using appropriate statistical tools. Digital photographs were taken and magnified for clarity in doubtful cases.

Results

The cases were categorised into age groups based on the age at the time of death. Among the one hundred and fifty instances analysed in the study, the highest proportion of cases (32.5%) were observed in individuals in their fourth decade of life, followed by the fifth decade (23.6%) and the sixth decade (19.8%). Out of the instances that met the specified criteria, the most common reason for death was Road Traffic Accident (RTA) in 77 (51.3%) cases, followed by hanging and drowning in 36 (24%) and 26 (17.3%) cases respectively.

Among the 150 cases examined, 67 cases exhibited varying degrees of atherosclerosis, with 58 cases being males and 9 cases being females [Figure 1 and 2]. The overall incidence of atherosclerosis was 44.7%. In our study, the presence of atheroma was observed in individuals over the age of 30. However, a notable increase in the occurrence and severity of atheroma was observed starting from the fifth decade of life and continuing until the ninth decade. Out of a total of 67 atheromas, 38 (56.7%) were fibroatheromas, 14 (20.9%) were fatty streaked atheromas, 10 (14.9%) were atheromas with prominent calcification, and 2 (3%) were preatheromas with minimal features of atheroma, fibroatheroma with haemorrhage and thrombosis, and fibroplaque atheromas, respectively.

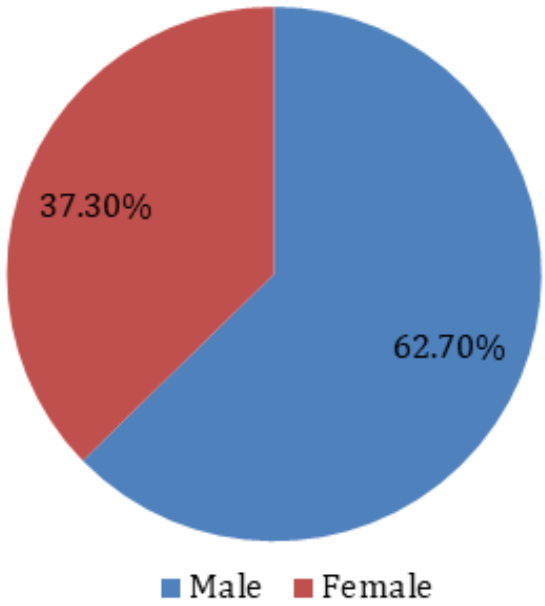

Figure 1: Sex distribution of victims

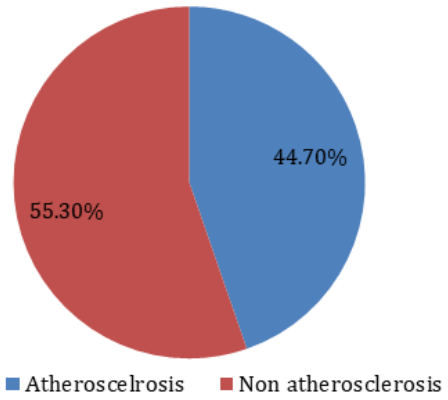

Figure 2: Atherosclerosis distribution of victims

Among the coronary arteries examined, the anterior descending branch of the left coronary artery exhibited the highest occurrence of atherosclerotic involvement, specifically 59%, followed by the left coronary artery at 26% and the right coronary artery at 15% [Figure 3]. Upon examination of the percentage luminal narrowing, it was observed that 33 cases (49.3%) exhibited thickening of the vessel wall with a lumen narrowing ranging from 50-75%. Additionally, 17 cases (25.4%) displayed thickening of the vessel wall with a lumen narrowing of less than 25%. Furthermore, 12 cases (18%) demonstrated thickening of the vessel wall with a lumen narrowing exceeding 75%. Lastly, 5 cases (7.5%) presented thickening of the vessel wall with a lumen narrowing ranging from 25-50%. Among the 67 instances examined in the study, triple vessel involvement was the most prevalent, occurring in 28 cases (41.8%). Out of the total instances, 23 (34.3%) exhibited involvement of a single blood vessel, whereas 16 (23.9%) indicated involvement of two blood vessels.

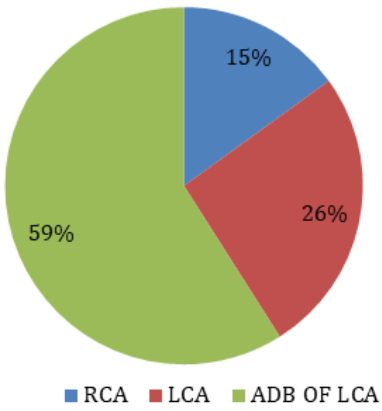

Figure 3: Atherosclerosis distribution in coronary arteries [RCA- Right coronary artery, LCA- Left coronary artery, ADB OF LCA- Anterior descending branch of left coronary artery]

During our examination of cerebral arteries, specifically the circle of Willis, we observed atherosclerotic involvement resulting in significant narrowing of the lumens in the following arteries, listed in descending order of severity: basilar artery (32.25%), internal carotid artery (25.3%), middle cerebral artery (17.6%), posterior cerebral artery (13.75%), anterior cerebral artery (7.4%), and communicating arteries (3.7%)[Figure 4].

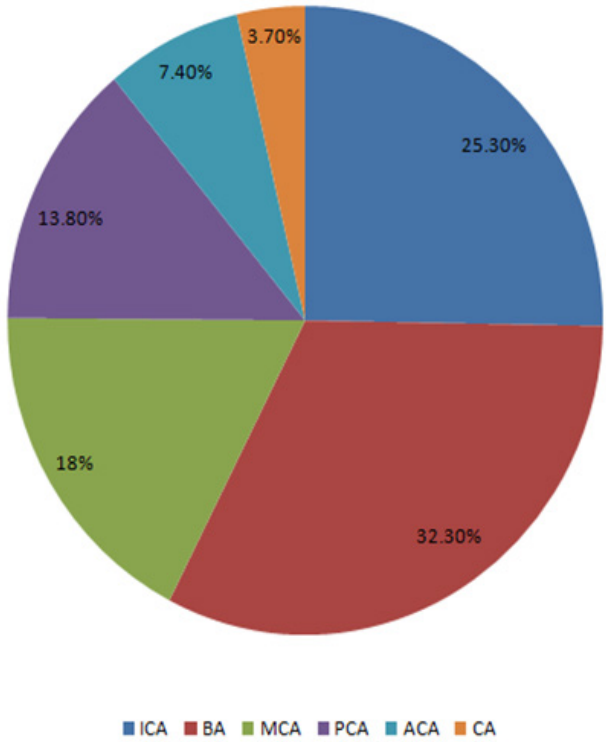

Figure 4: Atherosclerosis distribution in cerebral arteries

[BA- Basilar artery, ICA- Internal carotid artery, MCA- middle cerebral artery, PCA- Posterior cerebral artery, ACA- anterior cerebral artery, CA- communicating arteries]

Discussion

The autopsy investigation offers a method to comprehend the fundamental process that establishes a foundation for clinically severe atherosclerotic cardiovascular disease. Therefore, deaths presumed to be caused by cardiovascular pathology were deemed to be the most suitable sample from the living population for researching atherosclerosis. Certain epidemiological investigations have revealed certain factors that are undeniably significant in the progression of atherosclerosis [9].

The overall prevalence of atherosclerosis was found to be 44.7% in the present study which is comparable with the frequency given by Golshahi et al[10]. Significant atheroslcerotic changes appeared from the fifth decade onwards and thereafter there is a gradual increase in both frequency and severity were noted. After the fourth decade the frequency rises gradually and maximum incidence was seen in the ninth decade (43.3%). The results of the present study are comparable to those shown by Garg M et al[11] who also observed gradual increase in atherosclerotic changes with increasing decade. The sudden increase of atherosclerotic lesions in the fourth decade and further may be due to the increased stress, competition, employment and settlement related problems, these age groups have to suffer. All these modifiable life style related risk factors are known to increase the risk of atherosclerosis.

In the study, out of a total of 67 instances of atherosclerosis, 58 cases (43.24%) were males and 9 cases (14.89%) were females. This incidence is similar to the investigations conducted by Golshahi J et al[10]. Males are typically the primary earners while females tend to focus on domestic responsibilities. This dynamic increases the likelihood of stress among males, who also exhibit higher rates of smoking and drugs consumption.

The fibroatheromas was the most common type of atheroscelrotic change in our study (56.7%), next in frequency were fatty streaked atheromas (20.9%), followed by atheromas with prominent calcification(14.9%) and preatheromas (3%). Virmani et al in a similar study found out ruptured plaque as the most common type [12].

The prevalence of coronary involvement in the anterior descending branch of the left coronary artery was 59%, in the left coronary artery it was 26%, and in the right coronary artery it was 15%. According to Sudha et al, the Left Anterior Descending Artery was found to be the most often affected region by atherosclerosis[13]. Out of the total instances, 23 (34.5%) showed involvement of only one vessel, whereas 16 cases (23.9%) showed involvement of two vessels, and 28 cases (41.8%) showed involvement of three vessels. The most frequent finding in our analysis was the participation of three blood vessels, which aligns with the findings reported by Yezdi et al [14].

An isolated lesion can serve as conclusive evidence of the precise site where atherosclerosis initiates in an individual patient. Indeed, this statement holds true only if the condition necessitates a noticeable irregularity on a significant magnitude. We observed atherosclerosis affecting the lumens of the following arteries, ranked in order of severity: basilar artery (32.25% narrowing), internal carotid artery (25.3% narrowing), middle cerebral artery (17.6% narrowing), posterior cerebral artery (13.75% narrowing), anterior cerebral artery (7.4% narrowing), and communicating arteries (3.7% narrowing). The aforementioned findings are in accordance with the study conducted by Resch JA et al[15]. Clearly, this discovery emphasizes that the degree of atherosclerosis is highest in the arteries with the largest diameter. Analysing the atherosclerotic patterns in the circle of Willis and their relationship with vascular anatomy is important from a pathogenic perspective. Laplace's law states that the tension in the wall of a vessel is directly proportionate to its radius. Consequently, bigger arteries are often more susceptible to atherosclerosis[16].

Conclusion

Atherosclerosis has become a recent epidemic that is impacting a comparatively younger generation. This study would assist doctors in implementing early interventions to halt the advancement of the disease and aid forensic pathologists in formulating opinions regarding the cause of death.

Conflict Of Interest: Nil

Source of Funding: Self

Ethical Clearance: Ethical clearance:- Obtained from institutional ethics committee, Government Medical College, Kannur. IEC No. 17/2022/GMCK dated 5.5.22.(attached in this email).

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Original Research Article

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Age Estimation from Endochondral Ossification Pattern of Thyroid Cartilage in the Population of Punjab

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Abstract

Objective: The present study aims at studying the ossification of thyroid cartilage and to compare it with age of the individual.

Methods: The study was conducted in 300 samples of thyroid cartilage collected during autopsy in the department of Forensic medicine in a tertiary care hospital. Each thyroid cartilage is divided in to thirteen anatomical area and ossification in each defined area was studied through gross and cut section features and classified as ossified and not ossified areas. The samples were grouped in to seven groups of age and ossification features were compared between the age groups.

Results: On analysing the ossification pattern of thyroid cartilage in thirteen defined anatomical areas and comparing it with the age, a peculiar sequence of ossification was noted, and it was also observed that frequency of ossification increases significantly with increasing age groups.

Conclusion: Ossification of thyroid cartilage helps in establishing the age of individual and it can be categorised to an age group of ten years.

Key words: Thyroid cartilage, Age estimation, Ossification, Calcification

Introduction

Forensic medicine experts continue to search for newer methods to estimate the age of individual as it forms an indispensable aspect in establishing the identity of an unknown individual. Most of age estimation methods are based on the ossification of various long bones. The thyroid cartilage being a hyaline cartilage undergoes endochondral ossification with advancement of age. Endochondral ossification of thyroid cartilage is indicated by development of vascular system, invading the perichondrium, seen

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as reddish-brown colouration at the midsection of the cartilage. Development of vascular system into the cartilage is termed as marrow foci. Presence of this vasculature is a prerequisite for determination of ossification. Ossification of hyaline thyroid cartilage is also indicated by hard consistency due to deposition of calcium and phosphate minerals over the dead chondrocytes.[1]

In the past several studies[2-15] have been conducted to explore the use of thyroid ossification as a potential tool for age estimation. Most of such studies were radiological analysis either with x ray (cephalometric and cervical spine radiographs) or computed tomography (multi-slice) to evaluate the degree of ossification of thyroid cartilage. It was mainly based on the computerised measurement of ossification areas in the thyroid cartilage[2,3], quantification of radio-opacity of thyroid cartilage[4] and computerised estimation of volume of ossified thyroid cartilage[5]. One of the drawbacks of these studies was that the thyroid cartilage ossification was not distinguished fromossification of other laryngeal cartilages, calcified lymph nodes, calcified atherosclerotic plaques, foreign bodies, and metastatic calcification.

In the present study, the endochondral ossification of thyroid cartilage was studied through gross and cut section features and analysed for estimation of age of an individual within a target native population.

Objectives:

1. To determine the ossification of various defined areas of thyroid cartilage
2. To calculate any correlation between the ossification pattern of thyroid cartilage and age of the deceased.

Materials and Method

It is a prospective analytical study conducted from July 2012 to December 2013 on 300 cases autopsied in the Department of Forensic Medicine of a tertiary care hospital in Chandigarh. Written informed consent was taken from the legal heirs of the deceased.

Inclusion criteria

- All cases above the age of 18 years.
- Residents of Punjab having at least two generation of ancestors from Punjab.

Exclusion criteria

- Cases with injury to thyroid cartilage.
- Known cases of metastatic calcification in thyroid cartilage.
- Cases with advanced decomposition changes.

Method

The thyroid cartilage was dissected out during autopsy, with great care as not to damage the superior and inferior horns in the process. The entire thyroid cartilage was carefully dissected to remove all muscular and ligamentous attachments. The thyroid cartilage was sliced into thin parallel horizontal sections at equidistant from tip of superior horn to tip of inferior horn. The thyroid cartilage was divided into thirteen defined areas for the study of ossification pattern as described and shown in **Table 1** and **Figure 1**.

Table 1: Various anatomical areas of thyroid cartilage for ossification pattern assessment.

1. Right superior horn (RSH).	8. Right posterior branch (RPB).
2. Left superior horn (LSH).	9. Left posterior branch (LPB).
3. Cranial branch (CRB).	10. Right lower posterior triangle (RLPT).
4. Caudal branch (CAB).	11. Left lower posterior triangle (LLPT).
5. Anterior midline tongue (AMT).	12. Right inferior horn (RIH).
6. Right lamina (RTL).	13. Left inferior horn (LIH).
7. Left lamina (LTL).	

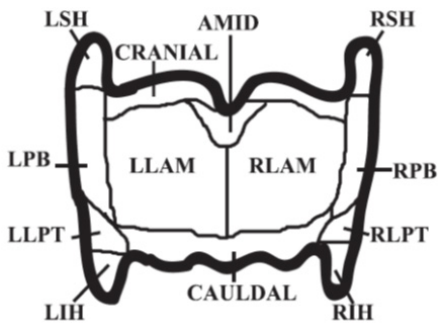

Figure 1: Anatomical areas of thyroid cartilage for assessment of ossification pattern

Each defined area of thyroid cartilage was assessed and classified as ossified or not ossified as follows. For each defined area of thyroid cartilage four factors namely consistency, colour, sensation of cutting, colour of cut surface were studied. presence of firm to hard consistency of cartilage, chalky white colour of cartilage, gritty sensation on cutting and brownish to red colour of cut section were taken as indicator of ossification.

All the observations were made independently by three observers and amean observation was taken as final observation of the given sample area and accordingly the sample areas were classified as either ossified or as not ossified sample area. For each defined area, the earliest age at which it shows ossification was noted. The total number of ossified and not ossified areas of each defined area and percentage of ossification for each defined area were also calculated. All the 300 samples were then categorized into different age groups as follows.

Age group 1 – 18 to 20 years

Age group 2 - 21 to 30 years

Age group 3 – 31 to 40 years

Age group 4 – 41 to 50 years

Age group 5 – 51 to 60 years

Age group 6 – 61 to 70 years

Age group 7 – 71 to 80 years

The total number of samples (S) for each age group was calculated. Then total study areas (A) of each group were determined by multiplying the total number of samples (S) in that age group with number of defined areas of each sample (13).

- Total study areas of an age group (A) = Total no of samples of that age group (S) * 13

The number of ossified areas (A1) and not ossified study areas (A2) for each group was calculated. The frequency of ossification of each age group was calculated by dividing number of ossified areas (A1) by total study areas (A) in that age group and expressed as percentage.

- Frequency of ossification = no of ossified areas (A1) / total study areas(A) *100

All the data were tabulated using Microsoft excel version 2010 and all analysis were carried out with the help of IBM SPSS Statistics package (version 20.0). In all analysis, a p value < 0.05 with 95 % confidence interval was considered statistically significant.

Results

For each of the thirteen defined anatomical area, the presence or absence of ossification was studied in all three hundred cases and then analysed with individual age. The number of ossified and not ossified areas of each defined area, percentage of ossification of each defined area, the earliest age at which each area ossified were tabulated in **Table 2**.

Table 2: Number of ossified and not ossified samples, percentage, earliest age of ossification.

AREA	NO OF OSSIFIED SAMPLES	NO OF UNOSSIFIED SAMPLES	PERCENTAGE OF OSSIFICATION	EARLIEST AGE AT WHICH OSSIFIED (years)
RTSH	119	181	39.6%	44
LTSH	123	177	41.0%	42
CRB	62	238	20.6%	53
CAB	118	182	39.3%	45
AMT	11	289	3.6%	63
RTL	16	284	5.3%	63
LTL	18	282	6.0%	62
RPB	182	118	60.6%	34
LPB	189	111	63.0%	32
RLPT	285	15	95.0%	18
LLPT	286	14	95.3%	18
RTIH	184	116	61.3%	33
LTIH	188	112	62.6%	32

On comparing the percentage of ossification of each defined area and earliest age at which each defined area ossified, a peculiar sequence of ossification with initiation from posterior and inferior areas and then progressing to superior and anterior areas was also noted. The ossification started in Posterior lower triangle areas followed by other areas and ended in Anterior Midline Tongue as follows.

- Right and left Posterior triangle
  –1st to ossify (started at 18 years)
- Right and left Inferior horns
  – 2nd to ossify (started at 32 & 33 years)
- Right and left posterior branch
  – 2nd to ossify (started at 32 & 34 years)
- Right and left superior horns
  – 3rd to ossify (started at 42 & 44 years)
- Caudal branch
  - 3rd to ossify (started at 45 years)
- Cranial branch
  – 4th to ossify (started at 53 years)
- Right and left lamina
  – last to ossify (started at 62 & 63 years)
- Anterior midline tongue
  – last to ossify (started at 63 years)

In each age group, the total number of samples (S), total number of study areas (A), the number of ossified (A1) and not ossified areas (A2), and frequency of ossification in each age group were studied and shown in **Table 3**.

Table 3: Number of samples, number of study areas, number of ossified and unossified areas, frequency in each age group of thyroid cartilage.

Age group (in years)	Total no of samples (S)	Total no of study areas (A)	Number of ossified areas (A1)	Number of unossified areas (A2)	Frequency of ossification
1 (18 to 20)	23	299	24	275	8.02%
2 (21 to 30)	81	1053	155	898	14.71%
3 (31 to 40)	64	832	343	489	41.22%
4 (41 to 50)	65	845	549	296	64.97%
5 (51 to 60)	46	598	455	143	76.08%
6 (61 to70)	19	247	230	17	93.11%
7 (71 to 80)	2	26	25	1	96.15%

It was observed that the frequency of ossification increased significantly in each group as age increases with minimum frequency of ossification observed in age group one 1 and maximum frequency of ossification observed in age group 7.

Discussion

A number of studies in the past has used thyroid cartilage for estimation of stature[16-18]orgender.[18-20]Several radiological studies[6-8] have observed the ossification of thyroid other laryngeal cartilages and classified them into various stages of ossification. In the year 1958, Keen and Wainwright [6]were the earliest to define, recognizable stages of radiopacity of the thyroid, cricoid, and arytenoid cartilages in male and female subjects in accordance with the age. The ossification pattern of thyroid cartilage was analysed with age by Grand Maison et al,[4]Ajmani et al,[9] Cerny,[10]Mupparapu and Vuppalapati,[11] Jurik AG,[12] Hately et al,[13]Gravin et al[14] and Turkmen et al.[15] In all the above studies the ossification pattern varies in accordance with both sex and age. In the present study the ossification pattern was studied only in accordance with age and not with sex as the number of male samples and number of female samples varied grossly(238 male samples and 62 female samples).

In the present study, Ossification of thyroid cartilage was first seen at the age of 18 years and the completely not ossified thyroid cartilage was last seen at the age of 23 years. These findings were consistent with the study documented by Hately et al,[13] Garvin

et al,[14] and Turkmen et al.[15] In Hately et al [13]study, a total of 516 cases of which 259 were males and 257 were females were analysed. According to this study the first ossified thyroid cartilage was seen at the age of 18 years among males and at the age of 16 years among females. Garvin et al [14] conducted their study on 104 isolated human laryngeal structures (68 men and 36 women) This study also documents that the first ossified sample of thyroid cartilage at the age 19 years. The study conducted by Turkmen et al[15] was done in 300 lateral cervical radiography of which 139 males and 161 females, also documents the first ossified sample of thyroid cartilage in the age group of 10 – 19 years of age.

In the present study, above 20 years of age all cartilages were ossified except for three cases. This observation was consistent with the study conducted by Hately et al,[13]where all the cartilages were ossified above the age of 20 years except for two cases.

In the present study the ossification starts at the posterior and inferior parts of thyroid cartilage and then proceeds from to superior and anterior parts of thyroid cartilage. The right and left posterior triangle were the first regions to ossify followed by ossification of inferior horns and posterior branches of both sides. This observation was similar to the findings of the work reported by Gravin et al[14]and the study conducted by Turkmen et al[15].

The study conducted by Gravin et al[14] in the year 2008 observed that the left and right posterior triangles are the first to ossify, documented in individuals as young as 19 years of age. The inferior horns and the posterior branches are the next to ossify. Complete ossification of the laminae and cranial branches of the thyroid cartilage were not observed in individuals younger than 39 years of age.

The study conducted by Turkmen et al[15] analysed the ossification of thyroid cartilage at four parts. (postero-inferior, postero-superior, centro-lateral and anterior). It also documented that the ossification started in the postero-inferior parts of thyroid cartilage in both males and females, in the 10–19 years age group.

The anterior midline portion of thyroid cartilage was the last portion to be ossified in the present study. This area was first seen to be ossified at the age of 63 years. This finding was consistent with the work done by Gravin et al[14] and Turkmen et al[15]. The pattern of ossification proceeding from posterior and inferior parts to superior and anterior parts could be due to vascular pattern of thyroid cartilage which invaginates the posterior and inferior parts of thyroid cartilage and then as age progresses it invaginates to superior and anterior areas of thyroid cartilage.

In the present study the frequency of ossification increased from age group 1 to age group 7. This finding was consistent with the study conducted by Mupparapu and Vuppalapati[11] in the year 2005. In the study conducted by Mupparapu and Vuppalapati[11] the frequency of ossification was observed to be 59% in males and 16% in females in age group 3 (31 to 40 years), 75% in males and 37% in females in age group 4 (41 to 50 years) and 95% in males and 54% in females in age group 5 (51 to 60 years). In our study the samples varied from 18 years to 80 years and so we were able to observe the increase in frequency of ossification in six age groups from 8% in age group 1 to 96% in age group 7.

Conclusion

In our study on comparing the ossification pattern of thirteen defined areas a peculiar sequence of ossification of thyroid cartilage was found and the frequency of ossification was found to increase significantly with increase of age in decades. As per our study, by analysing the ossification pattern of a thyroid cartilage, we can estimate the age of the individual and group it into any one of the age groups defined. Ossification pattern in the present study though was analysed with gross and cut section features, it only classifies the thyroid cartilage areas as ossified and not ossified. And it fails to recognise various degrees of ossification of the thyroid cartilage. Further studies if done with histological methods to observe various degree of ossification, it may help to narrow down the age estimates to increased precision.

Ethical Clearance: This study was conducted after the approval of Institutional Ethics Committee clearance of Post Graduate Institute of Medical Education and Research with reference number 8857/PG-2Trg/2011/3445-46 dated 05.02.2013.

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Conflict of Interest: Nil

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