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Original Article

Analysis of Burn Mortality in Burn Centre: Manipal

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ABSTRACT

Analysis of burn mortality was done in Kasturba Medical College Hospital, Manipal. For that we retrospectively analysed hospital records of patients admitted in the burns ward of the Department of Plastic Surgery in Kasturba Medical College hospital from January 2005 to December 2010. Mortality was high in females (13.5%) as compared to males (6.6%). Highest mortality rate was in the age group of 51 to 60 years (41.2%), followed by 21–30 years (21.8%) and 11–20 years (21.1%). Burns involving more than 90% of total body surface area were invariably fatal, followed by 81–90% of total body surface area burnt and 71–80% of total body surface area burnt. Body surface area <10% and 11–20% had the least mortality rate (0%). Superficial burn (1.7%) has least mortality rate compared to deep burn (20.4%). Most of the deaths occurred in patients who sustained flame burns, followed by scald and electrical burns. Mortality rate was high in suicidal injuries, followed by homicidal injuries and accidental injuries. Most common cause of death was septicemia, which was seen in 45 cases (73.8%) followed by electrolyte imbalance, which was seen in 5 cases (8.2%).

Key words; Burns; Analysis; Mortality

INTRODUCTION

Burns represent an extremely stressful experience for both the burn victims as well as their families. Often, the circumstances of burns are enveloped in mystery, obscurity and unreliable statements. Severe burn injury will have serious physical and psychological effects on patients life[1]. In developing countries burn mortality is very high as various authors have reported. Lack of proper burn centre, poverty and ignorance are the contributing factors for mortality. The aim is to analyse the mortality in our burn centre to find ways to reduce the mortality and improving the care given to the patients[2].

MATERIALS AND METHODS

Material consists of patients admitted in the burns Ward under department of plastic surgery in Kasturba Medical College hospital, Manipal. It was a 5-year retrospective study from January 2005 to December 2009. The information regarding survival, expired, type of burn, circumstance of burn, depth of burn, total body surface area burnt and age were extracted from patient's hospital files and was incorporated into our proforma.

Statistical analysis was done using SPSS software.

RESULTS

Mortality was high in females (13.5%) as compared to males (6.6%; Table 1). Highest mortality rate was in the age group of 51–60 years (41.2%), followed by 21–30 years (21.8%) and 11–20 years (21.1%; Table 2). Burns involving more than 90% of total body surface area were invariably fatal, followed by 81–90% of total body surface area burnt. Body surface area <10% and 11–20% had the least mortality rate (0%; Table 3). Superficial burn (1.7%) has least mortality rate compared to deep burn

(20.4%; Table 4). Most of the deaths occurred in patients who sustained flame burns, followed by scald and electrical burns (Table 5). Mortality rate was high in suicidal injuries, followed by homicidal injuries and accidental injuries (Table 6). Most common cause of death was septicemia, which was seen in 45 cases (73.8%), followed by electrolyte imbalance, which was seen in 5 cases (8.2%) (Table 7).

Table 1: Mortality

Gender	Outcome			Total
	Survived	Expired	Discharged against medical advice	
Male	141 (46.5%)	20 (6.6%)	16 (5.3%)	177 (58.4%)
Female	66 (21.8%)	41 (13.5%)	19 (6.3%)	126 (41.6%)
Total	**207 (68.3%)**	**61 (20.1%)**	**35 (11.6%)**	**303**

Table 2: Age group and mortality

Age group in years	Total number of cases	Total number of death
<10	53	7 (13.2%)
11–20	38	8 (21.1%)
21–30	101	22 (21.8%)
31–40	58	11 (19%)
41–50	33	6 (18.2%)
51–60	17	7 (41.2%)
61–70	2	0 (0%)
>71	1	0 (0%)
Total	**303**	**61**

Table 3: Total body surface area burnt and mortality (*n*=303)

Total body surface area burnt (%)	Number of cases	Number of death
<10	67	0
11–20	63	0
21–30	43	3 (7%)
31–40	40	9 (22.5%)
41–50	28	7 (25%)
51–60	18	9 (50%)
61–70	11	6 (54.5%)
71–80	8	5 (62.5%)
81–90	14	11 (78.6%)
91–100	11	11 (100%)
Total	**303**	**61**

Table 4: Depth of burn and mortality (*n*=303)

Depth of burn	Total number of cases	Total number of death
Superficial	58	1 (1.7%)
Deep	49	10 (20.4%)
Superficial and deep	196	50 (25.5%)
Total	**303**	**61**

Table 5: Burns etiology and mortality (*n*=303)

Burn aetiology	Total number of patients	Total number of deaths
Flame	**184**	**56 (30.4%)**
Scald	60	4 (6.7%)
Electrical	51	1 (2%)
Chemical	8	0 (0%)
Total	**303**	**61**

Table 6: Circumstance of burn and mortality (*n*=303)

Manner of burn	Total number of cases	Total number of death
Suicidal	12	8 (66.7%)
Accidental	288	52 (18.1%)
Homicidal	3	1 (33.3%)

Table 7: Causes of death in burns

Cause of death	Number of cases	Percentage (%)
Hypovolemic shock	5	8.2
Respiratory burns	4	6.6
Sudden cardiac arrest	2	3.2
Electrolyte imbalance	5	8.2
ARDS with sepsis	5	8.2
ARF with sepsis	3	4.9
Sepsis with MODS	15	24.6
Sepsis	22	36.1
Total	**61**	**100**

ARDS: Adult Respiratory Syndrome, ARF: Acute Renal Failure, MODS: Multiple Organ Failure

DISCUSSION

Mortality rate was 20% in our study, which is consistent with studies done by Olaitan *et al*[2], but lower than reported by Bang *et al*.[3] (28%), Yoshika *et al*.[4] (42.2 %) and Ashish[5]. Age of the person, percentage of total body surface area burned and inhalational injury are the important risk factors for mortality rate.

Mortality rate was high in females who were involved in 41 cases, whereas males were involved 20 cases. These findings are in concurrence with the studies reported by Subramanyam[6], Usama[7] and Kamran *et al*.[1] The reason could be high rate of serious burn injuries in female compared to males.

We observed in our study that mortality was high in 51–60 years age group (41.2%). This correlates with the study done by Olaitan *et al*.[2] who reported mortality of 50% in the age group of more than 65 years, reason being that elderly people could not withstand the burning injury.

Elderly people have thinner skin, poorer microcirculation and increased susceptibility to infection and the rate of burn shock, inhalation injury, pulmonary pathology, septicemia and renal failure is higher than in younger people. Children have lower mortality than adult due to smaller number of flame burns and a lower total body surface area.

Suicidal injuries (66.7%) had high mortality rate followed by homicidal injuries (33.3%). These findings are similar to those of Subramnyam[6] and Laloe[8] studies. This can be explained by the fact that fire accelerants that are used to commit suicide cause severe burns associated with inhalational injury.

Flame burns accounted for 30.4% mortality, followed by scalds, which accounted for 6.7% mortality rate. This is in accordance with the findings observed by Subramanyam[6], Benito-Ruiz *et al*[9], Olaitan[2] and Ashraf[10]. This can be explained by the fact that flame causes severe burns and greater depth along with inhalational injury.

The mortality rate increased as the body surface area burns increased. Burns over 90% of total body surface area showed 100% mortality rate, while no mortality was reported in burns <20%. This is consistent with study done in Brazil by De Souza *et al*.[11] and Olaitan[2].

Septicemia accounted for 73.6% of deaths. This is in accordance with findings of Mago[12], Ragheb *et al*.[13] and Singh *et al*.[14] Infection in burn patients is the leading cause of morbidity and mortality. Thermal injury destroys the skin barrier that normally prevents invasion by microorganisms, making the burn wound the most frequent area of sepsis in these patients. The dysfunction of immune system, large cutaneous bacterial load, the possibility of gastrointestinal bacterial translocation, prolonged hospitalisation and invasive diagnostic and therapeutic procedure, all contributes to sepsis.

CONCLUSION

Mortality was high in females as compared to males. Highest mortality rate was in the age group of 51–60 years (41.2%). Burns involving more than 90% of total body surface area were invariably fatal. Body surface area <10% and 11–20% had the least mortality rate (0%). Mortality was more in Flame burn, followed by Scald. As the burn surface area increases mortality also increased. Septicemia was the major cause of burn death.

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Original Article

A Comparative Evaluation of CT Scan Findings and Autopsy Findings in Fatal Head Injury Cases

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ABSTRACT

A study titled 'A comparative evaluation of computed tomography (CT) scan findings and autopsy findings in fatal head injury cases' was carried out in the Department of Forensic Medicine, M.S. Ramaiah Medical College, Bangalore, from October 2009 to March 2011 over a period of 18 months to correlate autopsy findings with CT scan findings in fatal head injury cases. All fatal cases of head injury subjected for post-mortem examination, where ante-mortem CT scan reports were available, were taken up for study. Post-mortem examination of each case was carried out and various types of head injuries were recorded and photographed and the respective CT scan reports were collected. Further, a comparative evaluation of post-mortem findings with that of the CT scan reports was analysed. Of the 270 cases of head injury, 44 (16 %) were hospitalised and a CT scan-head was done. In 37 cases (84%), skull fractures were observed at autopsy, whereas in only 20 cases (45%) the same was commented upon in the CT scan. Basal fractures were more under reported than the vault in the CT scan. Most common type of fractures missed in the CT scan was solitary fissured fracture followed by comminuted fracture. Fractures involving middle cranial fossa were missed more often than other fossae in CT scan. Among intracranial haemorrhages, subarachnoid haemorrhage was missed more frequently than others.

Key words: CT scan; autopsy; head injury; skull fractures; intracranial haemorrhage; traumatic brain injury.

INTRODUCTION

'Head injury' as defined by the National Advisory Neurological Diseases and Stroke Council is a morbid state, resulting from gross or subtle structural changes in the scalp, skull and/or the contents of the skull, produced by the mechanical forces[1]. It is also defined as 'any injury that causes lesion or functional damage of cranium, meninges and brain'[2]. The early diagnosis of structural damage and initiation of appropriate treatment is of utmost importance in saving the life of patients with head injury[1].

Computed tomography (CT) scan is commonly used as an initial diagnostic tool to look for various kinds of lesions in cases of head injury. The CT scanning is said to reveal promptly, accurately and non-invasively the intracranial and parenchymal abnormalities in acute cranio-cerebral trauma that were previously recognised only at autopsy, therefore, the CT scan (head) is indispensable in the diagnosis of the various traumatic lesion and their management, it also carries prognostic value[3].

In many patients, CT scan may look normal, yet the patient may have a poor Glasgow Coma Scale. When such fatal cases are subjected to post-mortem examination, various new lesions are observed, which were undetected in a CT scan. So at times, some disparity is observed between CT scan findings and autopsy findings. Some lesions are appreciated during post-mortem examination, but may have gone undetected or missed by a CT scan and *vice versa*[4].

Autopsies provide confirmation, clarification and correction of ante-mortem clinical diagnoses, and as a consequence an 'opportunity for clinicians to enhance their medical knowledge and diagnostic skill and apply this to all patients under their care'[5]. The purpose of this study was to correlate the CT scan and autopsy findings in cases

of fatal head injury. This study highlights potential pitfalls of newer technology with enhanced resolution and the continued value of the autopsy in serving as a 'gold standard' for validating newer and emerging technology.

AIMS AND OBJECTIVES

(a) To correlate autopsy findings with CT scan findings in fatal head injury cases.

(b) To identify the lesions caused by head injury, which are most likely to be missed or may remain undetected by CT scan examination but are appreciated at autopsy or *vice versa*.

MATERIALS AND METHODS

All fatal head injury cases subjected for medico-legal autopsy to the Department of Forensic Medicine, M.S. Ramaiah Medical College, where prior CT scan-head was done, were taken up for study over a period of 18 months. Further a comparative evaluation of post-mortem findings of the head injuries with that of the CT scan report were analysed.

Inclusion Criteria

Fatal head injury cases with ante-mortem CT scan-head reports were included in the study. By the retrospective record analysis of the autopsy registry of cases fulfilling the inclusion criteria, 35 cases were eligible. Keeping this, an attempt was made to include 32 cases (after 10% loss). However, a total of 44 cases fulfilled the criteria and were taken up in the study prospectively.

Exclusion Criteria

Cases where surgical intervention had led to a gross discrepancy between the CT scan findings and autopsy findings were excluded.

Prior ethical clearance was obtained.

RESULTS AND DISCUSSION

Deaths due to head injury constituted 270 (22 %) of the total autopsies (1,260) conducted during the study period. Out of these, in 44 (16%) of the cases the individuals were hospitalised and a CT scan-head had been done.

Table 1: Age and sex distribution of the cases

Age group (years)	No. of cases (%)	Male	Female
0–19	04 (9.5)	3	1
20–39	19 (43)	17	2
40–59	13 (29.5)	11	2
60–69	06 (13.5)	2	4
>70	02 (4.5)	2	0
Total	44 (100)	35 (79.5 %)	9 (20.5%)

The vulnerable age group was those in the 20–39 years followed by age group of 40–59 years as in any other study. The obvious reason being that they from the work group, and hence, prone to road traffic accident, falls, assaults, which are one of the major cause for head injuries.

In all, 35 cases (79.5%) were males and constitutes more than three-fourth of cases, as they are more into the outdoor activities, such as driving vehicles, working outdoors, posing them risk due to accidents, whereas females succumbed mainly to either accidental falls at their residence or due to road traffic injury (RTA) they being pillion riders without head gear.

Kelly C. Bordignon and Walter Oleschko Arruda observed in their study that highest frequency of head trauma occurred in the 21–30 years (25.1%) age group, followed by the age groups 11–20 years (21.6%) and 31–40 years (17.5%). In all, 1306 (67.3%) patients were male and 654 (32.7%) were female (sex ratio M:F=2:1)[2].

Table 2: Trauma mechanisms

Mechanism of trauma	No. of cases	Percentage (%)
Road traffic injury	39	88.6
Fall	5	11.4
Total	44	100

In all, 39 cases (88.6%) were due to RTA injury and remaining 11.4% (5 cases) were due to fall. Surprisingly, there were no cases due to other forms of violence such as assault.

Similar observation was made by Gururaj and Sastry Kolluri, where RTA constituted 62%, fall constituted 22% and assault constituted 10%[3].

Table 3: Distribution of cases according to time interval between CT scan and death

Time interval between CT scan and death	No. of cases	Percentage (%)
<12 h	10	22.8
12–24 h	8	18.2
1–2 days	3	6.8
2–7 days	17	38.6
>7 days	6	13.6
Total	44	100

The relation between time of CT scan and death is significant in our study as the findings by the radiologists and that of the autopsy would significantly vary depending upon the survival period, as there may be some pathophysiological changes or healing that may bring about a change. This has to be borne in mind while comparing the findings.

Table 4: Scalp injury

Total no. of cases	Scalp injury at autopsy	Scalp injury commented in CT scan report
44	39	6

(*33 scalp injuries were either missed or not commented upon)

Of the 44 cases, scalp injuries were noted in 39 cases at autopsy (Fig No. 1 b), whereas CT scan reported scalp injury in only 6 cases (Fig No. 1 a). This disparity (39–6=33) can be attributed to the very simple reason that the scalp injury being very much evident to the naked eye/clinical examination or because the injury could have been minimal and less significant as compared to the injury to the calvaria and its contents. Thus, the chance of under reporting by the radiologist is very high.

In a study done by Mohammad Zafar Equabal *et al*., scalp swelling or haematoma was observed in 86.3% of the cases and the CT scan concurred in all cases. It was also the most common CT scan finding[6].

Table 5: Skull fractures

Total no. of cases	Detected at autopsy	CT scan report
44	37	20

(*17 cases which had fractures were missed)

Of the 44 cases, in 37 cases skull fractures were observed at autopsy (Fig No. 2 a) but in only 20 cases the same

PHOTOGRAPHS HIGHLIGHTING THE FINDINGS IN CT SCAN WHEN COMPARED WITH AUTOPSY

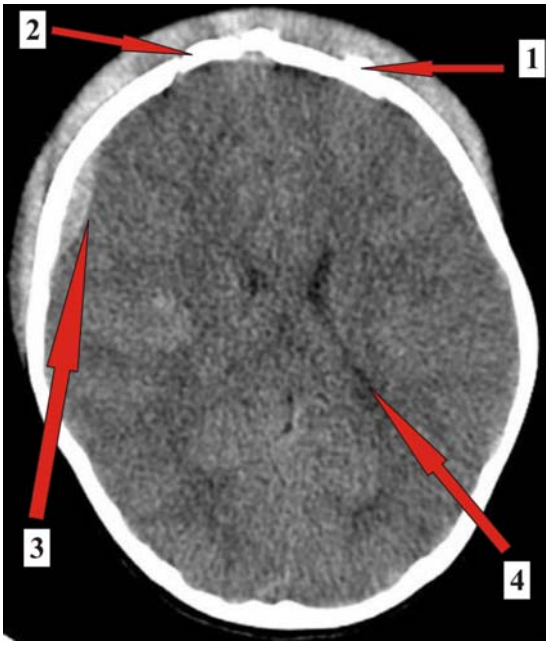

Figure 1(a): CT scan showing various lesions viz - diffuse hyperdense scalp swelling (1), bifrontal fracture (2), right frontal extradural hematoma (3) and brain oedema (4).

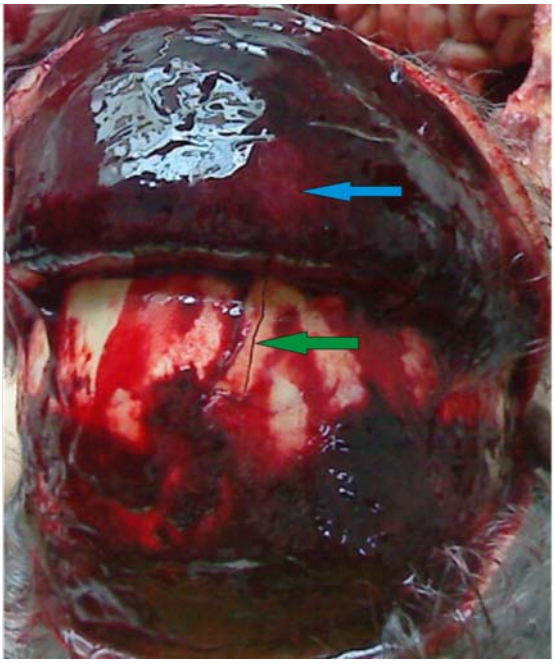

Figure 1(b): Diffuse scalp extravasation (blue arrow) over fronto parietal region with fissured fracture (black arrow), which was not reported in CT scan.

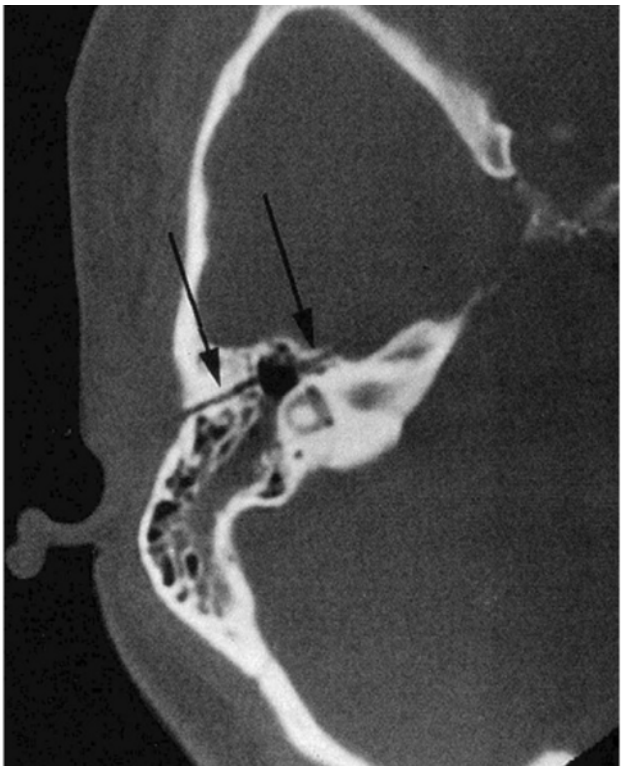

Figure 2(a): CT scan showing longitudinal temporal bone fracture

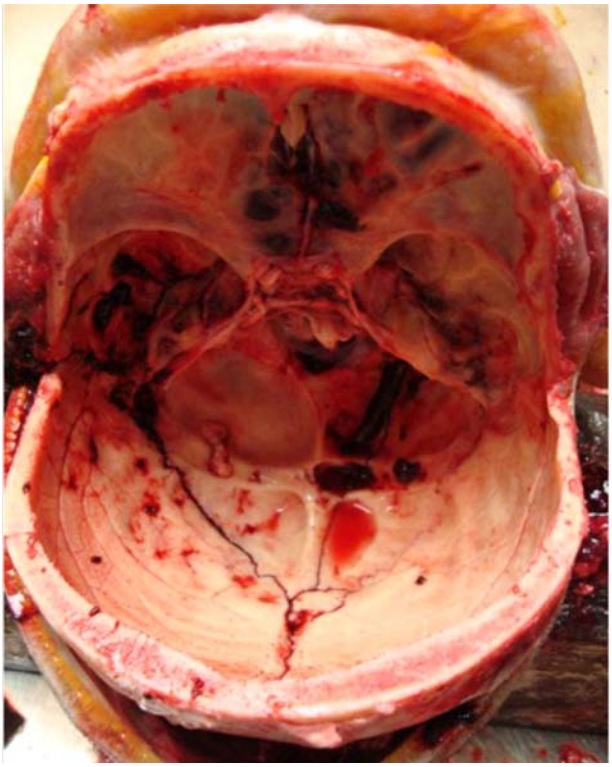

Figure 2(b): Similar lesion observed at autopsy over of base of skull involving left middle and posterior cranial fossae (occiput and petrous temporal bone). Fracture occiput was missed by CT scan in this case.

was commented upon in the CT scan (Fig No. 2 b). A disparity of (37–20) 17 cases was observed.

Sharma and Murari in their study observed that among skull fractures, 76.3% of them were diagnosed in both CT scan and autopsy; whereas 23.7% of them remained undiagnosed by CT scan[4].

Table 6: Anatomical location of skull fractures

Location	Autopsy		CT Scan		Missed
	No.	Percentage (%)	No.	Percentage (%)	No.
Vault	5	13.5	7	35	***+2 NIL**
Base	17	46	9	45	**8 (47)**
Both	15	40.5	4	20	**9 (53)**
Total	37	100	20	100	**17 (100)**

***Two fissure fractures noted at CT scan are those which had comminuted fractures along with fissured fractures of the base of skull, which were not commented in the CT report.

None of the fractures of the vault alone were missed in CT, as the vault being smooth any fractures involving it are easy to be picked up by CT, whereas eight cases (47%) of exclusive basal fractures were missed and nine cases (53%) involving both base and vault were missed in the CT scan. This is due to the various fossae and crevices at the floor or the fracture being too small to have been picked up by CT scan as there are very high chances where in only the outer table or the inner table is involved. Skull fractures are readily identified on the bone windows of CT scan, but small non-displaced linear skull fractures may be missed on CT scan and further the CT scan has low sensitivity for basilar skull fractures. The clinical examination is still more reliable than CT scan in the detection of basilar skull fractures.

Ashis Pathak *et al*. observed that both vault and the basal fractures are also likely to be missed when they are undisplaced and even a bone window image would be unable to detect them[7].

Christina Jacobsen *et al*. have stressed the involvement of middle cranial fossa in 80% of the cases with fractures, which in their study was an area where fracture diagnosis was difficult[8].

Table 7: Type of fractures

Type	Autopsy No. (%)	CT scan No. (%)	Missed No. (%)
Depressed	1 (2.7)	1 (5)	NIL
Fissure	27 (73)	16 (80)	11 (64)
Comminuted	4 (10.8)	1 (5)	3 (18)
Depressed andcomminuted	1 (2.7)	NIL	1 (6)
Fissure andcomminuted	4 (10.8)	2 (10)	2 (12)
Total	37 (100)	20 (100)	17 (100)

Most commonly missed fractures in CT scan were fissured fractures located over vault/base followed by comminuted fracture (five cases). In two cases, where in there were both fissured and comminuted located over the base were missed.

Mukesh K Goyal *et al*. in their study have observed that 77 cases (65%) had linear fractures and 13 cases (11%) had depressed fractures, whereas CT scan was able to pick up 65 cases (55%) and 19 cases (16%), respectively[9].

Table 8: Fossae involved in basal fractures

Fossae	Autopsy (32)		CT Scan (13)		Missed (19)
	No.	Percentage (%)	No.	Percentage (%)	No.
ACF	8	25	3	23	5 (62.5%)
MCF	11	34.5	6	46.2	5 (45.5%)
PCF	7	21.9	2	15.4	5 (71%)
ACF and MCF	3	3.1	1	7.7	2 (33%)
ACF and PCF	1	6.2	NIL	NIL	1 (100%)
MCF and PCF	2	9.3	1	7.7	1 (50%)
Total	32	100	13	100	19 (40%)

ACF: anterior cranial fossa; MCF: middle cranial fossa; PCF: posterior cranial fossa.

Fractures of MCF alone were missed in 45.5% of the cases in CT scan, whereas in 62.5% of the cases fractures of ACF alone were missed and in 71% of the cases fractures of PCF alone were missed. Over all, MCF fractures were missed in 8 (50%) of 16 cases.

In a similar study, Christina Jacobsen *et al*. observed that 13 of 34 cases of middle cranial fossa fractures were detected by CT scan followed by anterior cranial fossa where 11 of 21 cases were detected and in posterior cranial fossa no fractures went undetected by CT scan. But in a second reading of the same film 25 of 34 cases of middle cranial fossa fractures were detected by CT scan followed by anterior cranial fossa where 12 of 21 cases were detected[8].

Table 9: Intracranial haemorrhage

Type	Autopsy	CT scan	Missed
SDH	37	30	7 (19%)
SAH	41	21	20 (48%)
EDH	4	3	1 (25%)
ICH	7	5	2 (28%)

EDH: extradural haemorrhage; ICH: intracerebral haemorrhage; SAH: subarachnoid haemorrhage; SDH: subdural haemorrhage.

In CT scan, subdural haemorrhage (SDH) was missed in 7 cases (19%), subarachnoid haemorrhage (SAH) was missed in 20 cases (48%), intracerebral haemorrhage (ICH) was missed in 2 cases (28%) and extradural haemorrhage (EDH) was missed in 1 case (25%) (Fig No. 3 a & Fig No. 3 b). Sharma and Murari in their study

Figure 3(a): CT scan showing extradural haemorrhage (crescent shaped hyper dense) over right temporal region.

Figure 3(b): Extradural haemorrhage (blue arrow) over left temporo-occipital region missed by CT scan in this case.

have observed that among EDHs, 66.7% were diagnosed in both CT scan and autopsy; whereas 33.3% of them remained undiagnosed by CT scan. The SDHs were diagnosed in both CT scan and autopsy and no mismatch was diagnosed. Among SAH, 64.3% were diagnosed in both CT scan and autopsy, whereas 35.7% of them remained undiagnosed by CT scan. Among ICHs, 70% were diagnosed in both CT scan and autopsy, whereas 30% remained undiagnosed by CT scan[4].

Early CT can fail to diagnose small epidural (EDH), which can either expand or re-bleed later, causing neurological deterioration. Obtaining the CT scan too early, a common problem especially in inner-city hospitals, and not repeating the same after requisite time could lead to the discrepancy in the findings at autopsy and CT scan. A small subdural (SDH) may only appear as increased density of the tentorium as the subdural blood tracks along it. CT scan may fail to recognise this iso-dense SDH and the age of the bleed further decreases the chance of detection. CT scan detects over 90% of SAH within 24 h (corollary is that 10% are missed). It may become negative after 3 days with change in blood density.

Table 10: Traumatic brain injury

Type	Autopsy	CT scan	Missed
Contusion	31	19	12 (38%)
Laceration	1	NIL	1 (100%)
Cerebral oedema	29	23	6 (20%)

Cortical contusions were observed in 31 cases, whereas in CT scan contusions were observed in 19 cases only. A disparity of 12 (38%) is observed. CT scan failed to pick up a solitary laceration and 23 (20%) of the 29 cases of cerebral oedema. Interplay of pathophysiological changes, healing, therapeutic intervention and most importantly the timing of the CT scan would certainly contribute for this disparity. This has to be borne in mind while comparing the findings. Non-haemorrhagic contusions are often not visualised on initial CT scan, but will tend to show mild oedema or haemorrhagic conversion over 24–48 h. The contusions and laceration of the inferior aspects of the temporal and frontal lobes are not readily visualised in CT scan because of beam hardening artefact, which is a well-documented limitation of the CT scan procedure.

Parenchymal injuries along with small hematomas or vault fractures near the bone have a chance to be missed in a CT. Apart from primary changes, delayed (secondary) changes in the brain in the form of infarction, hemorrhage and diffuse swelling also lead to changing pattern of lesion in the CT scan done at different intervals. Non-visualisation of lesions in CT scan in fatal cases can be due to a too early imaging done in critically ill patients. Lawrence Jacobs observed an overall accuracy of 86.2% of CT scan in correctly identifying pathology of the brain[10].

CONCLUSION

- Of the 270 cases of head injury, only 44 (16 %) were hospitalised and subjected to CT scan-head. In all, 79.5% were males commonly between 20–39 years age group.
- 39 Cases (88.6%) were due to RTA and 5 cases (11.4%) due to fall and none due to assault.

- On comparison of autopsy and CT findings disparity was observed thus: scalp 33cases and skull fractures 17 cases.
- Eight cases of exclusive basal fractures and nine cases involving both base and vault and also eight cases of MCF fractures were missed.
- Of the haemorrhages, SDH were missed in 7 cases, SAH in 20 cases, ICH in 2 cases and EDH in 1 case in the CT scan.
- Contusions were not detected in 12 cases more so of the inferofrontal and inferotemporal lobes
- Cerebral oedema was not detected in 6 (20%) of the 29 cases.

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Brief Communication

Role of Forensic Medicine Expert in Police Encounters

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ABSTRACT

Police encounter is the term used by the Indian Police Service or Indian Military/Paramilitary forces when explaining the death of an individual at their hands who was deemed by them to be a militant or 'subject of interest'. It refers to extra judicial killings or executions not authorised by a court or by the law. Such encounters also go by the name of 'staged encounters', where weapons are planted on or near the dead body to provide a justification for killing the individual. Common reasons given for the discrepancy between records showing that the individual was in custody at the time of his encounter, is that he/she had escaped[1]. The police in Indian metro cities have a very high rate when it comes to encounter killings. Since October 1993: 2,560 cases of police encounters have been brought into the notice of National Human Rights Commission (NHRC), of them according to NHRC 1,224 cases have been found fake encounters. It means every second police encounter is fake in the country[2]. Human right activists consider these encounter killings, together with torture by police in lock-ups and custodial deaths, to be gross human right violation. The fact that the dead person had a criminal background that does not give a legal authority to police for such encounters, as the law decide on the basis of evidence of such allegations.

Keywords: Forensic medicine Expert, Police encounter, Postmortem, Human Rights

POLICE ENCOUNTER

Police encounter is a term used by Indian security forces to explain and excuse the death of an individual at their hands. The term was often used during the Punjab insurgency between 1984 and 1995. During this time, Punjab Police officials would often report 'encounters' to local newspapers and to the family members of those killed. The victim was typically a person the police deemed to be a militant, or to be involved in the militant separatist movement, though proof of alleged militant involvement was rarely given. Such encounters have also been referred to as 'staged encounters' or 'fake encounters', as these deaths were often believed to be the result of torture or outright execution. Ultimately, the practice became so common that 'encounter' became synonymous with extrajudicial execution[3]. The Punjab police specifically targeted the families of suspected militants in encounter killings to punish them[4]. It is alleged that police would typically take a suspected militant into custody without filing an arrest report. If the suspect died during interrogation, security forces would deny ever taking the person into custody and instead claim that they were killed during an armed encounter[5]. Many Indians believe police would add weapons to the dead body to demonstrate cause for killing the individual, stage managing the encounter, leading to the popular phrase 'fake encounter killing'[6]. They would also concoct a story about militants staging an attack, or the suspect attempting to escape while being escorted to recover militant arms[7].

A CASE CITED OF ALLAHABAD ZONE

A criminal Bhuwar Nishad was killed in a such alleged encounter by Allahabad UP Police in Ghoorpur area of Allahabad on 20 July 2009. According to eyewitness on the request of relative of Dilip nishad, who was killed by Bhuwar on 25 June 2009, police reached Madaripur village to arrest him. As Bhuwar got the news of police, he ran away in boat towards Ghoorpur village. Relatives of Dilip

followed him on other boat. During this run, one of the person sitting on boat allegedly hit him with blunt hard wooden PATWAR, which caused lacerated wound of scalp. After this struggle, he was caught by police. According to villagers, at the time of arrest of Bhuwar there were no firearm injuries present, only there was massive bleeding from his head (lacerated area).Then he was taken in police jeep with a fake message that he is injured with bullet and they are taking him for the treatment to SRN Hospital. Police left at 12:00 h and reached at 13:45 h. Whereas SRN is only 20 km away. According to villagers police might shot him in the jeep[8].

In the postmortem report, first injury was due to firearm with an entry wound of 1 cm muscle deep situated on right side of chest 3 cm outwards from right side of the nipple with an exit wound of 2 cm x 2 cm on right side of chest 9 cm below the neck bone. Second injury is also of firearm with an entry wound of 1 cm x 1 cm deep into lung penetrated from back side of right of chest. According to postmortem report, it appears that one bullet from behind and second from back side below shoulder has been shot. Forensic expert opine that two bullets were fired from back. According to postmortem report, third injury is lacerated wound on back side of head 7 cm x 7 cm bone deep with haematoma present. Fourth and fifth injuries are abrasion over right shoulder 2 cm x 9 cm and over left shoulder 10 cm x 2 cm, respectively. Sixth injury is abrasion of 5 cm on right side of front of head. Seventh and eighth injuries are lacerated wound 1 cm x 1 cm bone deep on right side over head and above right ear and 2 cm x 2 cm on left side of head, respectively. According to postmortem report, all above injuries were inflicted before firearm injuries. Forensic expert are of the view that it appears from postmortem report that there was lengthy battle.

It is very much clear from above postmortem report that injury nos. 3 and 6 are sufficient enough to cause the death of person in ordinary course of nature then what was the need of firearm injury? And how police did the encounter?

Police abuse of authority is so prevalent in Uttar Pradesh that the Allahabad High Court responded in outrage in a 2001 opinion 'A large number of petitions are coming up before this court with allegations against the Police that they are behaving like bandits, thieves, rapist and petty criminals…The police are supposed to protect the people and not to rape, black mail or loot them…it is high time that the police also start behaving in a civilised manner'.

INTERNATIONAL CONVENT ON CIVIL AND POLITICAL RIGHTS (1979)

Indian government has signed on International covenant on civil and political rights in the year 1979 [10]. Articles 6 and 9 of it states that:

Article 9:-1. Everyone has the right to liberty and security of person. No one shall be subjected to arbitrary arrest or detention. No one shall be deprived of his liberty except on such grounds and in accordance with such procedure as are established by law.

2. Anyone who is arrested shall be informed, at the time of arrest, of the reasons for his arrest and shall be promptly informed of any charges against him.

3. Anyone arrested or detained on a criminal charge shall be brought promptly before a judge or other officer authorised by law to exercise judicial power and shall be entitled to trial within a reasonable time or to release. It shall not be the general rule that persons awaiting trial shall be detained in custody, but release may be subject to guarantees to appear for trial, at any other stage of the judicial proceedings, and, should occasion arise, for execution of the judgment.

4. Anyone who is deprived of his liberty by arrest or detention shall be entitled to take proceedings before a court, in order that that court may decide without delay on the lawfulness of his detention and order his release if the detention is not lawful.

5. Anyone who has been the victim of unlawful arrest or detention shall have an enforceable right to compensation.

Article 6:-1. Every human being has the inherent right to life. This right shall be protected by law. No one shall be arbitrarily deprived of his life.

2. In countries which have not abolished the death

penalty, sentence of death may be imposed only for the most serious crimes in accordance with the law in force at the time of the commission of the crime and not contrary to the provisions of the present Covenant and to the Convention on the Prevention and Punishment of the Crime of Genocide. This penalty can only be carried out pursuant to a final judgment rendered by a competent court.

FAKE ENCOUNTER IN TERMS OF LAW

Supreme Court has given verdict that in rare of rarest of case death punishment can be given but UP police is giving death sentence in the name of self-defence and duty responsibility as a said encounter. Human right commission has also supported the high court's concern in their 2001 report and the statistical data given about the encounters in UP were astonishing.

Section 21 of Indian constitution has given right to live to all citizens .It was observed by human rights activists that central and state government were not serious to implement the right to live in ground reality.

Section 46 of the Criminal Procedure Code proscribes touching an arrestee 'unless there be it submission to the custody by word or action'. It is only on forcible resistance or evasion by the arrestee that an officer can 'use all means necessary to affect the arrest'. However, a cop still does not have 'a right to cause the death of a person who is not accused of an offence punishable with death or with imprisonment for life'. Sections 99 and 100 of the Indian Penal Code read together amplify the limits to private defence to public officials in discharge of their duties-under Section 99 'no right of private defence against an act which does not reasonably cause the apprehension of death or of grievous hurt'; 'no right of private defence against an act which does not reasonably cause the apprehension of death or of grievous hurt'; 'the right to private defence in no case extends to the inflicting of more harm than it is necessary to inflict for the purpose of defence'[11].

Section 100 supplements Section 99, 'The right of private defence of the body extends to the voluntary causing of death or of any other harm to the assailant if: (i) such an assault as may reasonably cause the apprehension that death will otherwise be the consequence of such assault; (ii) such an assault as may reasonably cause the apprehension that grievous hurt will otherwise be the consequence of such assault; (iii) an assault with the intention of committing rape; (iv) an assault with the intention of gratifying unnatural lust; (v) an assault with the intention of kidnapping or abducting; (vi) an assault with the intention of wrongfully confining a person, under circumstances which may reasonably cause him to apprehend that he will be unable to have recourse to the public authorities for his release [(11)].

Committee of Concerned Citizens (an independent collective of individuals sharing a deep and common concern on this climate of violence, brutalisation and insensitivity) has been repeatedly highlighting these issue of encounters, precisely because it relates to extinguishing of human life and right to life by the Government itself—Government which is expected to protect life and liberty under the Constitution—and for which no recompense is possible. Such killings have become part of the administrative practice of the State, consciously pursued and encouraged. Such fake encounters can no longer be considered as isolated aberrations or administrative miscalculations or termed as excesses or unintended transgressions of law by individual police personnel. They can only be perceived as the calculated and deliberate system response of the State, which is adopting a policy of annihilation of individuals, unable to comprehend a complex problem, which is the result of inequity and denial of justice[12].

REMARKS

To avoid such inhuman activities, it is not only the responsibility of police but also of team of doctors performing the postmortem to pursue their duty properly, sincerely and as per law.

The problem of police brutality has a wide range of causes. The police force has an inordinate amount of power and discretion delegated to them by the legal system, the political climate and society in general. The internal reward system, which provides monetary incentives or promotions for carrying out extrajudicial executions, also acts as a catalyst. In addition, victims

hail primarily from the disenfranchised, poverty-stricken, lower caste and illiterate sections of society, which generally lack access to the few legal remedies that actually exist. A lack of cohesion between local organisations has rendered the existing support system incapable of combating the problem. Furthermore, systemic and endemic corruption in the police and within the political and judicial agencies exacerbates the problem and ensures that such crimes go unpunished.

The doctor performing autopsies of such cases are under immense pressure from high authorities (police/ administration) to justify the encounters.

Doctors can commit mistake in noting down the findings (knowingly or unknowingly), which is against medical and legal ethics. The authors proposes that in all these cases of custodial deaths, post-mortem examination should be conducted by a board of more than one doctor, out of which at least one doctor should either be a forensic medicine expert or should have got proper training in dealing such cases. An inexperienced team of doctors has limited value to conduct such important medico-legal postmortems and to find out the exact cause of death.

The autopsy of such cases is a challenging job and requires an expertise opinion who got the in depth knowledge of forensic medicine. The model autopsy procedure should be followed with utmost care. The autopsy should be conducted by a team of doctors and should also include a forensic expert along with senior experienced doctors. It should start with panchnama and if possible the statement of eyewitness should also be scrutinised along with First Information Report. Videography and coloured photography should be taken before starting and while conducting the postmortem examination. Each and every step of dissection focusing on the ante-mortem and post-mortem injuries over the body should be differentiated and recorded as a piece of evidence. The other recommendations issued by NHRC in this regards should also be adhered to in these cases like autopsy protocol and format of post-mortem report.

The opinion about cause of death should be ascertained on the basis of external, internal findings, injuries present over the body, visceral examination (if needed) and histo-pathological examination (if needed) to exclude any pathology. The detailed autopsy should be done so that cause of death of the individual should be known to authorities, NHRC and general public also.

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Review Article

Impact of Forensic Technology on Justice Delivery System in India: Issues Relating to DNA Fingerprinting

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ABSTRACT

Science and technology have made a huge invasion in our lives. Since the beginning of this world, the intelligence of human beings has resulted in the growth of science and technology according to the interests and needs of humankind. The modern inventions of science and technology shall have serious impact on the law and the justice delivery system of any country. The evolution of science and technology has enabled law enforcement agencies to solve many apparently 'cold crimes', which have made people to associate forensic science with detection of crimes. The basic function of forensic technology is to assist in the administration of justice. DNA technology could be the greatest single advancement in the search of truth, conviction of the guilty and acquittal of the innocent since the advent of cross-examination. This technology has revolutionised the modes of investigation of violent crimes as a result of its precision in matching physical and biological evidence from a crime scene to either convict a perpetrator or vindicate a convicted offender. In essence, DNA evidence is rapidly becoming irrefutable proof of identification. The pace of using DNA technology in the worldwide justice delivery system is increasing. Despite the increase in the use of DNA technology, there is no legislation providing for general administration of the application of DNA technology in India. Although the Indian justice system has realised the importance of the DNA technology in safeguarding the sentinels of justice since its inception, it is serving as a helping hand to the justice system of the country. The law of the country is bound to change due to the revolutionary scientific changes. Hence, an effort must be made to better administer the application of the DNA fingerprinting, so that criminals can be convicted easily and more reliably.

Keywords: Justice delivery system, Forensic Technology, DNA Evidence, DNA fingerprinting, Criminal Investigation.

INTRODUCTION

The rapid availability of new technology in the world of crime has not only provided law enforcement officials with a greater array of tools and new methods to aid them in the pursuit of criminal justice, but it has also provided them with new challenges, as criminals now have a similar advantage in aiding them in their illegal activities. Thus, we have seen the advent of Virtopsy[1], DNA fingerprinting, fingerprinting, wireless communications, the motor car and other devices, which have long since become mundane. The adaptability, and the malign creativity of criminals, however, requires the ongoing development of means to prevent, or at least to minimise, their harmful activity. The bondage of law and technology has always been a boon to the society, resulting in numerous intriguing cases being correctly investigated, retaining the sanctity of the Judicial system. The role of forensic fraternity in assisting the various national and state agencies in maintenance of law and order has been paramount. Forensic focusses on the

1.Virtopsy, refers to a non-invasive autopsy performed on a human body it uses various techniques including 3D surface scanning, cat scans and MRIs. It can be used to make forensic analysis in a easier way in order to determine the cause of death in some cases. However it has not totally replaced the other traditional methods of making such analysis. See: http://www.pcmag.com/encyclopedia/term/55824/virtual-autopsy., last visited on 15th March 2013.

areas in which medicine and human behaviour interface with the law. The basic function of forensic technology is to assist in the administration of justice. The opinion of forensic experts is expected to be independent and scientific, and therefore it not only corroborates the crime but may also help an innocent person who has been wrongly implicated. Against this background, the primary aim of this article is to consider the likely impact of DNA technology on justice delivery system. It focusses on two major aspects of DNA technology: the utility of the DNA test as a powerful tool for human identification, crime scene investigations, parentage determination and admissibility of DNA samples recovered from the crime scenes in the courtroom.

What is DNA fingerprinting?

Now-a-days, the use of DNA fingerprinting technology has gained acceptance in the field of forensic and life sciences, and courts in Europe, the USA and Asia have frequently availed of DNA evidence in deciding cases. Before discussing DNA evidence, let us first talk about another popular forensic evidence, the fingerprint. The fingerprint, a century old and unique to an individual, is a powerful and proven identifier. All human beings are born with a characteristic set of ridges on their fingertips. The ridges, which are rich in sweat pores, form a pattern that remains fixed for life. Even if the skin is removed, the same pattern will be evident when the skin regenerates. Some of the typical patterns found in fingerprints are arches, loops and whorls. When we touch something, a small amount of the oils and other materials on our fingers is left on the surface of the object we touched. The pattern left by these substances, which collect along the ridges on our fingers, make up the fingerprints that police look for at the scene of a crime. Fingerprints collected as evidence can be compared with fingerprints on file or taken from a suspect. For instance, if the evidence found at the crime scene is an individual's right thumbprint, and a suspect is identified, the right thumbprint or the 'known' print is compared to that found. If the fingerprint is different, it is considered as an 'exclusion' or not that of the suspect. But if the pattern of the skin in the thumb is the same, it is deemed a 'match'. Fingerprints have probative force, but for many heinous crimes, such as murder and rape, no fingerprints are left behind[2]. Hence, there was a need to look for other identifying biological markers that can be taken from blood, tissue or semen. Tests for protein, cell surface and blood groupings came about but were nowhere as remarkable as fingerprint until it was possible to read DNA.

DNA is shorthand for deoxyribonucleic acid. DNA is the biological material, which contains all the genetic information within living organisms, including human beings. The ability of a cell of a human body to replicate itself is due to the presence of the DNA 'blueprint' in the chromosomes within the nucleus of each cell. Each human cell contains 23 pairs of chromosomes within its nucleus. One-half of each pair of chromosomes is provided by each parent at the time of conception. Although most of the information stored in human DNA includes general information common to all humans, some of the information is unique to a particular individual. Only identical twins have identical DNA. The DNA information unique to a particular individual is stored in genes known as polymorphic genes and their location on a DNA molecule is called a polymorphic site or locus. By isolating and identifying certain segments of the DNA molecule contained in human tissue samples (e.g., blood, skin, hair follicles or semen stains), it is possible to identify the individual who is the source of the DNA[3].

When DNA testing is carried out on a crime scene, it is performed on certain locations (loci) in a DNA sample. When a suspect's DNA is analysed, it is done so at the same loci to make a valid comparison. If a single feature is different, it is excluded and the suspect is considered innocent. Otherwise, there is basis to prosecute[4]. DNA fingerprinting technology is so advanced that even if the blood is disintegrated the DNA remains stable unless it is burnt by fire[5]. It is a scientifically accepted fact that the

2. www.forensic-evidence.com/site/retrieved on 15 september2012
3. www.libcd.law.wisc.edu retrieved on 15 september2012
4. www.thailawforum.com/articles/ retrieved on 15 september2012
5. In *State* vs. Sushil Sharma, 2007 CriLJ 4008; DNA test was carried out with the blood samples of the parents of Naina Sahni and the tissues(muscle) taken from the semi-burnt body of the woman lifted from the tandoor.

DNA can be preserved for a very long period of time, if the proper preservation procedures are followed[6]. So Court held in a case that it is not proper to say that the examination of sperm and semen done after 4 months was valueless[7]. The scope of error in DNA printing, including malfunctioning of the instruments, human error and use of chemicals beyond expiry date, is 1 in 32 billion[8].

Utility of DNA Evidence in Criminal Investigation

DNA evidence can be useful in criminal investigations and prosecutions. The use of DNA has become inseparable with the investigation of violent and sexual crimes. In fact, recent advances have made DNA analysis a tool in the investigation of less serious crimes as well.

Table 1: Uses of DNA fingerprinting in criminal investigations

To determine the identity of the perpetrator	Comparing a profile derived from semen in a rape victim's vagina with the suspect's profile.
To determine whether suspect had prior contact with the victim	Comparing a profile derived from bodily samples found on the suspect's body with a victim's profile, or vice versa.
To determine the identity of the victim	Comparing a profile from an unidentified person or corpse with a known person's profile.
To infer the common involvement of one person in separate crimes	Comparing profiles in two crime scene samples.
To confirm or negate a suspicion	Comparing the profile of a suspect with a profile derived from a sample found on or in the victim's body, or vice versa.

Initially, in the Aarushi Talwar murder case[9], fingerprinting was applied and DNA was extracted from the clothes containing blood stains. Also several fingerprints were found on the glasses of the house at the time of the murder. Several narco analysis tests were applied on Aarushi's father on CBI's suspicion, but after no match was found Aarushi's father was discharged. Similarly, identifying the victims of the 11 September 2001, World Trade Center attack presented a unique forensic challenge, because the number and identity of the victims were unknown and many victims were represented only by bone and tissue fragments. At the time of the attack, no systems were in place for rapidly identifying victims in disasters with more than 500 fatalities. The National Institutes of Justice assembled a panel of experts from the National Institutes of Health and other institutions to develop processes to identify victims using DNA collected at the site. Panel members produced forms and kits needed to enable the medical examiner's office to collect reference DNA from victims' previously stored medical specimens. These specimens were collected and entered into a database. The medical examiner's office also received about 20,000 pieces of human remains from the World Trade Center site, and a database of the victims' DNA profiles was created. New information technology infrastructure was developed for data transfer between the state police and medical examiner's office and to interconnect the databases and analytical tools used by panel members. In 2005, the search was declared at an end because many of the unidentified remains were too small or too damaged to be identified by the DNA extraction methods available at that time. Remains of only 1,585 of the 2,792 people known to have died had been identified. In 2007, the medical examiner's office re-opened the search after the Bode Technology Group developed a new methodology of DNA extraction that required much less sample material than previously necessary. The victim DNA database and the new

6. Vinay Kumar vs State. Accessed on 25 September 2012: http://www.indiankanoon.org/doc/
7. Kali Ram v. State of Maharashtra, 1989 Cr.L.J. 1625 (Bom)
8. Dharam Deo Yadav vs State Of Uttar Pradesh. Accessed on 25 April 2012: www.indiankanoon.org/doc/
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methods have allowed more victims to be identified, and further identifications will be possible as forensic DNA technology improves[10].

Admissibility of DNA Evidence

The importance of DNA evidence has been recognised around the world due to its 99.9% accuracy and reliability. Even in the absence of statutory recognition, DNA testing is used in Indian cases. Although the Criminal Law was silent on DNA analysis, the courts have interpreted the same in the spirit of section 53 of the Code of Criminal Procedure, 1973. The Andhra Pradesh High Court in *Ananth Kumar* vs. *State of Andhra Pradesh*[11] has held that although there is no clear provision in the Criminal Procedure Code for taking such blood samples, there is no prohibition against taking such blood samples of an accused by exercising powers under section 53 of the code. The Court observed that taking samples of blood and semen would come within the scope of examination of the arrested person and therefore, 'examination of a person by a medical practitioner must logically take in examination by testing his blood, sputum, semen, urine etc.' The court further held that section 53 provides the use of such force as is reasonably necessary for making such an examination. Therefore, it was held that whatever discomfort might be caused, samples of blood or semen may be taken from an arrested person under the provision of sections 53 and 54 of the Criminal Procedure Code. Further, in the case of *Jamshed* vs. *State of Uttar Pradesh*[12], Division Bench of the Allahabad High Court, relying on the judgment of the Supreme Court in *State of Bombay* vs. *Kathi Kalu*[13] held that taking a blood and urine test is not prohibited by article 20(3) of the constitution.

Article 20(3) of the Indian Constitution provides that no person accused of any offence shall be compelled to be a witness against himself. This article is a guarantee against self-incrimination and aims at protecting the accused against possible police torture during investigation. Hence, a person can remain silent if the answer to any question would tend to incriminate him. This has resulted in a debate as to whether DNA or other tests can be done on the accused. However, it is also a well-settle principle of law that no one can take advantage of his own wrong. Moreover, Article 21 also speaks of a fair and reasonable procedure. So, making use of DNA technology for investigative purposes does not mean a denial of the right under article 20(3) of the constitution, especially, when it is carried out under the supervision of the judiciary so as to ensure that the procedure is just and fair. Hence, DNA tests should be made as they will not only enable the investigative agencies to reach the real culprit, but also ensure speedy investigation and trial[14].

The reports of DNA experts are dealt under section 293 of the Code of Criminal Procedure. The court can scrutinise the report given by the expert whenever it is necessary[15]. The court should not take that report as it is

10. Accessed on 05 September 2012: http://www.ornl.gov/hgmis/elsi/forensics.shtml; Maninder Pal Singh Kohli accused of murdering Hannah Foster in Hampshire in 2003 was apprehended in India and extradited to UK by the British Police in 2007 after his wife consented to DNA testing from their two sons and Forensic Science Service was able to infer a DNA profile for the fugitive criminal from their DNA, which matched the DNA of the semen of the accused found on the clothes of Hannah Foster.

11. 1977 Cr LJ 1797

12. 1976 Cr LJ 1680

13. AIR 1961 SC 1808.

14. Anshu Jain. 'DNA Technology and its Impact on Law' 2006; NALSAR Law Review vol.3 41-48 at p. 46

15. Criminal Procedure Code: Section 293. Report of certain Government Scientific Experts- (1) Any document purporting to be a report under the hand of a Government Scientific expert to whom this section applies, upon any matter or thing duly submitted to him for examination or analysis and report in the course of any proceeding under this Code may be used as evidence in any inquiry, trial or other proceeding under this Code. (2) The Court may, if it thinks fit, summon and examine any such expert as to the subject matter of his report. (3) Where any such expert is summoned by a Court and he is unable to attend personally, he may, unless the Court has expressly directed him to appear personally, depute any responsible officer working with him to attend the Court, if such officer is conversant with the facts of the case and can satisfactorily depose in Court on his behalf. (4) This section applies to the following Government Scientific experts, namely:
(a) any Chemical Examiner or Assistant Chemical Examiner to Government; (b) the Chief Inspector of Explosives; (c) the Direct or of Finger Print Bureau; (d) the Director, Haffkeine Institute, Bombay; (e) the Director (Deputy Director or Assistant Director) of a Central Forensic Science Laboratory or a State Forensic Science Laboratory; and (f) the Serologist to the Government.

without making an analysis[16]. People have different views regarding scientific evidence like DNA. It cannot be subjected or questioned; only legal analysis can be done on the collection and authentication of a scientific sample[17]. In the case of *Geetha* vs. *State of Kerala*, the[18] Court held that the report of DNA fingerprinting issued by the Centre for DNA Fingerprinting and Diagnostics (CDFD) can be admitted in evidence even without examination of the expert under Section 293 of the Criminal Procedure Code. Similarly, the Apex Court in *State of H.P.* vs. *Mastram*[19], had held that the report of DNA fingerprinting cannot be rejected on the ground that the Government Scientific Expert who has issued the same, is not enumerated under sub-section (4) 293 of Criminal Procedure Code. The Supreme Court had rather held that the report of DNA fingerprinting has to be admitted in evidence under sub-section (1) of Section 293 as a report, which is issued under the hand of a Government Scientific Expert.

Now, the Code of Criminal Procedure (Amendment) Act, 2005, gives statutory recognition to DNA profiling by inserting an explanatory clause in section 53 of Criminal Procedure Code[20].

DNA Evidence and Paternity Issues

DNA analysis is a most powerful tool for human identification, crime scene investigations and parentage determination. Before the advent of DNA testing, human identity testing was largely carried out through a blood type test. DNA analysis has now superseded blood testing and is the most accurate method currently available for human identification. Since its discovery from 30 years ago, the use of DNA for human identity and relationship testing has emerged as a powerful tool in both civil and criminal justice systems. DNA testing can reveal whether two or more individuals are related as well as determining the nature of their relationship. Today, it is possible to identify people by a single hair, as well as to obtain information about their gender and ethnic background, and, within the next couple of years, identify their age[21].

DNA profiles of the mother and the child are obtained to determine which half of the child's DNA was inherited from the mother. The other half is inherited from the father. If the man does not have DNA types in his profiles that match the paternal types in the child, he is excluded. If he has, he is not excluded as the father. Indian courts have given more importance to social parentage than the biological one. Echoing the maxim *Pater est quem nuptiae* demonstrant (the father is he whom the nuptials indicate), Section 112 of the Indian Evidence Act, 1872, is based on the rule that the child born in wedlock should be treated as the child of the man who was then the husband of his mother[22]. The only exception is when the husband proves that he had no access to his wife at the time of conception of that child. The legislative concern is against illegitimatising a child as he should not suffer social disability because of the lapses of parents. In *Gautam Kundu* vs. *State of West Bengal*[23], the Supreme Court held that the Court cannot compel the father to submit to a DNA test in order to determine the paternity.

16. *Madan Gopal Kakkad* vs. *Naval Dubey* 3 SSC 204 (1992).
17. Pillay VV. Textbook of Forensic Medicine and Toxicology, 14th Edition, 2004: p-89, Paras Medical Publishers, Hyderabad.
18. 2005 (2) DMC 286
19. (2004) 8 SCC 660
20. Criminal Procedure (Amendment) Act, 2005: Amendment of section 53 - The following Explanation shall be substituted, namely: 'Explanation– In this section and in sections 53A and 54,- (a) 'examination' shall include the examination of blood, blood stains, semen, swabs in case of sexual offences, sputum and sweat, hair samples and finger nail clippings by the use of modern and scientific techniques including DNA profiling and such other tests which the registered medical practitioner thinks necessary in a particular case.
21. Accessed on 10 September 2012: http://www.articledashboard.com
22. Section 112 of the Indian Evidence Act: Birth during marriage, conclusive proof of legitimacy- The fact that any person was born during the continuance of a valid marriage between his mother and any man, or within 280 days after its dissolution, the mother remaining unmarried, shall be conclusive proof that he is the legitimate son of that man, unless it can be shown that the parties to the marriage had no access to each other at any time when he could have been begotten.
23. (1993) 3 SCC 418

The same sentiment was echoed in *Syed Mohd. Ghouse* vs. *Noorunnisa Begum*[24]. This case had also laid down some guidelines which are:

1. Courts cannot order a blood test as a matter of course.
2. No one can be compelled to give a blood sample for analysis.

In *Smt. Kanta Devi and another* vs. *Poshi Ram*[25], the Supreme Court emphasised that 'Section 112 of the Evidence Act was enacted when DNA tests were not even in contemplation of the legislature. The result of a genuine DNA test is said to be scientifically accurate, but even that is not enough to escape from the conclusiveness of Section 112 of the Act, e.g., if a husband and wife were living together during the time of conception, but the DNA test reveals that the child was not born to the husband, the conclusiveness in law would remain unrebuttable. This may seem to be hard on the husband who would be compelled to bear the fatherhood of a child of which he may be innocent, but even in such a case, the law leans in favour of the innocent child from being bastardised, if his mother and her spouse were living together during the time of conception. Hence, the question regarding the degree of proof of non-access for rebutting the conclusiveness must be answered in the light of what is meant by access or non-access.' The effect of this decision is it encouraged law makers to strictly adhere to a conventional, unscientific, ineffective and biased system of justice. Here one must not forget that the responsibility of the courts is to provide the search for truth. When that process can be aided by forensic science that yields reliable results, the interests of the justice system and society are served. Besides, every person has the right to enjoy the benefits and application of scientific progress (Art. 15, International Covenant on Economic, Social and Cultural Rights) more significantly when claiming rights to due process and to be presumed innocent under the Constitution. Every child seeking to enforce the right to know and be cared for by his/her parents pursuant to Art. 7, UN Convention on the Rights of the Child, may avail of proof allowed by the Rules on Evidence and any method other than those such as a DNA paternity test to prove parentage. *Malimath Committee*[26] also recommended to the Law Commission of India that Section 112 of the Evidence Act should be revised as follows:

"112. The fact that any child was born during the continuance of a valid marriage between its mother and any man, or within 280 days,

(*i*) after the marriage was declared nullity, the mother remaining unmarried; or

(*ii*) after the marriage was avoided by dissolution, the mother remaining unmarried; shall be conclusive proof that such person is the legitimate child of that man, unless

(*a*) it can be shown that the parties to the marriage had no access to each other at any time when the child could have been begotten; or

(*b*) it is conclusively established, by tests conducted at the expense of that man, namely,

(*i*) Medical tests, that, at the relevant time, that man was impotent or sterile, and is not the father of the child; or

(*ii*) Blood tests conducted with the consent of that man and his wife and in the case of the child, by permission of the court that, that man is not the father of the child; or

(*iii*) DNA genetic printing tests conducted with the consent of that man and in the case of the child, by permission of the court that, that man is not the father of the child; and

Provided that the court is satisfied that the test under sub-clause (*i*), sub-clause (*ii*) or sub-clause (*iii*) has been conducted in a scientific manner according to accepted procedures, and in the case of each of these sub-clauses (*i*) or (*ii*) or (*iii*) of clause (*b*), at least two tests have been conducted, and they resulted in an identical verdict that the man is not the father of the child. Provided, further

24. 2001Cri. L.J. 2028; see also, *Amarjit Kaur* v. *Harbhajan Singh* 2003 (10) SCC 228.
25. 2001 (5) SCC 311;see also, *Banarsi Dass* v. *Teeku Dutta (Mrs.)* 2005(4)SCC449
26. *Report of Committee on Reforms of Criminal Justice System*, Vol. I, Government of India, Ministry of Home Affairs, India, 2003.

that where that man refuses to undergo the tests under sub-clauses (*i*), (*ii*) or (*iii*), he shall, without prejudice to the provisions of clause (*a*), be deemed to have waived his defence to any claim of paternity made against him.

Explanation I: For the purpose of sub-clause (*iii*) of clause (*b*), the words 'DNA genetic printing tests' shall mean the tests conducted by way of samples relatable to the husband and child and the words 'DNA' mean 'deoxyribonucleic acid'.

Explanation II: For the purposes of this section, the words 'valid marriage' shall mean a void marriage till it is declared nullity or a voidable marriage till it is avoided by dissolution, where, by any enactment for the time being in force, it is provided that the children of such marriages, which are declared nullity or avoided by dissolution, shall nevertheless be legitimate.

However, in the case of *Sharda* vs. *Dharmpal*[27], the Supreme Court took an optimistic view regarding the admissibility of DNA tests in a court of law. It is not only profitable but also appropriate to bear in mind that Section 45 of the Indian Evidence Act empowers the Courts to appreciate scientific evidence in a matrimonial case. Thus, the Supreme Court categorically observed that:

1. A matrimonial court has the power to order a person to undergo medical test.
2. Passing of such an order by the court would not be in violation of the right to personal liberty under Article 21 of the Indian Constitution.
3. However, the court should exercise such a power if the applicant has a strong prima facie case and there is sufficient material before the court. If despite the order of the court, the respondent refuses to submit himself to medical examination, the court will be entitled to draw an adverse inference against him.'

Now-a-days, the courts are slowly considering the importance of a DNA test and in many instances have deviated from the decision in Kundu's case. For example in *Kanchan Bedi* vs. *Gurpreet Singh Bedi*[28], a DNA test of the child was directed where the defendant was denying any marriage had taken place between him and the plaintiff and therefore he was not the father of the child. In the case of *State through C.B.I.* vs. *Amaramani Tripathi*[29], the paternity of a 6-month-old foetus in the womb of the deceased was conclusively established with the help of DNA test.

Now courts are giving due weight to DNA evidence. A DNA test was conducted on dead foetus in the sensational Premanada Swami's case, a god man who was charged with the rape of 13 ashram girls and murder of one of its inmate teenage girls in his ashram. Before the Supreme Court DNA test established 45-year-old Swami Premananda as the biological father of the foetus as a result of rape of 19-year-old Arul Jyothi[30]. Similarly, in a recent high-profile case, the Supreme Court refused to dismiss the Delhi High Court's decision ordering Congress Leader N.D. Tiwari to undergo a DNA test, which is very important from the view point of the admissibility of such evidence. In this case, Rohit Shekar has claimed to be the biological son of N.D. Tiwari, but N.D. Tiwari was reluctant to undergo such test stating that it would be a violation of his Right to Privacy and it would cause him public humiliation. The Court ruled: 'There is of course the vital interest of child to not be branded illegitimate; yet the conclusiveness of the presumption created by the law in this regard must not act detriment to the interests of the child. The protective cocoon of legitimacy should not entomb the child's aspiration to learn the truth of her or his paternity.'[31] This was held to be a leading landmark judgment towards modernisation of the constitution as per the changing demands of the time, which proves the flexibility of our law, which can be easily molded so as to serve the ends of justice.

27. (2003) 4 SCC 493 at 524
28. 2003 (103) Delhi LT 165
29. 2005 AIR 3490
30. Kamalanantha vs State Of Tamil Nadu, (2005) 5 Supreme Court Cases 194.
31. Accessed on 25 September 2012: http://netindian.in/news/2011/02/25/00011267/hc-denies-reprieve-n-d-tiwari-paternity-suit-case

Relevance of DNA Evidence in Criminal Cases

A variety of offences, such as rape, murder, extortion, armed robbery and drug trafficking, lend themselves to the application of DNA collection and testing. In the same vein, DNA evidence, as a tool for identification in criminal cases, works both ways. It may help clear a suspect from criminal liability or serve as proof to convict an accused. Even if the possibilities of coincidental match, lab error, contamination and tampering are discounted, a DNA profile match does not necessarily establish guilt beyond reasonable doubt. This is because there may still be the possibility that the defendant's DNA sample was innocently left at the crime scene before, during or immediately after the offence. Of course, other evidence in the case may negate this possibility. There has been one case in Australia *Queen* vs. *Frank Allan Button*[32], where DNA evidence has been used to overturn a wrongful conviction. This was the case of Frank Button, who served 10 months of a 7-year sentence for the rape of a 13-year-old girl in Queensland in 1999, before having his conviction overturned by the Queensland Court of Appeal. As Kirsten Edwards reports:

'The girl initially denied knowing the rapist and provided a description of the man to police. She then changed her original statement and nominated Frank Button as the rapist. DNA evidence was not used in the trial. A rape kit was prepared. Vaginal swabs obtained from the rape victim revealed the presence of spermatozoa, but testing failed to yield a conclusive DNA profile. Sheets and pillowcases from the victim's bed were also sent to the lab but were not tested at all. Button was convicted and sentenced to 7 years prison. He lodged an appeal that raised the absence of scientific evidence in his case.

When the lab test of the bedding from the girl's room was done, a semen stain was discovered on the complainant's bed sheet and it revealed a DNA profile, but the profile did not match Frank Button. Alarmed, the lab tested the vaginal swabs again. This time the lab found a male DNA profile. This profile also did not match Button. In fact, it was the same profile found on the sheets. The profile was run through the Queensland convicted offender database and matched the DNA profile of a convicted rapist who met the victim's initial description of the offender and lived in the same community. Frank Button was released after serving 10 months in jail, where he was bashed and sexually assaulted. The Queensland Court of Criminal Appeal described the case as 'a black day in the history of criminal justice administration in Australia.'

Prior to the use of DNA evidence, matters involving the offence of rape could be solved primarily by circumstantial evidence only. It was very difficult for the victim of rape to prove the offence in the absence of either circumstantial evidence or an eyewitness, which was very rare. Since the introduction of the DNA evidence, this has been greatly simplified. First samples of the seminal fluids found at the scene of crime by the investigating officer are analysed. If this is not available, then samples of the seminal fluid are extracted from the victim's body itself. The DNA from this sample is then compared with the DNA sample taken from the accused. If the report establishes that these samples match, then this acts as evidence in the court proving rape[33]. In the *Priyadarshini Mattoo*[34] rape and murder case, the Apex Court pulled up trial court for not taking up DNA expert's opinion. The Supreme Court wondered why the trial judge chose not to listen to Lalji Singh, a scientist involved in DNA technology since 1974 and a person acknowledged in a SC judgment of 2005 as an expert. He had developed indigenous techniques for DNA fingerprinting, which are now being used. The Court observed that 'the tendency of the trial judge to rely on textbooks on DNA profiling rather than to listen to experts' testimonies during trial

32. The Queen v Frank Allan Button [2001] QCA 133.
33. The amendment of Cr.PC by the Cr.PC (Amendment) Act, 2005, has brought two new sections, which authorizes the investigating officer to collect DNA sample from the body of the accused and the victim with the help of medical practitioner. Section 164A(2) of the criminal procedure code, laid down mandatory description of material taken from the victim of rape for DNA profiling. Again in section 53A criminal procedure code provides that examination of accused person of rape by medical practitioner would be also mandatory.
34. *Santosh Kumar Singh* vs. *State*. Accessed on 20 September 2012: http://www.kanoonindia

may have led to the acquittal of convict Santosh Singh and delayed justice for his victim. The court cannot substitute its own opinion for that of an expert, more particularly in a science such as DNA fingerprinting, which is a recent development.' Thus, the court accepted the identification of the accused on the basis of the DNA report of the semen stains on the swabs and slides and the underwear of the deceased and the blood samples of the appellant and awarded him life imprisonment. The police were criticised for not having employed a DNA test during investigation and it was observed by court that, in case of rape, where injuries on the vagina of the victim are so grave and serious, in our opinion, either pubic hair or semen of the accused ought to have been found from the body of the victim[35].

It is not disputed that a DNA test is very useful for establishing the identity of a dead person whose body is recovered that is not in an identifiable condition because of decomposition etc. In *State* vs. *Sushil Sharma*[36], The appellant had not only pumped bullets in the head of the deceased but had also chopped off her limbs and then took the body to his restaurant in the heart of the city and placed it on the tandoor and burned it. Delhi High Court admitted the positive report that DNA extracted from the tissues of the charred body and from the blood of the parents matches thereby confirming that the body burned on the tandoor of Bagia restaurant was that of Naina Sahni.

Similarly, in *Dharam Deo Yadav* vs. *State Of Uttar Pradesh*[37], a religious tourist and young lady Diana Clare Routley from New Zealand visited Varanasi in 1997 and was reported missing by her father L.N. Jack Routley after 1 year since her last call. Dharam Dev Yadava, an unregistered tourist guide, was interrogated as suspect and buried skeleton of a human body was recovered from the cemented floor of a room in the house of the accused in district Gazipur. The body was identified as deceased using DNA technology. Session's Court awarded the principal accused hanging till death, which was confirmed by the High Court.

In *Pantangi Balarama Venkata Ganesh* vs. *State of Andhra Pradesh*[38], it was alleged that the accused and the co-accused had fired at the deceased. Witnesses identified the assailant as wearing a pink shirt and testified that the accused had been injured during the firing. The pistol used and the blood-stained pink shirt were recovered and the blood found on the shirt was found to match with the blood of the accused as per a DNA test. Further, as the accused admitted to having been at the crime scene, the Court, relying on all the available evidence including the DNA evidence, found him guilty. The Court relied on an article by Dr. Lalji Singh, which hailed the conclusive nature of the results of a DNA declaring that 'the DNA test gives the perfect identity. It is a very advanced science.'

Collection and Application of DNA Evidence

A study by the National Institute of Justice (NIJ) of the United States' Justice Department showed that there are many unusual sources of DNA evidence that need to be explored by an investigator[39]. These include saliva found on the flap of an envelope containing a threat letter, spittle collected from the sidewalk where a suspect in a sexual assault case was under surveillance and blood collected from a bullet that had injured an assailant himself in a case of murder. Collection of samples at the scene of a crime requires some skill and observance of basic rules of hygiene. There are two dangers here. One is that, as in the case of hand fingerprints, there is a distinct possibility of several persons having left their DNA behind in a crime scene. The need, therefore, is to identify all visitors and collect their samples (apart from those of the victim/ suspect). This assiduous process can try an officer's patience. Second, DNA samples are extremely susceptible to contamination. It is essential that the technicians collecting the sample adopt all the precautions that as a

35. *State of Gujarat* vs. *Kishnbhai*, MANU/GJ/0506 /2005
36. Supra note 5
37. Supra note 8
38. MANU/SC/1306/2009
39. *Accessed on 15 September 2010: http://www.justnet.org/.pdf*

surgeon would adopt while performing a critical surgery. Any slackness could render the entire operation wasteful and susceptible to easy picking of holes by the defense counsel during a trial.

Thus, the judges and the justices are responsible for application of DNA evidence. They must receive training on the proper application of DNA technology that will be of help to them when accepting or rejecting the expert's opinion and in evaluating the factors leading to that conclusion. The DNA expert witness also plays a pivotal role in the use of the evidence in court. The witness must be properly qualified as an expert. The gathering and chain of custody of the DNA sample must be protected from contamination so that the court will consider it in resolving the issues and in deciding the case. The expert witness must also be aware of the fact that when DNA evidence is rejected in the lower court, it is abuse of discretion on the part of the judge that must be proved on appeal.

Moreover, it is incumbent upon the DNA expert witness to work closely with the lawyers educating them about the technology. The witness must be prepared for cross-examination by the opposing party, using prior and consistent expert testimony. When testifying, the expert witness must anticipate questions that sometimes call for answers beyond the scope of area of expertise. The witness must make sure that as an expert, terms have been defined for the record, confident in what he/she knows and knows that the opinion evidence counts because he/she is the expert.

Evolving Impact of DNA Technology on the Criminal Legislation

Evolution of DNA technology is having a major impact on laws as they have or are being amended in much legislation worldwide. Enactment of law regarding the collection, use, storage, admissibility and creation of DNA database for DNA evidence reflects the impact of DNA technology on a criminal justice system. Forensic–DNA fingerprinting has now been used in many criminal and civil cases around the world, and has become an established technology. 'Forensic Science International'[40] has a special issue relating to the legal position of Forensic DNA Analysis in Europe. It reports that the following countries have accepted DNA analysis as reliable, viz., Denmark, Sweden, the Netherlands, Belgium, The Republic of Ireland, France, Italy, Greece, Spain, Portugal, Austria, Switzerland and Germany, subject to certain limitations. For instance, in Denmark, the results of investigations were used more systematically since 1990 in criminal cases, such as rape, homicide, etc. Since 1990, there has been a tendency in court decisions to put more and more emphasis on DNA investigations. In Sweden, DNA analysis has been regarded by the court, and in the public opinion, as an important tool for forensic case work right from the beginning. In 1990, the Dutch Supreme Court admitted the use of DNA as exculpatory evidence. A new DNA legislation was incorporated into the Dutch Code of Criminal Procedure from 1 September 1994, which forces non-consenting defendants to give biological reference samples, and the results of the DNA tests can be used as proof of guilt. In so far as France is concerned, the consent of interested parties is mandatory with the restriction that in the case of a suspect his refusal can be interpreted as prima facie evidence.

The vision of justice to which the criminal justice system is based on: should be a proper balance between the protection of civil liberties, presumed innocence and procedural rights of persons, and the needs of the state to apprehend, punish and rehabilitate perpetrators of crime. People have an expectation of privacy with respect to the content of their DNA sample, regardless of where it has been obtained or acquired[41]. It is pertinent to mention that the adoption of DNA technology in the criminal justice system has encountered resistance from the public on the ground of violation of basic human rights under Articles 20(3) and 21 of the Indian Constitution. However, since the advantages of the techniques outweigh the disadvantages, many countries, as pointed

40. Martin PD, Rittner C, Schnieder, PM. Proceedings of the European Symposium: Ethical and Legal Issues of DNA Typing in Forensic Medicine, 1997; 88(1): 15.
41. *R.R. Gopal* v. *State of Tamil Nadu*, AIR1997 SC 264

out, have either adjusted or amended their existing laws, or have enacted specific legislations to strike a balance between the two conflicting opinions. Despite such adverse situations that exist in some countries, DNA technology has come to be accepted and admitted by both the legislature and the judiciary in the interest of justice and security. The successful adoption of the new technology has encouraged many other countries to adopt and apply the technology to identify conclusively the actual perpetrators of the crimes and the criminals. Thus, Justice K. Hema observed that 'DNA fingerprinting has risen like a new star in the horizon of Law. Let us catch its shine before it is too late and be ready for tomorrow. Let necessary inclusion be made into the statute for a worthy cause.'[42]

There is a unanimity that DNA evidence plays a crucial role in helping the courts of law to arrive at logical conclusions. In the light of new developments in forensic science, the Home Ministry, Government of India, constituted a committee under the chairmanship of Dr. Justice V.S Malimath to suggest reforms in the criminal justice system[43]. This committee suggested comprehensive use of forensic science in crime investigation. According to the committee, DNA experts should be included in the list of experts given in section 293(4) of the Code of Criminal Procedure, 1973.

Now, The DNA Profiling Bill of 2007, which is pending in Parliament, is expected to be considered and become a law sometime in the near future. If Parliament passes the DNA Profiling Bill, 2007, India will soon join the league, creating a national DNA database that will help police to arrest serial offenders and give a boost to forensic investigation. The role of the database would be to compile profiles of convicts, under trials and suspects as well as from material obtained from crime scenes. At present, India does not have a law that empowers the government to collect and store DNA profiles of convicts. DNA profiles of those convicted for crimes like murder, sexual assault and burglaries can be prepared, then in crimes like murder and sexual assault, there is a tendency on the part of the criminal to repeat offences if not convicted[44]. Once the DNA profile of a criminal is created, then the next time if a similar crime occurs, it may be possible to run it through the database and get a match. This would also be helpful to identify a suspect and increase the rate of conviction also.

Globally, the judiciary is depending more and more on scientific evidence in comparison to eye witnesses. The future of the judicial system in India is loaded with cases like the Nithari rape and murder case, Arushi murder case, Jessica Lall case etc. They all have suffered because of the inferior forensic facilities in our country. The case highlights the hazards of a conducting shabby investigating system. The Supreme Court has taken steps to modernise the judiciary investigating system and gradually consider the scientific evidences when delivering the judgments. Due to lack of legal or medico-legal, scientific awareness and knowledge among victims, investigating agencies, medical and paramedical staff, the end result is either 'justice hurried is justice buried' or 'justice delayed is justice denied' to the victims. Prevention and detection is better than conviction. As has been happening all these years, forensic technology is an ornamental and cosmetic utility of the investigating agencies, which completes the formality of the legal process and satisfies the lay public. It is show cased and remembered only when major or sensational crimes occur to satisfy the inquisitive and demanding media and citizens. Compared to other disciplines of science and technology, forensic medicine is static and stunted in India. It is not being utilised in its own right with the full thrust to help the investigating law enforcement agencies and the criminal justice system. The benefits of improving, regulating and re-organising forensic medicine *vis-à-vis* other technologies are obvious as it virtually assists the law enforcement agencies in criminal investigations, provides proactive assistance, enhances internal security, helps criminal justice administration and reduces the risk of wrongful convictions.

42. *supra note 18*
43. *Supra note 26.*
44. Sheldon Krimsky, Tania Simoncelli. Genetic Justice: DNA data banks, Criminal Investigations, and civil liberties, Columbia University Press, Newyork 2011; pp-306-307

Recently, the Ministry of Home Affairs, Government of India considered a bill, namely, Forensic Science Service (Regulatory Board) Bill, 2011. Once this Bill is passed, it is expected by the government that private forensic laboratories will take over burdened national and state forensic facilities. However, the government has failed to realise that when the private labs come to exist the Indian criminal justice system will face another kind of problem. For instance, in *Shanti Bhushan case*, the government lab, namely, The CDFD, Hyderabad, reported that the disputed CD was genuine while private forensic lab reported that the CD was doctored. Thus, to privatise the forensic laboratories is perilous and any compromise will jeopardise the whole criminal justice system in the country. Therefore, the government should stop this Bill from being enacted in present shape and increase manpower and infrastructure in government lab to dispose of cases urgently. The developed countries are using the private sector to the minimum extent after their federal and state laboratories are fully developed. Presently, the CDFD is the only Government-approved DNA fingerprint testing center, which is now being used in this country to solve crimes. Thus, in India, the regional forensic laboratories have to first develop fully and then think about involving the private sector.

CONCLUSION

Coming to the conclusion, DNA fingerprinting is the most effective tool for solving crimes when appropriate physical evidence is available. DNA evolution has drawn the attention of the judiciary, to focus on evaluation and admission of DNA technology into court. Various decisions gave confidence to the judges to exercise greater freedom to appraise scientific evidence, which would help to resolve remaining issues of admissibility. DNA evidence exonerates the innocent and alerts law enforcement to pursue the true offender. By convicting the guilty and discharging the innocent, DNA evidence truly serves the interests of justice, but it is important that investigating officers, forensic analysts and members of the judiciary be aware of the necessity of obtaining authentic biological (genetic) samples and of the problems that may be encountered. The capability of DNA evidence to establish innocence or guilt of crime beyond a reasonable doubt is being acknowledged by the judiciary in various countries. India is not lagging behind, although DNA technology has not yet been fully welcomed in the investigation process and justice delivery system. Gradually, India is acknowledging the outcome of DNA testing, it is moving towards passing legislation, which will deal with DNA technology and set up a DNA database. Additionally, the introduction of DNA fingerprinting has revolutionised forensic science and the criminal justice system. DNA technology has given police and the courts a means of identifying the perpetrators of various crimes with a very high degree of confidence. The Indian judiciary has passed various decisions based on DNA evidences. Finally, it is also important to strengthen crime victims' confidence in the judicial process by employing DNA technology in searching for truth. The investigation process needs to be hastened by acknowledging DNA evidence as a powerful tool of current and future need; otherwise the criminal justice system will suffer.

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Case Report

Knotless Noose in Hanging: A Case Report and Review of Literature

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ABSTRACT

Knot in a noose encircling the neck has its own forensic significance in cases of hanging. The pattern of ligature mark and the mechanism of death in hanging with different knot positions are found in literature. However, when such knots are absent in noose, the post-mortem findings are different, which needs to be discussed. We report one such case of hanging, where neck compression had occurred by a ligature material with a loop that did not encircle the neck and did not bear a knot. The findings are discussed along with the mechanism of death in such cases along with a review of literature.

Keywords: Knot, Ligature, Hanging, Mechanism of death, Autopsy

INTRODUCTION

Hanging is that form of asphyxia that is caused by suspension of the body by a ligature which encircles the neck, the constriction force being the weight of the body or part of it[1]. In a case of typical hanging, the ligature runs from midline above the thyroid cartilage symmetrically upwards on both sides of the neck to the occipital region, this pattern occurs due to the typical position of knot at the occipital region. However, in practice, atypical hanging with the knot at any position other than the occipital is more commonly observed[2]. When the ligature compresses the neck, the vital structures, namely, jugular veins, carotid arteries, vagus nerve, spinal cord or the airway may individually or in combination get compressed depending on the weight of the constricting force. The pattern of ligature mark on neck, cause of death and fatal period alters accordingly to the structure damaged, which could be demonstrated at autopsy. Ligature material, method of tying, knot position, weight of the body, time of suspension, etc., are responsible for the varied post-mortem findings in a case of hanging. Knot in a ligature material is used for forming a loop, which may be of various types. A simple slip-knot produces a running noose, whereas a reef-knot or granny-knot produces a fixed loop[1]. The presence of knot and its position in a ligature material determines the compressive force exerted by the ligature on the neck and the depth of ligature mark will be more on the side of the neck opposite the knot[3]. We hereby report a rare case of hanging with a ligature without any knot as a point of suspension on the noose and discuss the mechanism of death with review of literature.

CASE REPORT

Alleged history of a 45-year-old male, found hanging from a ceiling fan at his residence on the afternoon hours. He was working as a security guard and was a known alcoholic. According to his wife, he was suffering from some mental illness and was at home without attending duty for the past 5 days. He was consuming alcohol and remained solitary in his room for most part of the day. On the fateful afternoon, when his wife had gone out, the victim hanged from the hook above the ceiling fan of his room using an electric wire (Figure 1). He was discovered after 2–3 h when his wife returned home, who immediately called her neighbours. The foot of the victim was found touching the bed and floor, beneath the point off suspension (Figure 2). Police was called who inspected the scene of occurrence and shifted the body to mortuary for autopsy. The ligature material used was a blue coloured electric wire, which was removed by slipping it through the head.

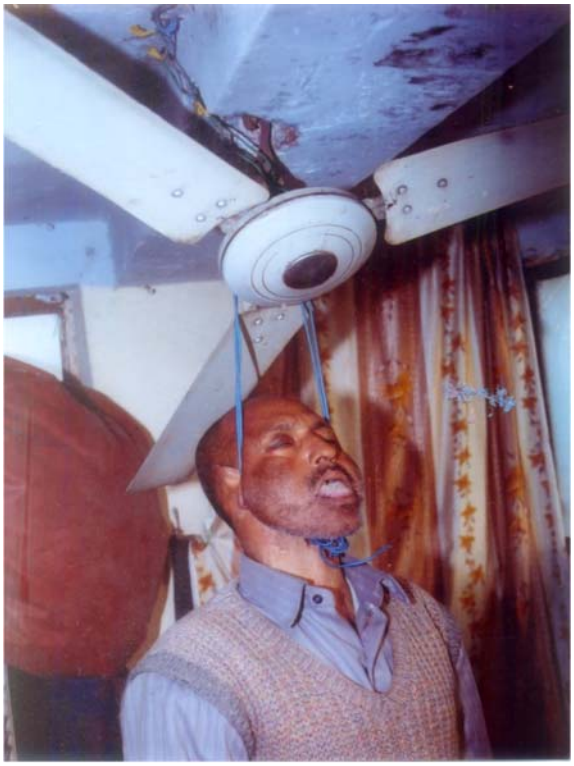

Figure 1: Hanging from the hook with a knotless loop

Figure 2: Partial hanging: Legs touching bed and floor

It was sealed by the investigating officer and brought along with the body.

AUTOPSY FINDINGS

The body of the male adult aged about 45 years, average built was brought into the mortuary in a state of full rigor mortis. Post-mortem lividity was present faintly over the dependent parts except at pressure areas. Bluish discoloration of nails, lips were present. Tongue was dark brown in colour, dry in appearance and seen to be protruding out of oral cavity between the teeth. Neck examination revealed a dark brown parchmentised ligature mark present over the upper one-third of the neck, just below the chin region extending upwards and backwards crossing the face anterior to both the ears on either side. Ligature mark was 6 cm below the mentum and 10 cm above the supra-sternal notch on the anterior midline of the neck. The width of the ligature mark was 0.5 cm. On the facial region, the ligature mark was seen 1 cm and 1.5 cm anterior to right and left tragus of ear, respectively. On dissection of neck, subcutaneous tissues beneath the ligature mark were dry and glistening. There was no extravasation of blood or hematoma onto the soft tissues of the neck. Neck muscles, vessels and thyro-hyoid complex were intact. There was no knot mark present over neck. The photographs of scene of occurrence did not bear any knot in the noose of ligature. The ligature was not found encircling the neck; instead it was across the chin region and over the face.

DISCUSSION

In a case of hanging, the noose usually encircles the neck, which is secured by the knot. Knot position and pattern in the ligature material is not only important for understanding the mechanism of death, but also the manner of death in some cases[4]. In judiciary hanging, the knot is positioned below the chin so as to create sudden hyperextension, which causes fracture of the cervical vertebrae, damaging the brain stem or spinal cord and, hence, immediate death. In some cases, decapitation might also be seen. In cases of hanging with a slip- knot, the ligature mark on the neck may produce full encirclement, whereas when the knot is fixed, the ligature mark would be incomplete at the area where the loop rises towards

the knot. This pattern is usually seen at the sides of the neck or on the nape of neck depending on the position of the knot. Badkur *et al*. conducted a study on 200 hanging cases where they gave nomenclature for knot position in hanging based on anatomical landmarks[5]. Polson observed that the lateral aspects of the neck, i.e., right or left side are the common sites for the knot in a case of hanging, whereas suspension of a knot below the chin is rare[6]. Nikolic *et al*. conducted a study to determine the frequency of hyoid-laryngeal fractures in hanging in relation to the position of the ligature knot and found that fracture frequencies of the thyroid cartilage show a statistically significant difference in relation to the ligature knot position among persons older than 30 years, which also indicated the ipsilateral and posterior position of the knot[7]. Knight described about deciding the manner of death based on knot position and pattern, in a case of self-strangulation, where there were multiple loops of ligature secured with a complex knot[4]. Behera *et al*. reported a case where a 20-year-old female committed suicide by hanging with a nylon rope around her neck without a knot and the body was found in reclining position, hanging from a low-lying tree in a remote corner of a park with dense vegetation, giving the impression of homicide disguised as a suicidal hanging[8].

Behera *et al*. reported another case of hanging where in they found ligature tied to two point of suspension without any knot in the loop[9]. However, in this case, the ligature loop was found to be held by the deceased in a cadaveric spasm instead of a knot, for constricting the neck. Kumar reported a case of hanging without knot in the noose[10]. The ligature mark in that case was found to be encircling the neck extending up and backwards behind both ears. Face was congested and bluish discoloration of nails suggested asphyxia to be the cause of death. It was a case of complete hanging and the tongue of the deceased was seen to be protruded between the teeth as described by the author as a finding. However, in our case, the victim had used an electric wire, which had not encircled the neck, instead had crossed under the chin in a U-shaped manner, extending to front of the ears onto the facial region with right ear pinna seen to be entrapped within the ligature. There was no knot to constrict the ligature. The legs were touching the bed and the ground, which was suggestive of partial hanging. In our case also, we observed the tongue of victim being protruded out and bluish discoloration of nails and lips, which suggested asphyxia to be the cause of death. The mechanism in these kinds of cases are due to the constricting force of the ligature due to weight of body or part of it onto the neck, which causes narrowing of the laryngeal and tracheal lumina, forcing the root of the tongue against the posterior wall of pharynx, blocking the airway[1]. There was no congestion of head and neck region, as the venous drainage was not obstructed in the neck. A tension of about 15 kg needed to block the trachea, could have been possibly contributed by the weight of the part of the body. We report this case due to its rare occurrence and also to highlight the importance of its mechanism that may be useful in cases where the ligature has been removed from the body, when discovered soon after hanging or where the noose is unavailable for the autopsy surgeon due to prior removal by relatives or the police.

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Journal Scan

Medicolegal death diagnosis in Tokyo Metropolis, Japan (2010): Comparison of the results of death inquests by medical examiners and medical practitioners

Hideto Suzuki, Tatsushige Fukunaga, Takanobu Tanifuji, Nobuyuki Abe, Atsuko Sadakane, Yosikazu Nakamura, Atsushi Sakamoto

Legal Medicine 2011; 13: 273-79

Abstract

Japanese methods of death inquests are still in developmental stages and many problems have been uncovered since an inspection error was reported in 2007. In this study, we investigated the latest results of medicolegal deaths in the Tokyo Metropolis, which is composed of areas with and without the medical examiner system, and compared the results of inquests performed by official medical examiners with those by medical practitioners to re-evaluate the effectiveness of the medical examiner system for the Japanese death inquiry system. By using death certificates as inquest records in the Tokyo Metropolis, 2010, we made a comparison of the autopsy rates, causes of death and the numbers of death certificates containing defects between the inquests performed by official medical examiners and those by medical practitioners. Age distributions and male to female ratios were not different between the two groups. The autopsy rate of the medical practitioners' cases was only 5.5%, whereas that of official medical examiners' cases was 21%. The proportion of deaths due to circulatory system disease was higher in medical practitioners' cases than in official medical examiners' cases ($P < 0.01$), and the proportion of deaths from cerebrovascular disease in medical practitioners cases was twice as high as that in official medical examiners' cases. The number of ambiguous causes of death, such as unspecific heart failure and arrhythmia, certified without autopsies was much higher in medical practitioners' cases than in official medical examiners' cases. For accidental deaths, the proportion of deaths by poisoning and heatstroke was lower in medical practitioners' cases than in medical examiners' cases ($P < 0.01$). The proportion of death certificates containing defects was much higher in medical practitioners' cases (24.1%), especially in the rural areas (45.4%), as compared to official medical examiners' cases (1.3%). The lower autopsy rate and the higher frequency of defects in death certificates in medical practitioner's cases likely led to the differences in the mortality statistics between the two groups. On the other hand, the medical examiner system leaves room for further improvement, such as in the autopsy rate. This study supports the necessity for implementation and improvement of the medical examiner system, and for reinforcement of under/postgraduate medicolegal education in Japan.

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Journal Scan

Comprehensive evaluation of pericardial biochemical markers in death investigation

Osamu Kawamoto, Tomomi Michiue, Takaki Ishikawa, Hitoshi Maeda

Forensic Science International 2013; 224: 73-79

Abstract

Pericardial fluid (PCF) is a well-preserved cadaveric material in cases without structural damage. The present study investigated fundamental serum components of PCF, including total proteins (TP), albumin (Alb), urea nitrogen (UN), creatinine (Cr), uric acid (UA), glucose (Glu), sodium (Na), potassium (K), chloride (Cl), calcium (Ca) and magnesium (Mg) in PCF with regard to the postmortem and survival periods, and cause of death in serial medicolegal autopsy cases (*n*=288) with intact pericardial and cardiac structures within 48h postmortem. The amount of PCF (mostly 5–25ml) showed no survival or postmortem time dependence, or difference among the causes of death. For all cases, there were moderate postmortem decreases of Na and Cl, and increases of K and Mg, which were insufficient for application to estimate the time since death; however, characteristic findings with regard to the cause of death were detected in cases of hours-long survival, especially in 'functional causes of death': higher Alb, UN, Cr, UA, K and Mg, and lower Na, Cl and Ca in intoxication; lower TP, Alb, Cr, K and Mg, and higher Na and Cl in hypothermia (cold exposure); higher Alb, UN, Cr, UA and Mg, and lower Glu and Ca in hyperthermia (heatstroke). These observations suggest the usefulness of pericardial biomarkers for investigating the cause and process of death to reinforce pathological and toxicological findings.

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Journal Scan

Methadone-related deaths in Norway

Jean-Paul Bernard, Ingrid Havnes, Lars Slørdal, Helge Waal, Jørg Mørland, Hassan Z Khiabani

Forensic Science International 2013; 224: 111-116

Abstract

The use of methadone in opioid maintenance treatment (OMT) is potentially associated with a number of adverse effects and the risk of fatal toxicity. Increased methadone availability may lead to an increase in methadone-related deaths. We have investigated methadone-related deaths in Norway over the period 2000–2006. Methadone-positive samples over the period 2000–2006 were identified from forensic toxicological investigations, and demographic and toxicological data were retrieved. The cases were cross-linked with the Norwegian Cause of Death Registry and regional OMT registers. A total of 312 individuals had died after taking methadone over the period 2000–2006, predominantly men with a mean age of 36. In 85% of cases (*n*=264), the deceased had died of a methadone-related intoxication, most often in combination with other drugs, including benzodiazepines, cannabis and other opioids. Only 22% of the deceased had been in OMT at the time of death. A larger proportion of OMT patients had died of causes other than intoxications compared to those not in OMT (30% vs. 8%, respectively), most commonly related to disease. One methadone-related death occurred, on average, every week over the time period investigated. Only 22% of the deceased were registered in opioid maintenance treatment (OMT) programs. The findings underline the need to control diversion of medication from OMT programs.

DOI : 10.5958/j.0974-4487.10.3.028

Journal Scan

Physicians' knowledge and continuing medical education regarding fitness to drive: a questionnaire-based survey in Southeast Switzerland

Matthias Pfäffli, Michael J Thali, Sebastian Eggert

International Journal of Legal Medicine 2012; 126: 357-62

Abstract

Valid information for physicians in Switzerland concerning knowledge and continuing education in traffic medicine is not available. Also, their attitude to the legally prescribed periodic driving fitness examinations is unclear. In order to gain more information about these topics, 635 resident physicians in Southeast Switzerland were sent a questionnaire (response rate 52%). In a self-estimation, 79% of the queried physicians claimed to know the minimal medical requirements for drivers which are important in their specialty. Statistically significant differences existed between the specialties, whereby general practitioners most frequently claimed to know the minimal medical requirements (90%). It appears that the minimal medical requirements for drivers are well known to the queried physicians. Fifty-two percent of the physicians favored an expansion of continuing education in traffic medicine. Such an expansion was desired to a lesser extent by physicians without knowledge of the minimal requirements (p <0.001). A clear majority of the medical professionals adjudged the legally prescribed periodic driving fitness examinations as being an expedient means to identify unfit drivers. A national standardized form for reporting potentially unfit drivers to the licensing authorities was supported by 68% of the responding physicians. Such a form could simplify and standardize the reports to the licensing authorities.

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Original Article

Determination of Stature from Head Length of People of Gujarati Origin

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ABSTRACT

When a victim is unknown, anthropologist plays a key role in preparing biological profile. Developing such profile entitles studying remains noting genetic characteristic of shape and size, which allow estimation of age, sex, population and ancestry. Estimation of stature is considered as an important parameter in medico-legal and forensic examination. An attempt is made to find out correlation and to derive a regression formula between head length and body height in Gujarat region. The material consists of 239 students from Gujarat University. Students were selected as subject because of the easy. The age was in the range of 21 to 25 years. The length of head was measured between two craniometric points, glabella and inion. Spreading caliper was used to measure head length. Height of the subject was measured with standard height measuring instrument in anatomical position. Measurements were taken at fixed time to avoid diurnal variation. The result obtained was analysed and attempt was made to derive a formula between head length and total height of an individual. The result shows that there is a definite correlation between head length and height of an individual. In spite of the racial and ethnical variation, this formula may be a definite correlation between head length and height of an individual.

Keywords: Anthropometry, Correlation, Head length, Total height

INTRODUCTION

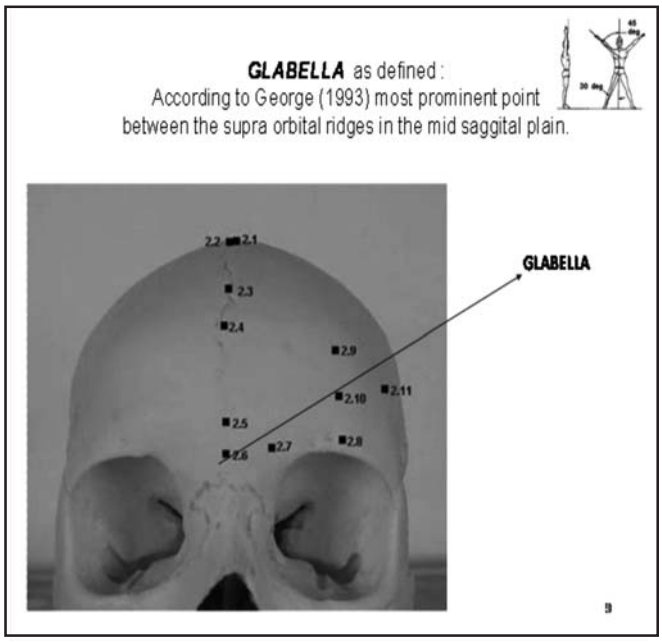
Stature is estimated by measuring total body length or extrapolating from bone length.Estimation of height from the length of head has also attracted many workers to derive a formula, Saxena SK *et al.*,[1] but no significant formula has been derived to calculate the height from head length in Gujarat. Considering the importance of stature for personal identification and the work done in this regard for Guajarati people, an attempt has been made to find out the correlation (if any) between head length and body height in Gujarati population. Hence, first - time somatometric measurements, which are carried out to find out correlation and to derive a regression formula between head length and body height of people of Guajarati origin of the age group 21 to 25 years, were taken at fixed time

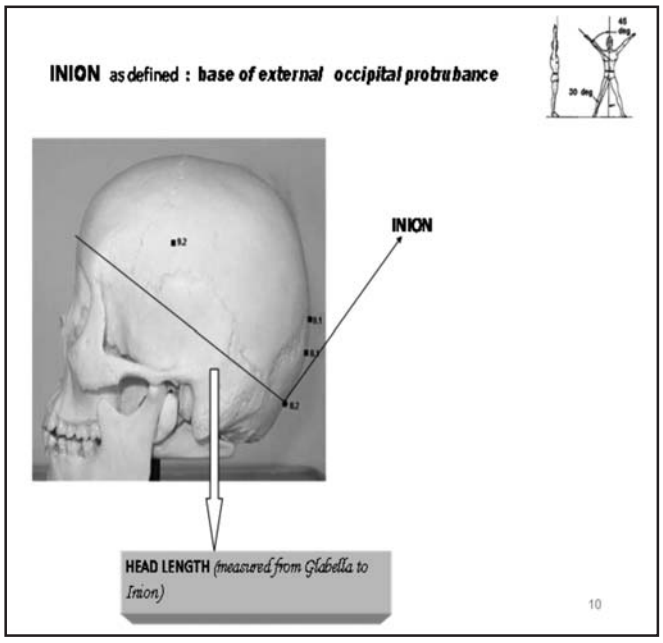
Forensic anthropology is the application of the science of physical anthropology and human osteology (the study of the human skeleton) in a legal setting, most often in criminal cases where the victim‘s remains are more or less skeletonised. A forensic anthropologist can also assist in the identification of deceased individuals whose remains are decomposed, burned, mutilated or otherwise unrecognisable. The adjective “forensic” refers to the application of this subfield of science to a court of law. Anthropos- from the Greek for man, we extend this today to mean all of humanity, ology - (logos) the study of - Forensic anthropology is the application of the science of physical anthropology to the legal process. The identification of skeletal, badly decomposed, or otherwise unidentified human remains is important for both legal and humanitarian reasons. Forensic anthropologists use regression equations to determine sex, age, stature, and race of skeletal remains. Regression equations are mathematical equations developed from studies of bones of individuals of known sex, age, race, and stature, and are used to predict such things of even fragmentary skeletal remains.

Measuring Instruments Used

ROUND HEADED SPREADING CALIPER

HEIGHT MEASURING INSTRUMENT





MATERIAL AND METHOD

Total number of students participated in study was – 239, among them 114 were males and 123 were female. To measure head length of an individual, a fine calibrated round headed spreading caliper made in Germany was used and Head -length was measured with the help of spreading Calliper from Glabella to inion. Study carried out at Gujarat University campus- Ahmedabad.

Precaution Taken While Taking the Measurement

During the measurement of height of an individual, shoes were asked to remove along with socks, to obtain accurate height. During the measurement of height of girls, they were asked to remove their hair bands and clips. While measuring head length, students were asked to sit on chair in straight posture. To remove error in measurements, the measurements were repeated thrice and their mean is taken in to consideration. All measurements, i.e., head length and height, were taken at fixed time between 2 to 5 pm. Giles and Hutchison[2] have reviewed the major sources of extraneous variation in attempting to determine a "true" stature. These include average variation of nearly an inch attributable to the time of day; gravity pulls down on the vertically oriented during the course of a normal day.

RESULT AND DISCUSSION

In the present study we have observed the correlation of height (in anatomical position) with head length among Gujarat University students of various subjects.

Table 1 shows number of students from various department of Gujarat university.

Table 2 shows that the age ranges from 21 to 25 years, mean head - length from 17.02 to 18.58 cm and total mean height from 152 to 172.61 cm with a significant correlation between them.

Table 3 shows recorded observation values to obtain regression formula.

Table 4 shows the correlation coefficients between various parameters, such as between age and height, between age and head- length and between height and head- length. It is positive, suggesting that it is significant.

Table 1: The study material consists of 239 students from different departments of Gujarat University

Department	No of student
Mathematics	13
Forensic science	20
Environmental science	3
Life science	2
Chemistry (PhD)	2
B.K. School of Management	42
K.S. School of Management	23
Chemistry	18
Physics	10
Electronics	9
Rollwala College (MCA)	27
L.D. Engineering	19
B.COM	1
M.COM	2
Microbiology	1
Master of Labour welfare (MLW)	1
Language	8
Geography	3
Psychology	1
Master of Arts	5
M. Library	16
B. Library	16
Institute of Chartered Financial Analysts of India (ICFAI)	1
Saurashtra University	1
MPHIL (Social Science)	1
Working people	2
Biochemistry	2
Total	239

Table 2: Age versus Head and Height Length

Age (years)	Mean height (cm)		Mean head length (cm)	
	Male	Female	Male	Female
21	171.9697	155.6465	18.43030303	17.61627907
22	171.7273	155.617	18.24	17.28
23	169.5714	156.1111	18.36825397	17.38
24	170.0789	159.15	18.54	17.18
25	172.6125	152	18.58333333	17.02

Table 3: Recorded observation values to obtain regression formula

Parameter	Age (years)	Head length (cm)	Height (cm)
Range	21- 25	15.5 - 19.8	144 - 187.5
Mean	22.20921	17.79	162.52
Standard deviation	1.190896	0.862302923	13.433
Standard error	0.077033	0.8689	0.055777739

Table 4: Correlation- coefficient

Parameter	Co-efficient value
Age and height	+0.104882715
Age and head length	+0.101723551
Height and head length	+0.538274

Various workers have shown significant correlation between height and different parts of the body. Singh and Sohal[3], Jit and Singh[4] have shown a significant correlation between height and length of clavicle. Charnalia[5], showed the significant correlation between height and foot-length, where correlation coefficient was 0.46. Athawale[6] derived a regression equation between total height and forearm bones. Joshi[7] have derived regression equation between tibia and total height in Gujarati population. Suneel Qamra[8] made a study on height and foot length and derived a correlation coefficient for foot breadth (male 0.42 female .0.47) and foot length (male 0.69, female 0.70). Shroff[9] have also derived the height from the length of superior extremity and its segments But no data, available in the literature regarding the estimation of stature from the head length, except Saxena[1] who derived a regression equation between head-length and height in Agra population (U.P.). Their correlation coefficient between head -length and height was +0.2048. According to Glaister[10], nasion-inion length (head-length) is 1/8 of the total height of an individual.

CONCLUSION

- The obtained data have been subjected to statistical computation and various regression equations for stature estimation are derived for individual of Gujarati origin within an age group of 21- 25 years.
- Regression equation for male of Gujarati community

  STATURE = 131.8103 + 2.141924 × (HEAD LENGHT) (Error rate= ±4.254707)
- Regression equation for female of Gujarati community

  STATURE = 72.61486 +4.748918 × (HEAD LENGHT) (Error rate= ±5.06813)
- Regression equation for both sexes(male and female)

  STATURE = 13.35136 +8.384971 × (HEAD LENGHT)

The co-relation coefficient values obtained for various parameters like age & height, age & head length, height and head length all are positive, suggesting that a significant relation exist between them (Error rate= ±5.56418)

- Using average of head length from Glabella to Inion, including the standard error, one can arrive at a fairly accurate estimation of height. From the results obtained and discussed previously, it can be concluded that head–length is a function of stature determination.
- The correlation coefficient between head length and height is +0.538, which is the most significant (The correlation coefficient (worked out by one of the earlier worker Shah GV[14]) between head length and height is +0.53 in B.J. Medical college students of age group 17 to 22 years in Gujarat).
- It is clear that if either of the measurements (head length or total height) is known the other can be calculated and this fact may be of practical use in medico-legal investigation and in anthropometry.

Significance

- Remains are often incomplete. In those cases a forensic anthropologist will need to estimate stature by extra polating it from the length of individual bones or combination of long bones. This is done by using regression formulae developed for reference population of know stature.
- Here in present study the regression equation obtained can help in stature estimation of individual of Gujarati origin of age group 21-25 years
- Using regression equation, stature can be calculated for decomposed or skeletonised remains encountered from Gujarat region or suspected to be from Gujarati community.

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Original Article

Pattern and Distribution of Fatal Injuries in Road Traffic Accidents at Udaipur

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ABSTRACT

The term accident has been defined as an occurrence in a sequence of events, which usually produces unintended injury, death or property damage. Today, accidents are among the leading causes of death, in some cases the foremost cause. This study is having a lot of importance in this Udaipur region, as this area is very hilly, having most of the population as tribes, congested and important national highways, a lot of mines, marble industries, India's prime tourist locations, a lot of beautiful lakes, low education level in general population, use of two-wheelers in maximum extent by farmers and labourers in their daily routine livelihood works, hard geographical conditions, high rainy areas that makes the transportation quite difficult, faulty roads, primary and secondary referral centres with inadequate resources and manpower and most important factor that makes this area very vulnerable for fatal road traffic accidents is low awareness level regarding traffic rules, regulations and civic sense in general population.

Keywords: Laceration, Road Traffic Accidents, Regional Injuries, Fatal Injuries

INTRODUCTION

Motor vehicle surface transport commenced with Cugnot's steam tricycle in 1769. Ryan[1] conducted a study to examine the pattern of anatomical injury in victims of motor vehicle crashes who die prior to reaching hospital.

Dhillon[2] studied the pattern and distribution of injuries in fatal road traffic accidents in Shimla, Himachal Pradesh. The material comprised of 50 cases, who dead of head injury, limp injuries and combination of injuries. Out of 50 cases, maximum road traffic accidents occurred in January, February and in May and June. A total of 44% of people died in zero hour, which had no chance of receiving first aid also. The temporal bone fractures were in maximum number of cases followed by frontal bone (10%), parietal and occipital bone (8%).

Biswas studied the pattern of road traffic accidents in North-East Delhi[3]. Yadav[4] studied the correlation between intracranial hemorrhages and skull fractures. The study was conducted on 150 cases of fatal head injury brought to mortuary in Department of Forensic Medicine for medicolegal post-mortem examination, where the death was cranio-cerebral damage were included in the study. They concluded that correlation between the skull fractures and intracranial hemorrhage was found to be statistically significant.

MATERIALS AND METHODS

The study was conducted in the Department of Forensic Medicine at RNT Medical College, Udaipur. The period of the study was a full 1 year from 1 March 2008 to 28 February 2009. Cases of deaths due to vehicular/road accidents brought during this period were included in this study. During the period of study (i.e., full 1 year), 200 cases of accidents deaths were considered for this epidemiological study.

OBSERVATIONS

As shown in Table 1, out of 200 cases 150 cases (75%) were resident of rural areas, whereas 50 cases (25%) were from urban areas.

Table 1: Rural and urban distribution (*n*=200)

Place of residence	Male		Female		Total	
	No. of cases	%	No. of cases	%	No. of cases	%
Rural	129	75.8	21	70	150	75
Urban	41	24.2	09	30	50	25
Unknown	00	00	00	00	00	00
Total	170	100	30	100	200	100

Table 2: Distribution of cases according to the place of accident (*n*=200)

Place of accident	No of cases	Percentage (%)
National highway	114	57
State highway	30	15
City road	26	13
Village road	30	15
Approach road	00	00

Out of 200 cases included in this study, 114 cases (57%) occurred on national highways.

As depicted in Table 3, motorcyclist did the common groups of victims involved in fatal accident comprise 88 cases (44%).

Table 4 gives data analysis regarding various causative factors leading to accidents. The factor of human error is found to be most significant (168 cases, 84%), in which drivers were at fault in majority of cases (54%) as against faults of others, like pedestrian, slow moving vehicles, compromising just 22.5%.

The 200 subjects had total of 242 injuries or group of injuries believed to have been fatal or contributing to death. Head injury was dominant in all road users (50.8%) followed by thoracoabdominal in 15.3% and multiple injury in 12.8%. The combination of head and abdominal injuries were the least accounting for death (seven cases, 2.9%). The mean fatal lesion per case was 1.21.

DISCUSSION

According to a study conducted by National Transportation Planning and Research Centre, New Delhi, a person is killed or injured in every 4 min in traffic accidents in India[5].

Like other epidemic diseases, road traffic accidents involve three factors: agent, host and environment, i.e., the road use, the vehicle and the road environment. The detailed study of these factors will help in control and prevention of the accidents and reducing morbidity and mortality[6].

The most common age group involved in fatal traffic

Table 3: Type of road user killed in the road accidents (*n*=200)

Type of road user killed	Male		Female		Total	
	No. of cases	%	No. of cases	%	No. of cases	%
Pedestrians	37	21.7	16	53.3	53	2.5
Motorcyclist	88	51.8	00	00	88	44
Cyclists	05	2.94	00	0.0	5	2.5
Occupants of cars and jeeps	19	11.2	04	13.3	23	11.5
Occupants of medium vehicles	02	1.13	01	3.3	3	1.5
Heavy vehicles	13	7.6	03	10	16	8
Others	06	3.5	06	20.0	12	6
Unknown	00	00	00	00	00	00
Total	170	100	30	100	200	100

Table 4: Road accidents: causes and factors responsible (*n*=200)

Causes	No of cases	Percentage (%)
Human error		
I Fault of drivers	108	54
II Fault of pedestrians	28	14
III Fault of slow moving vehicles	17	8.5
IV Fault of passengers	15	7.5
Mechanical failure	10	5
Defective roads	06	3
Bad weather/poor visibility	16	8
Total	200	100

Table 5: Fatal injuries (*n*=200)

Fatal injury	No of cases	percentage
Head injury	123	50.8
Cervical spine injury	03	1.23
Chest injury	04	1.65
Abdominopelivic injury	13	5.37
Head and chest injury	08	3.3
Thoracoabdominal injury	37	15.3
Head and abdominal injury	07	2.9
Limb and fracture	16	6.6
Multiple injuries	31	12.8
Total fatal injuries	242	
Fatal injury per case	1.21	

accidents was 21–30 years. Males outnumbered females in ratio of 8.5:3. Two-third of all the cases was in the age group of 11–40 years in both sexes. This finding correlates with studies carried out by other workers[7].

In present study, 171 cases were married (85.5%) and 29 cases were unmarried (4.5%). The maximum number of victims were illiterate constituting 56% of all cases followed by below metric (21.5%) and 11% cases were metric but below graduate. The majority of cases were labourers and farmers accounting for 27% and 26%, respectively, of cases followed by businessmen.

Since the Udaipur population is mostly rural and tribal, three-fourth of cases were from the villages, whereas only one-fourth of cases were from the urban area (Table 1).

Out of 200 cases, 157 cases (78.5%) were of lower socio-economic status.

Two major national highways pass through the state of Rajasthan, i.e., national highway (NH) 8 and NH 76. Since NH 8 passes through Udaipur the maximum fatalities were from NH 8 accounting 57% of all cases, 15% of accidents occurred on the state highways and rest of the cases were from village and city roads (Table 2).

The maximum cases of accidents occur in the months of summer accounting for 95 cases (47.5%) followed by winters, 66 cases (33%). The least cases are seen in months of rainy season, 39 cases (19.5%).

The maximum numbers of cases in summer are due to increase movement of people due to various social events like marriages. Tribal people are having a lot of social gathering, festivals and their religious ceremonies. Moreover, in summer environment alcohol use is increased.

Motorcyclists were the commonest group of victims involved in fatal road accidents comprising 44% of total cases followed by pedestrians (26.5%) and occupants of cars and jeeps (11.5%; Table 3).

Two wheelers were the commonest offenders on road being involved in 57.5% of cases followed by cars and jeeps in 22% cases. The pedestrians and cyclists were hit by cars and jeeps in 22.6% and 20% cases, respectively.

The factor of human errors is found to be the most significant. In 84% cases, drivers were at fault in majority (54%) as against the faults of others on road, like pedestrians, cyclists, motorcyclists and passenger, comprising just 30% (Table 4).

Multiple body parts were involved in a single case. There were total of 630 injuries found in 200 cases (injury per case being 3.15). The commonest injuries were observed to head in 154 (77%) cases and to chest in 147 (73.5%) cases. Injuries to the abdomen were seen in 78 (39%) cases and to neck in 22 (11%) cases. Two hundred subjects had a total of 242 injuries or group of injuries believed to have been fatal or contributing to death. The fatal injury per case being 1.21

Table 6: Cause of death

Authors	Cause of death					
	Head injury (%)	Multiple injuries (%)	Chest injury (%)	Abdominal injury (%)	Head and chest injuries (%)	Head and abdominal injuries (%)
Sevitt (1968)[8]	24	22	25	8.2	10.8	10
Sevitt (1973)[9]	58	27	16	7	—	—
Chandra *et al*. (1979)[10]	49.46	28	—	22.52	—	—
Lau *et al*. (1998)[11]	39.6	49.1	—	—	—	—
Present study	46.5	53	—	—	—	—

Serious brain injury was dominant among all road users (50.8%) followed by multiple injuries (12.8%) and thoracoabdominal injuries (15.3%). The combination of head and abdominal injuries were the least accounting for death in 2.9% of cases (Table 5).

The incidence of fatal lesions varied in different road users. Head injury was commonest in pedestrians, cyclists and motorcyclists. Similar findings were noted by other workers like Sevitt[8,9], Chandra[10] and Ghosh[12] (Table 6).

CONCLUSION

Many road traffic accidents are caused by alcohol consumption by drivers. Strict penalty, rules and regulations for prevention of alcohol consumption by drivers should be imposed. Trauma centre should be created on NH 76 and NH 8 to decrease the mortality and morbidity in road traffic accident victims. On national highways, there should be public telephone booths with toll-free numbers so that information about accident can be given to nearest trauma centre and police station. Frequent teaching programmes should be planned for school going children about traffic rules and regulations. Establishment of trauma intensive care unit in all tertiary medical college hospitals should be compulsory. Speed limit is an important factor to decrease the road traffic accident.

As a whole, a multidimensional approach should be implanted to control the fatal road traffic accidents by increasing the awareness of general people by educating them regarding traffic rules and regulations, the maximum consumption of government resources, with the help of non-government organisations, proper human resources training, proper planning by government machinery and medical advancement to decrease the mortality and morbidity in road traffic accidents. So that an important and active group of society can be saved by this life-threatening disastrous events.

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Brief Communication

Cephalic Index of the Northern Bangalore: A Preliminary Study

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ABSTRACT

The cephalic index is the ratio of the maximum breadth of head to its maximum length. Cephalic index is very useful anthropologically to find out racial difference. The present study was carried out on 200 subjects (100 males and 100 females) in Hymanshu Jyothikala Vidyapeetha, Bangalore. The mean cephalic index was 83.5. The mean cephalic index for male was 81.7 and for female was 85.3. Cephalic index of the female is higher than the male. The difference between male and female cephalic index was significant. Majority of the study group were brachycephalic.

Keywords: Cephalic index, head length, head breadth.

INTRODUCTION

Human physical variability has been a subject of great interest for the scientists for a very long time and Anthropometry evolved as a standard scientific technique for measuring human body dimensions[1]. So far, many studies have been conducted in various parts of India and abroad applying the techniques of anthropometry. The science of anthropology uses many parameters that can be measured and compared with various subjects. Cephalic index is one among the lot.

Cephalic index is the terminology used in anthropology for having an easy identifying module or numerical to distinguish the given sample or individual, either into race, sex or even as identity of the individual[2]. Cephalic index was first identified by Swedish Professor Anders Rczitus, who used physical anthropology to classify ancient human remains found in Europe. For more than 150 years, cephalic index was used as a tool to classify individuals into racial categories. This helps us to determine the identity of a person in conditions of mass disasters. This evidence can be utilised as it is not time consuming, easy and cost effective[3].

MATERIALS AND METHODS

The present study was carried out with 200 (100 males and 100 females) students of Hymanshu Jyothikala Vidyapeetha, Bangalore, with prior ethical clearance. Only students belonging to northern regions of Bangalore were selected for the study.

The anatomical landmarks, glabella (g), inion (I) and euryon (eu) were marked. The anatomical landmarks were defined as follows:

Glabella: A point above the nasal root between the eyebrows and intersected by mid-saggital plane.

Inion: The distal most point placed on the external occipital protuberance in the mid-saggital plane.

Euryon: The lateral most point on the side of the head.

All the measurements were taken with subjects sitting on the chair; head in anatomical position. The each measurement was taken to the nearest 1 mm. The head length was measured with spreading caliper with scale from glabella to inion. Head breadth was measured as the maximum transverse diameter between the two euryons using spreading caliper with scale. The process

of measurements was explained to each and every subject. The written consent obtained from each and every subject before taking measurements.

Cephalic index was calculated as maximum breadth of head / maximum length x 100.

The results were tabulated and analysed.

RESULTS

The minimum cephalic index in males and females was 72.3 and 75.1, respectively. Maximum cephalic index obtained in males and females was 88.1 and 95.4, respectively (Table 1). The mean cephalic index was 81.7 and 85.3 in males and females, respectively. The difference in sex was statistically significant. The mean cephalic index was 83.5.

Table 1: Comparison of cephalic index between the genders of the study population

Sex	Minimum cephalic index	Maximum cephalic index	Mean cephalic index
Male	72.3	88.1	81.7
Female	75.1	95.4	85.3

The maximum length of the skull ranged from 14.2 to 21.7 cm in males and 14.4 to 21.9 cm was the range in females (Table 2). The maximum breadth varied from 11.9 to 17.8 cm and 11.7 to 17.5 cm in males and females, respectively (Table 3). Majority of the males were mesocephalic (75–79.9; 45%) and brachycephaly (80–84.9; 53%) was most common in females (Table 4).

Table 2: Comparison of head length of males and females

Sex	Minimum length of the skull	Maximum length of the skull	Mean length of the skull
Male	14.2	21.7	18.5
Female	14.4	21.9	18.1

Table 3: Comparison of head breadth in males and females

Sex	Minimum breadth of the skull	Maximum breadth of the skull	Mean breadth of the skull
Male	11.9	17.8	15.6
Female	11.7	17.5	14.5

Table 4: Cephalic phenotypes of the study population

	Male	Female	Total
Dolichocephalic (65–74.9)	09	00	09
Mesocephalic (75–79.9)	45	23	68
Brachycephalic (80–84.9)	29	53	82
Hyperbrachycephalic (85–89.9)	17	21	38
Ultrabrachycephalic (90–94.9)	00	03	03
Total	100	100	200

DISCUSSION

Gender and racial variation in the cranium were recorded by Williams *et al.*[4], who studied 500 (302 males and 198 females) medical students of Gujarat. The mean cephalic index for male was 80.42 and for female was 81.20. Most of their subject belongs to mesocephalic group[4]. Except for the male cephalic index, others are not similar to the results obtained in our study, this could be because human body are affected by ecological, biological, geographical, racial, gender and age factors.

Lobo *et al.*[5] studied 267 (157 males and 110 females) subjects of Gurung village, Nepal. The mean cephalic index for male was 83.10±6.08 and for female was 84.60±5.14. Most of their subject belongs to brachycephalic group[5]. The mean cephalic index of males is slightly more compared to our study, but the cephalic index of females and brachycephaly was similar to our study.

Mahajan *et al.*[6] studied 400 medical students of Punjab aged 17–23 years. The mean cephalic index for male was 81.34 and for female was 85.75[6]. The difference between the mean cephalic index of male and female of

Table 5: Comparison of cephalic index in different populations

Population	Cephalic index
West Africa[7]	77.89
Sri Lanka[8]	78.54
Bayelsa, Nigeria[5,9]	72.96
Southwestern Nigeria[10]	72.54
Bengal, India[11]	79.5
Central India[12]	79.8
Gujarat, India[13]	80.42
Saurashtra, India[14]	73.89
Bombay, India[14]	77.9
Present study	83.5

Punjab was statistically significant. Punjabi community can be categorised as brachycephalic. The results were similar to the results obtained in our study.

The cephalic index for males was significantly lower when compared to females. The smaller breadth of the head could be the reason for lower cephalic index in males when compared to females.

Cephalic index in the present study was higher than that described in other studies on different populations in abroad[7–10] and in India[11–14]. In the present study, the dominant cephalic phenotype was the brachycephalic. Table 5 shows the comparison of cephalic indices in different populations. The West African[7] and Sri Lankan[8] populations have commonly showed mesocephalic type, whereas Bayelsa[9] and Southwestern[10] population from Nigeria commonly showed dolicocephalic type of head. Indian populations from Bengal[14], Central India[12] and Bombay[7] have commonly showed the mesocephalic type of head. Whereas Gujarat[6] and Saurashtra populations[7] have commonly showed brachycephalic and dolichocephalic types, respectively.

It is clear from the above discussion that cephalic index differs in different regions of the country and obviously in different regions of the world. The reason for this could be attributed to evolutionary changes occurring in the growth of the head as some of these studies were conducted about 40–50 years ago. Also, this could be due to difference in the growth pattern, which depends on the environmental factors and habits. We recommend similar studies involving more number of subjects to create most recent cephalic index databases for different regions in India.

CONCLUSION

- The mean cephalic index was 81.7 and 85.3 in males and females, respectively.
- The majority of males and females were mesocephalic and brachycephalic, respectively.
- Majority of the Northern Bangaloreans were brachycephalic with mean cephalic index 83.5.
- The cephalic index was higher for females as compared to males.
- The difference between male and female heads cephalic index was significant.

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Case Report

Autopsy Diagnosis of a Rare Case of Near-Drowning

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ABSTRACT

The term near-drowning is commonly used for the victim who almost survives after an incidence of aspiration of fluid, but dies later due to complications of drowning. Drowning is one of the common causes of unnatural deaths in India, but the reporting of cases of near-drowning is rare. In the present case, dead body of a 1-year-old male child was brought to us for autopsy examination with a history of rescue from accidental drowning in a water tank at home. The victim was admitted in hospital before death for a few hours, where he was resuscitated but could not survive due to difficulty in respiration followed by irretrievable cardiac arrest. Detection of the cause of death in such cases is a difficult task for the autopsy surgeon, especially, in the absence of typical findings of ante-mortem drowning, which is frequently present in such cases. Absence of theses ante-mortem features of drowning might be due to the measures used in the treatment of the victim and that is why it is always better to correlate the autopsy findings with the history and clinical record, which can help us to understand the reasons of negative findings in a case of near-drowning. This case is presented here to discuss its different medico-legal aspects as it is rare of its kind.

Keywords: Drowning, Near-drowning, Accident, Autopsy

INTRODUCTION

Drowning is one of the most common causes of asphyxial deaths in India and thousands of innocent people drown every year because of lack of awareness of the hazards of water. The term near-drowning means 'when a person is in danger of drowning' but in medico-legal field near-drowning generally is defined as survival, at least temporarily, after suffocation by submersion in a liquid medium[1]. Most authors include the loss of consciousness while submerged as a criterion for the syndrome. However, some authors have argued that as pulmonary complications may follow the aspiration of water without the loss of consciousness, near-drowning should be defined as survival, at least temporarily, after aspiration of fluid into the lungs ('wet near-drowning') or after a period of asphyxia secondary to laryngospasm ('dry near-drowning')[2]. When the victim shows an apparent initial recovery from drowning but then dies hours or days after the incident owing to complications is termed as secondary drowning[3]. The cases of near-drowning are more common in the western world as compared to India, and most of the victims are children especially males of less than 10 years of age[4,5]. Ante-mortem features of drowning, clinical records and laboratory investigations may help us in determining the cause of death in such cases of near-drowning.

Case History

A 1-year-old boy, while playing at home, fell into the water tank and after some time he was rescued by relatives. He was immediately brought to the emergency department of a tertiary care hospital. On arrival, the patient was unconscious, gasping for breath, cyanosed and was responding to painful stimuli. His pulse and blood pressure was not recordable. He was resuscitated and admitted to the intensive care unit where his wet clothes were changed, suction was done and after intubation patient was put on a ventilator. His systolic blood pressure in right upper arm was recorded 90 mm Hg and electrocardiogram was showing ST elevation over pre-cordial leads with

evidences of ventricular tachycardia. Chest X-ray was showing evidence of pulmonary edema and the ultrasonogram abdomen was showing fluid and gases in the stomach and small intestines. After some time, his condition started deteriorating and finally collapsed to death following irretrievable cardiac arrest. The patient's condition was critical throughout his hospital stay and had survived for about 4 h following the drowning incident.

Medico-legal autopsy was performed on the next day morning and we found that the dead body was of a well-built and well-nourished male child with fully developed rigor mortis. He was having cyanotic lips and nails, cold and pale skin and slight blood stained frothy discharge over the nostrils. Abdomen was bloated and there were no evidences of any injuries over the body. Clothes were dried and features of goose skin or washer man's hands and feet were absent. During internal examination both lungs were found heavy, congested and edematous and slight bloody froth was noticed in respiratory tracts. All other organs were intact and congested on cut section. Death was attributed to myocardial infarction resulted from hypoxia of near-drowning.

DISCUSSION

The cases of near-drowning are more common in children due to accidental fall in water bodies. In these cases, the victim is not able to cry for help because of sudden submersion and aspiration of water into the respiratory tract and the victim is rescued either immediately or slightly after the incidence of submersion. Prognosis in children is often good, provided that cardiopulmonary resuscitation (CPR) is commenced immediately after or even during the process of rescue, and the child gasps within 40 min of rescue and regains consciousness soon afterwards[6]. In the present, case CPR was not made by the relatives of the victim as they were not aware about it. It is commonly observed in India due to lack of knowledge and practical experience of CPR among common people and when such victim of near-drowning reaches to hospital it is too late to revive him from hypoxia, which leads to cardiac arrhythmias and irreversible ischemic brain injury. Myocardial infarction resulting from irreversible hypoxemia is one of the common causes of death in cases of near-drowning. We can increase the chances of survival of the victims of near-drowning up to a certain extent by educating the masses regarding the CPR through common media.

The autopsy diagnosis of the cases of near-drowning is a tedious job for autopsy surgeon, because the findings are often minimal, obscure or sometimes completely absent. It becomes more difficult to establish it when the victim is resuscitated in a hospital and CPR has been done, which leads to the absence of reliable signs of ante-mortem drowning as we have also noticed in the present case. In described case, the body was not showing any signs of submersion, as the clothes were dry and features of goose skin or washer man's hand and feet were also absent, which might be due to changing of clothes during hospitalisation and procedures used to warm the body. Typical froth seen after drowning over the nostrils and mouth was also absent in this case, which was probably due to the suction and clearance of respiratory tract, done during the treatment. In all such cases, autopsy should be conducted as soon as possible because even a short delay in the autopsy is likely to obliterate the ante-mortem signs to a great extent, which are already obscure in the cases of death due to near-drowning. Bluish lips, bloated abdomen, cold and pale skin, frothy fluid in the respiratory tracts with heavy, congested and edematous lungs are the only reliable autopsy findings, which can be used with other supportive evidences (like the history of rescue from water and findings in clinical records) to prove the death due to near-drowning. To prevent the incidences of near-drowning, especially in children, they should not be left alone near water sources and whenever it happens immediate CPR should be done after the rescue of the victim.

CONCLUSION

Information regarding the cause of death and its correlation with circumstances of death is of paramount importance both for the investigating agencies and autopsy surgeons. Information regarding the autopsy findings in death due to near-drowning is not sufficient in the literature of forensic medicine, and most of the authors have not discussed regarding the obscure autopsy findings, their reasons and correlation with CPR, and their medico-legal significances. This case was presented here with

the aim to discuss that how timely done CPR can save the life of a victim of near-drowning and why autopsy findings are often minimal, obscure or sometimes completely absent in such cases.

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Case Report

Detection and Identification of Oily Stain on Clothes in Sexual Assault Case: A Case Study

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ABSTRACT

The presence of semen on the victim's clothes may be suggestive of sexual intercourse by the accused with the victim, but the presence of some additional material along with semen stains becomes a vital clue in the sexual assault cases. The present communication deals with the detection and identification of the oily stain on the clothes.

Keywords: Oily stains, rape, oil in sexual assault

INTRODUCTION

In sexual assault cases, non-ultimate samples such as undergarments of both accused and victims are usually sent for examination of semen/blood. The presence of semen on the victim's garments may be suggestive of sexual intercourse. In the sexual assault cases, sometime it is very difficult to prove rape. But there are greater chances of conviction when scientific evidence remains available. The presence of semen stains along with some additional material can be a vital clue in rape cases[1,2].

The examination of oils and fats is based on their composition. Oils and fats are tri-glycerides of fatty acids of saturated and unsaturated acids (oleic, linoleic, linolenic) in varying proportions. These may contain fatty acids of definite carbon number in higher proportion in some oils viz., arachidic acid (in arachis oil, groundnut, nut and peanut oil), crucic acid (in mustard, rapeseed and rape oil), normal iso-propionic and butyric acid (in butter and ghee both of animal fat), or vary in the percentage of free acids (due to hydrolytic splitting of glycerides of enzymes), vary in the nature and percentage of sterols in the unsaponifiable matter in animal fats and vegetable oils (cholesterol in animal fat and phytosterols in vegetable oils), vary in drying properties (the tendency to form solid film due to unsaturation) or vary in their tendency to undergo addition with iodine or iodine monochloride (due to variation in unsaturation present).

The above variation in fatty acid profile and other non-fatty acid or non-glyceride constituent (unsaponifiable matter, i.e., sterols: higher alcohols) are responsible to impart effect on their physical and their chemical properties viz., colour, refractive index, melting point, saponification point, alkaline hydrolysis behaviour, additive reactions, etc., the differences in physical behaviour and parameters based on chemical characteristics (saponification value, acid value, acetyl value, Reichert–Meissel value, polenske value, etc.) provide analytical guidelines or clues to the classification or characterisation of different oils and fats. Chemical tests are often performed to detect adulteration or rancidity.

The present communication deals with the detection and identification of oily stain in a sexual assault case using simple thin-layer chromatographic (TLC) and FT-IR method.

Brief study of case

In one of the cases, a mother lodged a complaint in police station that a person raped her 8-year-old daughter by

applying some oily material. Police nabbed the accused and seized some of the physical evidences like undergarments and an oil pouch. These seized articles were sent for the forensic examination with queries like whether the undergarments contain spermatozoa and oily stains.

MATERIALS AND METHODS

1. Semen/oil-stained garments of accused and victims.
2. A pouch of oil seized from accused.
3. A standard (similar) type of pouch procured from local market.

Extraction of oily stains from cloths

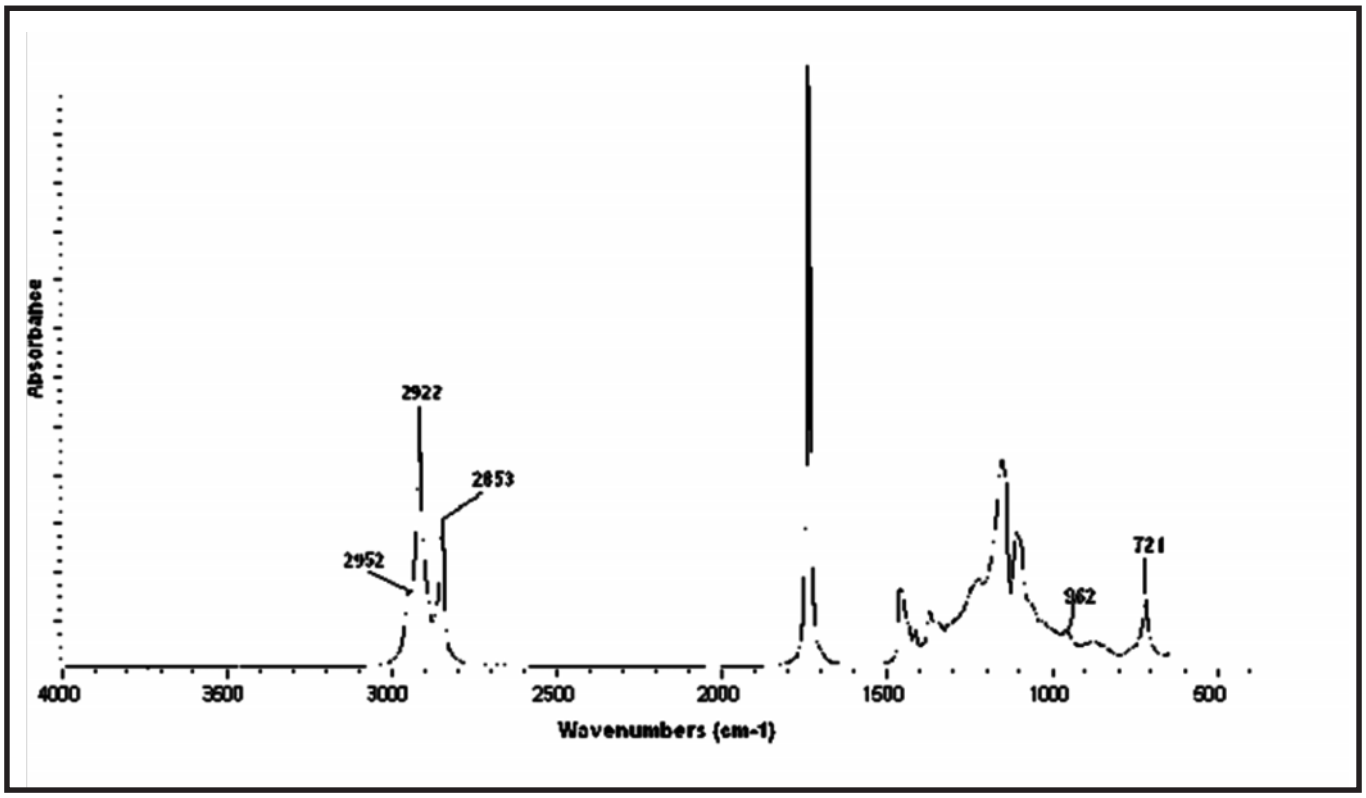
After routine semen examination the oil-stained garments were extracted with petroleum ether (60–80°C). The extract was then concentrated and used for TLC analysis. Similar extract was also prepared from oil pouch seized from accused and similar oil pouch procured from local market.

TLC Analysis[3]

Standard glass TLC plates were coated with slurry of silica gel G water to a uniform thickness of 0.25 mm. The plate was activated by heating in an oven at 110°C for about 1 h. An aliquot of above-mentioned extract and extract of pouch seized from culprit along with extract of oil pouch procured from local market were spotted on to the plate, which was prepared using petroleum ether/ diethyl ether/acetic acid (90:20:1ml) in a pre-saturated TLC chamber to a height of 10 cm. The plate was removed from the chamber, dried in air sprayed by 50% sulphuric acid and heated in an oven for 1 h and the brownish black-coloured spots were appeared at 2.0, 6.0 and 9.0 cm against the white background.

FT-IR Spectroscopy

FT-IR spectra studies were performed on the Perkin Elmer spectrophotometer using universal ATR accessories. Spectrum was recorded between 600 and 4,000 cm^{-1} and the obtained spectrum was compared,



which showed no deviation in both the samples. Major peaks (cm^{-1}) of both of the oils were at 2,952, 2,922, 2,853, 1,739, 1,466, 1,418, 1,378, 1,228, 1,161, 962 and 721.

RESULTS AND DISCUSSION

We utilised petroleum ether (60–80°C) for extraction of oily stains[4], which is a good solvent for oils and do not affect the cloth under examination, similarly, oils that are made up of fatty acids gives brownish black spots with 50% sulphuric acid solution on heating. In the present study, the extract of garment and oil pouch showed similar results[5].

CONCLUSION

The reported FT-IR procedure and reagents for TLC detection and identification of above oily stains are simple, sensitive and can be routinely used in forensic casework.

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Journal Scan

Applicability of an on-site test for its use in post-mortem blood

Amparo Arroyo, Marta Sánchez, Mariona Palahí, Maria Barbal, Ma Teresa Marrón, Agustí Mora

Legal Medicine 2011; 13: 240-44

Abstract

The number of deaths related to drugs of abuse makes necessary the use of an on-site test for those cases in which a rapid detection of the consumed drug is required. Cozart® DDS test provides a simple, fast and reliable tool for the qualitative on-site analysis in post-mortem blood. Owing that this test is prepared for oral fluid samples, a validation becomes essential in order to use it for a different matrix than the established one. According to that, results obtained by Cozart® DDS test used in post-mortem blood samples have been compared with a qualitative gas chromatography–mass spectrometry (GC/MS/MS). Positive results for cocaine family compounds (COC-F) were 43.75%, for opiates family compounds (OPI-F) 25.78%, and for cannabis family compounds (THC-F) 2.34%. Negative results were 28.13%. No amphetamines (AMP) or methamphetamines (MA) were found. Sensitivity and specificity was available for cocaine and opiates but not for cannabis because only five cases were detected. Sensitivity, specificity, predictive positive value and predictive negative value for cocaine were 98%, 91%, 88% and 99%, respectively. Sensivilty, specificity, predictive positive value (PPV) and predictive negative value (NPV) for opiates were 93%, 92%, 76% and 98%, respectively. Likelihood positive ratios for cocaine and opiates have been 10.92 and 11.69, respectively, while likelihood negative ratios have been 0.02 and 0.08, respectively. Results show the suitability of Cozart® DDS test for the qualitative detection of cocaine and opiates in post-mortem blood.

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Journal Scan

Prevalence of psychoactive substances, alcohol, illicit drugs, and medicines, in Spanish drivers: A roadside study

Trinidad Gómez-Talegón, Inmaculada Fierro, Juan Carlos González-Luque, F Javier Álvarez

Forensic Science International 2012; 223: 106-13

Abstract

Following population, geographic, road type and time criteria, Spain has carried out random, roadside controls of 3302 representative sample of Spanish drivers, including saliva analysis for 24 psychoactive substances and alcohol breath tests. The 81.4% of the drivers were male, with an average age of 34.8±11.8 (mean±SD). The 17% of the drivers were found to be positive to any of the substances analysed. The 6.6% of the drivers found positive to alcohol (>0.05mg/l in breath), 11% were found positive to any illicit drug, and 2% were positive to one of the medicines analysed. Some drivers were positive in more than one substance. The most common illicit drugs among Spanish drivers were cannabis (7.7%), or cocaine (3.5%), either alone or combined with other substances. The most prevalent medicines were the benzodiazepines (1.6%). As a tendency, higher figures for positive cases were observed among males than in females (being statistically significant the differences for alcohol, cannabis and cocaine). Alcohol and cocaine positive cases were more frequently found among drivers of urban roads. Alcohol positive cases (alone, >0.05mg/l), were more likely found as age increase (OR=1.02), those driving in urban roads (OR=2.13), and driving at any period than weekdays, while alcohol+drugs cases were more likely found among males (OR=2.819), those driving on urban road (OR=2.17) and driving at night periods. Finding a medicines positive case was more likely as elder the driver was (OR=1.05). There have been differences in the prevalence of positive cases of alcohol, cannabis and cocaine, in relation to the period of the week: in three cases the highest prevalence seen in night time. This study shows the high prevalence of psychoactive substances and alcohol in Spanish drivers, mainly illicit drugs (cannabis). This question requires a response from the authorities and from society, with an integral and multi-disciplinary approach that can heighten the population's awareness of the risks of driving under the influence of certain substances.

DOI : 10.5958/j.0974-4487.10.4.035

Journal Scan

Estimation of the time since death: post-mortem contractions of human skeletal muscles following mechanical stimulation (idiomuscular contraction)

Sophie Warther, Susanne Sehner, Tobias Raupach, Klaus Püschel, Sven Anders

International Journal of Legal Medicine 2012; 126: 399-405

Abstract

The mechanically stimulated idiomuscular contraction of skeletal muscles is part of the widely used compound method for death time estimation and therefore represents an item of high relevance and practicability in forensic case work. However, data on the topic are scarce and inconsistent and the currently reported maximum time span for the occurrence of the phenomenon until 13 h post-mortem (hpm) is based on a single case report from the beginning of the twentieth century. Therefore, idiomuscular contraction following mechanical stimulation has been investigated in skeletal muscles of 270 cases with assured time of death at defined post-mortem time points between 7 and 15 hpm. Of all investigated cases, 45 (16.7%) showed a positive reaction with a preponderance of cases of sudden death. Our investigations confirmed the upper time limit of 13 hpm up until idiomuscular contraction could be stimulated. With every hour of the post-mortem interval, a 0.61-fold decrease of the phenomenon's occurrence was observed (95%CI, 0.52–0.72; $p < 0.001$). Furthermore, several parameters showed significant correlations with the likelihood of the phenomenon's occurrence, namely stimulation of upper arm as opposed to the thigh ($p < 0.001$), gender ($p = 0.017$), and BMI ($p < 0.001$). These findings for the first time give reliable evidence of a post-mortem time limit of mechanically stimulated idiomuscular contraction and therefore contribute to the future application of the method in forensic case work.

DOI : 10.5958/j.0974-4487.10.4.036

Journal Scan

Nasal ciliary motility: a new tool in estimating the time of death

Maria Carolina Romanelli, Matteo Gelardi, Maria Luisa Fiorella, Lucia Tattoli, Giancarlo Di Vella, Biagio Solarino

International Journal of Legal Medicine 2012; 126: 427-433

Abstract

Determination of time since death is one of the most difficult and crucial issue in forensic medicine. Apart from body cooling, which is commonly used in the early postmortem interval (PMI), supravital reactions are the most interesting postmortem changes for time of death estimation. Nasal ciliary motility has been occasionally observed in postmortem period although no studies have focused on this phenomenon for forensic purposes. We aimed to evaluate the diagnostic usefulness of ciliary motility as a potential tool in estimating the time of death. Specimens of ciliated epithelium from 100 consecutive cadavers were obtained by scraping the nasal mucosa at three different postmortem intervals. The samples were then smeared on a slide, and an in vitro evaluation of ciliary movement was analyzed by phase-contrast microscopy. A postmortem nasal ciliary motility was observed, and a statistically significant relationship between decreasing ciliary movements and increasing postmortem interval was detected even in presence of putrefactive changes of nasal ultrastructure integrity. Some peculiar causes of death seem to influence ciliary motility in the early PMI, while no significant correlations with sex or age were observed. According to the results of this study, postmortem evaluation of nasal ciliary motility may be a bona fide and a feasible option for estimating the time of death.

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