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Patterns of Fatal Head Injury in Road Traffic Accidents

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Background: Head Injury is the single most common cause of mortality in vehicle accidents. Its outcome is a product of different mechanisms, types and amounts of head injuries and their anatomical locations.

Objective: To analyze the pattern of fatal head Injury in road traffic accidents.

Design: A retrospective autopsy based study conducted in correlation with the relevant clinical records and the reports from investigating agencies.

Subjects: Cases of Road Traffic Accidents subjected to medico-legal autopsy at the department of Forensic Medicine, Government Medical College and Hospital Chandigarh, India - a tertiary care center.

Main outcome: Young adults (both males and females) in their most productive years of life, are especially prone to head injury, as a result of vehicle accidents.

Results: Vehicle accidents comprised 35% (632) of the total medico-legal autopsies. Fifty-eight percent (367) had sustained head injury, 76% (279) had a Glasgow Coma Score of 8 or less at the time of presentation in the emergency, 72% (273) survived less than 24 hours. Subdural (62.40%), Subarachnoid (23.5%), Extradural (16%) and Intracerebral (9%) haemorrhages were the major causes of death. Skull fractures were detected in 88.1%, while cerebral contusions and lacerations occurred in 23.7%. Six percent developed intracranial infections.

Conclusion: For prompt treatment of such cases immediate Glasgow Coma Scoring, radiological evaluation, surgical Intervention and Intensive care is required. Establishment of trauma teams and proper infrastructure at the primary health care level is recommended.

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Head Injury has been defined[1] as, "a morbid state, resulting from gross or subtle structural changes in the scalp, skull, and/or the contents of skull, produced by mechanical forces". It has also been defined as physical damage to the scalp, skull or brain produced by an external force[2]. However, such force/impact, responsible for the injury needs not be applied directly to the head. Depending upon whether or not the dura-matter was torn, head injury may be termed as open or close type[3]. The extent and degree of injury to the skull and its contents is not necessarily proportional to the quantum of force applied to the head. According to Munro[4] "any type of cranio-cerebral injury can be caused by any kind of blow on any sort of head".

Severe head injury, with or without peripheral trauma, is the commonest cause of death and/or disability up to the age of 45 years in developed countries[5]. According to one study in Chandigarh[6] head injury accounted for 73% of all fatal road traffic accident cases. In a comparative study conducted by the authors[7], head injury was responsible for 63% road traffic accident fatalities in Jammu, 60% in Delhi and 58% in Chandigarh. It was a contributing factor to death in 11%, 13% and 15% of cases, respectively, at these places. This necessitated an in-depth analysis of the pattern of fatal head Injury in road traffic accidents.

METHODS

The study is a retrospective analysis of cases of fatal head injury subjected to medicolegal autopsy at the department of Forensic Medicine, Government Medical College and Hospital Chandigarh, during the period between 1996 to 2001. Only those cases of road traffic accidents where head injury was the cause of death or a major contributing factor towards the death of the victim were included in the study.

The clinical data of the patient including investigations and procedures, survival period, time and cause of death were ascertained from the hospital records. Information pertaining to the time and manner of road traffic accident was sought from the police records. These were then correlated with the post-mortem findings to conclude the analysis of each case.

RESULTS

During the period of study, death due to road traffic was 35% (632/1804) of the total number of autopsies conducted. Male victims showed a decline from 93% (1996) to 59% (2001) while the percentage of female victims registered a proportional increase from 7% (1996) to 41% (2001). Overall, males comprised 73% and the females 27% (Table 1).

Table 1-**Cases According To Years.**

Year	Total No.of autopsies	No. of RTA* Cases	% of RTA Cases	Males		Females	
				No.	%	No.	%
1996	226	121	53.54	113	93.39	08	06.61

1997	264	106	40.15	94	88.68	12	11.32
1998	287	96	33.45	85	88.54	11	11.46
1999	303	102	33.66	71	69.61	31	30.39
2000	352	113	32.10	46	40.71	67	59.29
2001	372	94	25.27	55	58.51	39	41.49
Total	1804	632	35. 03	464	73. 42	168	26. 58

* RTA: Road –Traffic Accidents.

Fifty-four percent (340) of victims in age group of 21 to 40 years. Seventy-eight percent (265) of them were males and 22% (75) were females. The elderly (>60) were involved in 4% (27) only (Table 2).

Table 2 -**Age and Sex distribution**

Age Group (In years)	Males		Females		Total	
	No.	%	No.	%	No.	%
0-10	17	73.91	6	26.09	23	03.64
11-20	76	82.61	16	17.39	92	14.56
21-30	167	79.90	42	20.09	209	33.07
31-40	98	74.81	33	25.19	131	20.73
41-50	80	86.02	13	15.98	93	14.72
51-60	52	91.22	05	08.78	57	09.02
> 61	20	74.07	07	25.93	27	04.27
Total	510	80. 70	122	19. 30	632	100

Forty-two percent (266) of the victims were pedestrians, followed by motor- cyclists [25% (158)], cyclists [13% (82)], etc. In 68% (182) pedestrians, 80% (127) motorcyclists and 43% (35) cyclists, head injury was the major factor leading to or contributing toward the death (Table 3).

Table 3 - **Victims of Road Traffic Accident**

Type of Road User	No.	%	Head Injury	
			No.	%
Pedestrians	266	42.08	182	68.42
Motor-cyclists*	158	25.00	127	80.37
Cyclists	82	12.98	35	42.68
Bus/Mini bus Passengers	49	07.75	11	22.45
Rest**	77	12.18	12	15.58
Total	632	100	367	58.07

*Both the drivers and the pillion rider

**Occupants of auto-rickshaws, cycle-rickshaws, cars, vans, trucks, tractors, etc.

Thirty six percent (132) had a Glasgow Coma Score of 3 or less at the time of presentation at the Emergency Department of the hospital whereas 67% (245) had less than 6 and 76% (279) LESS THAN 8 (Table 4)

Table 4 - **Glasgow Coma Score at the time of presentation**

GCS	No.	%
0-3	132	35.97
4-5	113	30.79
6-7	34	09.26
8-9	39	10.62
10-11	27	07.36
12-15	22	06.00
Total	367	100

Thirty four percent (124) died within an hour of the accident, 51% (187) within 6 hours and 72% (263) within 24 hours. Only 3% (12) survived for more than 1 week (Table 5).

Table 5 - **Survival Period**

Survival Period	No.	%
S.D*./B.D.**/< 1 Hour	124	33.79
1-6 hrs.	63	17.17
6-24 hrs.	76	20.71
1-3 days	59	16.08
3 days – 1 wk.	33	08.99
> 1 wk.	12	03.27
Total	367	100

* S.D: Spot Death ** B.D: Brought Dead

Thirty six percent (132) were investigated in one way or the other. Of these x-rays were done on 63% (83), 36% (48) had Computerized Axial Tomography (CAT) and 3% (4) had Magnetic Resonance Imaging (MRI). Eight percent (11) had diagnostic thoracic and abdominal tap. Twenty-two percent (81) received surgical intervention in the form of exploratory burr holes and craniotomy. Other surgical interventions included thoracotomy 11% (9), exploratory laprotomy 9% (7) and reduction of limb fractures 16% (13). 17% (63) patients needed intensive care management.

Among the various observations made at the time of autopsy (Table 6), scalp haematoma was the commonest external finding 34% (123). Skull fracture was present in 88% (323). The most common contributing factor towards death was intra-cranial bleeding. The commonest of this was subdural haemorrhage 62% (229), followed by subarachnoid

haemorrhage 23% (86) and extradural haemorrhage 16% (59). Cerebral oedema was the next major contributing factor towards death observed in 45% (166). Cerebral contusions and lacerations were noted in 24% (87)

Table 6 - **Autopsy Findings**

Findings	No.	%
Scalp Abrasions	56	15.26
Scalp Lacerations	104	28.34
Scalp Haematoma	123	33.52
Skull Fractures	323	88.01
Extradural Haemorrhage	59	16.08
Subdural Haemorrhage	229	62.40
Subarachnoid Haemorrhage	86	23.43
Intracerebral Haemorrhage	33	08.99
Cerebral Contusion/Laceration	87	23.71
Cerebral Oedema	166	45.23
Brain Abcess	22	05.99
Associated Fracture of Cervical Spine	09	02.45
Surgical Intervention	81	22.07

Skull fractures commonly involved multiple sites 24% (76), followed by parieto - temporal area 20% (64), base of skull 15% (50) and occipital area 10% (33). Fracture of frontal bone was recorded in 2% (8) cases only (Table 7).

Table 7- **Anatomical Location of Skull Fractures**

Location of Fracture	No.	%
Frontal	08	02.48
Fronto-Parietal	21	06.50
Parietal	19	05.88
Parieto-Temporal	64	19.81
Parieto-Occipital	24	07.43
Temporal	13	04.02
Occipital	33	10.22
Temporo-Occipital	15	04.64
Base of Skull	50	15.48
Multiple Sites	76	23.53
Total	323	100

DISCUSSION

In Road Traffic Accidents, head injury is the most common cause of mortality followed by thoraco-abdominal and the musculo-skeletal injuries in that

order[5,7,8]. The male: Female ratio is 3: 1 among the victims of road traffic accidents in the present study, which is in conformity with other workers[5, 9-12] who have reported similar results, ranging from 1.7: 1 to 8: 1. However, the proportional increase from 7% to 41% among the female road traffic fatalities is in contrast to the findings of workers elsewhere and is unique to the city of Chandigarh only. According to a study, the percentage of female victims of road traffic accidents, in Chandigarh, jumped from 19% to 80% in recent years[12].

The maximum number of victims (33%) belonging to the age group of 21 to 30 years is comparable to the results reported by other Indian workers. However, Akang et.al[13] and Lai et al[14], observed that the peak age of such victims was in the fourth decade, with the mean at 33 years.

Pedestrians followed by motorcyclists were the majority victims; collectively accounting for 67% of the road traffic fatalities. Drivers and passengers of various vehicles, rather than motor cyclists, have been reported to be the next vulnerable category of victims[15-17]. Akang et al[13] have reported 53% fatality among the passengers of vehicle accidents. This contrast can be attributed to the prevalence of transport system.

The present study reveals that head injury was most common among motorcyclists (80%) followed by pedestrians (68%) and cyclists (43%). Chandra et al[9] reported the incidence to be most common in cyclists followed by motorcyclists and pedestrians. The result reflects an unchanged pattern of fatal head injuries in the road traffic accidents over the years except for the change in the modes of transport.

Glasgow Coma Scoring of head injury at the time of presentation to the Emergency Department is an important prognostic factor and the level of consciousness should be determined and monitored regularly in all such patients[16]. In the present study, 76% had a GCS of less than 8 at the time of presentation and 72% died within 24 hours of sustaining the injury.

Documentation and localization of intra-cranial haemorrhages guides the neurosurgical intervention and is vital in the management of these patients. The unstable condition of the patient and the relative unavailability of CT scan may have contributed to a low rate of 22% surgical intervention in the present study.

Skull fractures, at one or multiple sites, observed in 88% of the victims. Cases of head injury with fractures of skull tend to have more complications and are more often fatal than those without fracture[8,17]. The bones involved in order of frequency, in the study were: Parieto-temporal (20%), Base of skull (15%), Occipital (10%) and Parieto-occipital (7%). However, in the majority of cases (24%) the fractures were found at multiple sites. Akang et al[13] in their study reported: Frontal (12%), Temporal (9%) and Parietal (9%). Chandra et al[9] reported: Temporal (59%), Occipital (58%) Parietal (50%) and Frontal (49%). Both series, however, have reported the skull fractures at multiple sites as the most common.

The commonest intracranial haemorrhage being subdural in our study (62%), followed by subarachnoid (23%) and extradural (16%) is in conformation to the observations made by Akang et al[13]. The findings differ with the observations of Chandra et al[9] who have reported subarachnoid haemorrhage as the commonest.

Another major factor responsible for death (45%), in the present study, was cerebral oedema.

CONCLUSION

Head injury was the major factor leading to or contributing toward death in 68% of pedestrian, 80% of motorcylists and 43% of cyclists.

Prompt treatment of head injuries involves immediate Glasgow Coma Scoring, Radiological Evaluation, Surgical Intervention and Intensive Care in all appropriate cases, as the first few minutes are crucial for the final outcome. Surgeons should follow the 3 R general management plan - Resuscitate, Review and then Repair[18]. The Advanced Trauma Life Support (ATLS)[16] guidelines should be adhered to, while treating all cases of suspected head injury.

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