



## Fatal craniocerebral injuries in victims who survived for some period

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### Abstract

It is a prospective study of 50 fatal head injury cases whose medico legal autopsy was done in the Institute of Forensic Medicine, Madras Medical College and Government General Hospital, Chennai from December 2007 to June 2008. There were total 50 cases of fatal craniocerebral injuries which needed admission either in Intensive Care Unit or neurosurgery. In the present study, male victims (47 cases, 96%) outnumbered female victims (3 cases, 6%) with an approximate male-female ratio of 16:1. Road traffic accidents (RTA) involving mainly pedestrians and two wheeler users were the most common cause of fatal head injury, seen in 43 cases (86%). Out of the total 50 cases of fatal head injury, brain stem injury was seen in 41 cases (82%). Skull bone fracture was found in 26 cases (52%), 11 cases were associated with primary brain stem injury and 15 cases with the secondary brain stem injury. Temporal and parietal bones were the common site of fracture, observed in 17 cases (34%). The range of survival period was wide, spreading from 6 hours to 600 hours; the mean survival period being 73.42 hours. Brain stem injury, which is generally associated with skull base fracture, was found to be the main factor governing the prognosis of the case.

### Key words

Head injury, Primary brain stem injury, Secondary brain stem injury, Road Traffic Accident.

### Introduction

Craniocerebral injuries (also known as head injuries) are one of the most fatal and common regional injuries ever known to human beings since time immemorial [1].

In the modern era also they are increasingly encountered daily worldwide. Notwithstanding developing countries like India fatal head injuries are now becoming the most common cause of death from trauma worldwide. It has a huge medical, social and economical bearing on the country as it involves especially younger age group population [2].

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The present study was conducted in the Institute of Forensic Medicine, Madras Medical College, Chennai, Tamil Nadu (India). It is one of the oldest and largest medical colleges and tertiary multidisciplinary health care centre in the country catering to a vast Chennai metropolitan city and different parts of the state. Because of heavy traffic congestion, the speed is limited and in majority of the incidents the anatomy of head is comparatively preserved though it is fatally damaged. In our study, we included only those cases having fatal head injuries as defined by The Royal College of Surgeons [3], U.K. Our main aim of the present study is to analyze the autopsy findings of this important regional injury in details and compare our findings with the previous studies.

### Material and method

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We selected 50 cases of fatal head injury that were admitted and died in our hospital. All these cases were either admitted in Intensive Care Unit or performed neurosurgery. Other brought in dead cases of fatal head injuries or cases of crushed head injuries were excluded from the present study because in such cases brain structure would be grossly damaged and moreover we wanted to include the likely future prognosis. After reflecting the scalp tissues, the vault of the skull and meninges were dissected to expose the brain by following the routine autopsy techniques. Detail information such as post mortem number, name, age, sex, date and time of injury, mode of injury, site of impact and other relevant data were noted. Other relevant information was also collected from the hospital records, police papers and relatives. Involvement of brain stem was confirmed with histopathological examination and identified as primary and secondary brain stem injuries. These data were tabulated for easy study and comparison with the previous available studies.

### Observation

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These 50 cases of fatal craniocerebral injuries comprised about 2.82% of all medico legal autopsies conducted during the study period. The incidence of brain stem involvement in fatal craniocerebral injury cases was very high, observed in 41 cases (82%). Amongst these 41 cases of brain stem injury, 16 cases (39.02%) were primary brainstem injury and 25 cases (60.98%) were secondary brainstem injury. Majority of the victims were middle aged male though the age range was wide spread from 4 – 87 years as per **Table - 1**.

Road Traffic Accidents (RTA) was the single most common cause of fatal head injury which was seen in 43 cases (86%) as shown in **Table - 2**. Homicidal head injury was observed only in one case. The most common site for brain stem hematoma was the Pons, seen in 12 cases (63.16%) as shown in **Table - 3**.

The incidence was high with lateral i.e. side to side force, 36 cases (72%) as shown in **Table - 4**. Skull bone fracture was encountered in 26 cases (52%). The occipital bone was the least commonly involved; seen in only one case (2%) as shown in **Table - 5**. In primary brainstem lesions gross hemorrhagic lesions were seen in dorsal, dorsolateral aspect of midbrain and dorsal aspect of upper Pons. In secondary brainstem lesions gross hemorrhagic lesions were seen in the midline and paramedian aspect of tegmentum of midbrain and Pons.

In majority of the cases, death occurred within 24 hours of hospitalization. The mean survival period was about 73.42 hours (range being 6 hours to 600 hours). The mean survival period of the primary brainstem injury was 41.55 hours and that of the secondary brainstem injury was 103.2 hours. Out of 16 cases of primary brainstem injury, 5 cases (31.25%) died within



24 hours and out of 25 cases of secondary brainstem injury, 4 cases (16%) died within 24 hours.

## Discussion

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In the present study male victims, 47 cases (94%) outnumbered female victims, 3 cases (6%) with an approximate male-female ratio of 16:1. Male dominance was also reported by various authors [4, 5, 6, 7] and is attributed to the fact that males are more mobile and frequently involved in outdoor activities than females. Male preponderance was observed in all age groups, most commonly affected age range being 21 to 50 years. Similar findings pertaining to age group were also reported by Amit MP et al. [2], Tyagi AK et al. [6] and Akang EEU et al. [7]. RTA emerged as the single most common cause of fatal head injury which was seen in 43 cases (86%). Most of the victims were two wheeler users or pedestrians in the age group of 20 plus to 50 years. In this respect our findings were consistent with the works of Kumar A et al. [4], Amit MP et al. [2], Tyagi Ak et al. [6] and Johnson MR et al. [8]. However, in the western countries the majority of people injured in road traffic accidents are car occupants [2, 9]. It could be due to differences in common mode of transportation, two wheelers being more popular conveyance in Chennai city and in fact in India. In most of the circumstances the manner of head injury was accidental in nature, 49 cases (98%) and there was 1 case, 2% of assault. Most of fall from height cases, 5 cases (10%), were reported from construction site. Two young patients were injured due to fall from the first floor (20 feet height) while playing.

Gross hemorrhagic lesions were seen in 19 cases, out of which 6 cases (31.58%) were associated with primary brainstem injury and 13 cases (68.42%) were associated with secondary brainstem injury. Hemorrhagic contusions were

seen in midbrain in 6 cases (31.58%), Pons in 12 cases (63.16%) and medulla in one case (5.26%). In cases of primary brainstem injuries, hemorrhagic lesions were seen in the dorsal and dorsolateral aspect of the midbrain and the dorsal aspect of upper Pons. In cases of secondary brainstem injuries, hemorrhagic lesions were found in the midline and paramedian aspect of tegmentum of the midbrain and the Pons. Present findings agreed more or less with the works of Chattopadhyay S, Tripathi C [10] and Ella FT [11]. In majority of cases the direction of force was "Lateral", i.e. from side to side, seen in 36 cases (72%). The unique observation during our present study is that those cases showing lateral impact also sustained secondary brainstem injury due to associated supratentorial traumatic mass with the midline shift. The second most common direction of force was from front to back, which was seen in 11 cases (22%).

Skull bone fracture was seen in 26 cases (52%); 11 cases associated with primary brain stem injury and 15 cases with secondary brain stem injury. Temporal and parietal bones were the common sites of fracture which was seen in 17 cases (34%). More or less similar observation was also reported by Chattopadhyay S, Tripathi C [10], Ghosh PK [12], Fimate L et al [13], Salgado MSL, Colombage SM [14] and Yavuz M et al. [15]. In case of skull base fracture, involvement of the middle cranial fossa was the maximum and similar observation was also reported by Menon A et al [9] and Tirpude BH [16]. Moreover, in majority of the fatal craniocerebral injury cases, skull vault fractures were found to be extended up to skull base. One unique observation in the present study was the higher incidence of "skull base fractures" with the primary brainstem injury cases and the "temporo-parietal skull fractures" with the secondary brainstem injury cases. We did not find any literature regarding this brain stem



injury relationship with skull bone fracture except this present study.

Marks PV and Lavy CBD [17] observed that age to be a major determinant of the degree of recovery following fatal head injury, stating: younger the age group better will be the prognosis. Though it is partly true with the present study also, we observed a strong relationship between the brain stem injury and the case fatality. Amongst the brain stem injury cases also, those showing primary brainstem injury were found to be more fatal. This finding is also in agreement with the findings of Shukla D et al [5], Pilz P et al [18] and Simpson DA et al. [19].

### Conclusion

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Fatal craniocerebral injury cases constitute considerable size of morbidity and mortality in our study centre. Incidence of brain stem injury in such a case is also very high. RTA involving the pedestrians and two wheelers users was the single most important cause of fatal craniocerebral injuries. In majority of the cases the primary brainstem lesions have been associated with basal skull fractures whereas majority of the secondary brainstem lesions were associated with vault fractures. Involvement of brain stem, primarily primary brain stem injury, was found to be an important factor determining the survival and prognosis of the victim.

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**Table - 1:** Cases distribution according to age and sex.

Age in Years	Male	Female	Total	%
0-10	-	1	1	2
11-20	5	-	5	10
21-30	6	-	6	12
31-40	9	-	9	18
41-50	11	2	13	26
51-60	9	-	9	18
61-70	4	-	4	8
71-80	1	-	1	2
Above 80	2	-	2	4
Total	47	3	50	100

**Table - 2:** Cases distribution according to mode of injury.

Mode of injury	Total	%
Road traffic accident	43	86
Fall from height	06	12
Assault	01	2
Total	50	100



**Table - 3:** Cases distribution according to brain stem hematoma.

Site	Primary brain stem injury	Secondary brain stem injury	Total	%
Midbrain	02	02	4	8
Pons	05	07	12	24
Medulla	01	02	3	6

**Table - 4:** Cases distribution according to direction of impact.

Direction of impact	No. of cases	%
Antero posterior	11	22
Lateral	36	72
Vertex	1	2
Unknown	2	4
Total	50	100

**Table - 5:** Cases distribution according to skull bone fracture.

Bone involved	No. of cases	%
Frontal	03	6
Parietal	07	14
Temporal	10	20
Occipital	01	2
Base	05	10
No fracture	24	48
Total	50	100