Cranio-Cerebral Injuries in Victims of Fatal Road Traffic Accident: A 5-year Post-Mortem Study

S.Gouda H[1]*, Meghana P.R[1], B. Prabha B[1]

[1]Department of Forensic Medicine & Toxicology, Father Muller Medical College, Mangalore, Karnataka, India

ARTICLE INFO

Article Type:
Original Article

Article History:
Received: 20 March 2014
Revised: 29 March 2014
Accepted: 29 March 2014

Keywords:
Road Traffic Accident
Skull Fracture
Intracranial Haemorrhage
Cerebral Injury

A B S T R A C T

Background:Victims of vehicular accident sustain different types of injuries, of which, head injury is considered as more fatal than injury to other systems. This study was carried out to know the incidence and pattern of cranio-cerebral injuries in victims of fatal vehicular accidents.

Methods: Medico-legal autopsies conducted on victims of vehicular accidents from 01-01-2008 to 31-12-2012 at the Department of Forensic Medicine, Father Muller Medical College, Mangalore, Karnataka, India, were retrospectively analysed.

Results: Deaths due to vehicular accidents constituted 69% of the total unnatural deaths. Cranio-cerebral injuries were present in 68.5% of victims of vehicular accident. Combination of skull fracture, intra-cranial haemorrhages and cerebral injury was seen in maximum number of victims (38.2%). If injuries are considered individually, most commonly observed injury was intracranial haemorrhage (90.7%), followed by skull fracture (78.9%). Subarachnoid haemorrhage was the commonest type of intracranial haemorrhage present (78.3%). In the skull vault, linear fracture was the commonest type (49%) and in the base, middle cranial fossa (68.3%) was the most commonly fractured fossa. Among the cerebral injuries, contusion of the brain tissue was the commonest injury seen. Frontal and temporal lobes were the most commonly injured parts of the cerebrum (65.8%).

Conclusion: Most of the cranio-cerebral injuries cannot be treated successfully because of their anatomical configuration. But, morbidity and mortality due to vehicular accidents can be reduced by preventing the occurrence of accidents. Therefore, the old saying, "Prevention is better than cure" holds good even here.

►*Implication for health policy/practice/research/medical education:* Cranio-Cerebral Injuries in Victims of Fatal Road Traffic Accident

►*Please cite this paper as:* S.Gouda H, Meghana P.R, B. Prabha B. *Cranio-Cerebral Injuries in Victims of Fatal Road Traffic Accident: A 5 year Post-Mortem Study. International Journal of Medical Toxicology and Forensic Medicine*. 2014; 4(2):77-82.

1. Introduction:

Road Traffic Accident (RTA) is any vehicular accident occurring on the roadway (i.e. originating on, terminating on, or involving a vehicle partially on the roadway) (1). In 1771, the first accident involving a motor vehicle took place in Paris when Cugnot's steam tractor hit a low wall in the grounds of the Paris arsenal. The first motor car accident in Britain resulting in the death of the driver occurred in Grove Hill, Harrow-on-the Hill, London, on 25-02-1899 (2). Since then, different countries have introduced many road safety policies and measures to prevent mortality and morbidity due to vehicular accidents. But, the present situation is such that lakhs of people are killed and millions are injured all over the world every year due to vehicular accidents.

World Health Organization has revealed in its first ever Global Status Report on Road Safety that more people die in road accidents in India than anywhere else in the world, including the populous China. Calling road fatalities an "epidemic" that will become the world's fifth biggest killer by 2030. It said that 90% of deaths on the world's roads occur in low and middle-income countries though they have just 48% of all registered vehicles. The statistics for India are alarming (3). As per the National Crime Records Bureau of India, number of persons injured and died in road traffic accidents in 2012 is 469913 and 139091 respectively (4).

Of all the regional injuries, those of head are most common and account for about 60% of fatal road accidents. The brain and its coverings are vulnerable to that degree of trauma as would rarely prove fatal, if applied to other parts of the body (5).

Objective of the study was to know the incidence and pattern of cranio-cerebral injuries in victims of RTA Cases were studied with respect to fracture of skull, intra-cranial haemorrhages and injury to the brain.

*Corresponding author:*S.Gouda H, MD.Associate Professor.Department of Forensic Medicine & Toxicology Father Muller Medical College, Mangalore, Karnataka, India

E-mail: hareeshfmt@rediffmail.com

2. Materials and Methods:

Medico-legal autopsies conducted on victims of RTA from 01-01-2008 to 31-12-2012 at the Dept. of Forensic Medicine, Father Muller Medical College, Mangalore, Karnataka, were retrospectively analysed to study the cranio-cerebral injuries sustained by the deceased. The required data were obtained from the post-mortem reports.

3. Results:

In the present study, victims of fatal RTAs were 111, constituting 69% of total autopsies conducted during the study period. Males comprised 82.9% (92 cases) and females 17.1% (19 cases) of the total fatalities. Maximum number of victims were in the age group 21-30 years (24 cases; 21.6%) and minimum (1 case; 0.9%) in 91-100 years age group (Table 1). Majority of the victims were motorcyclists (43 cases; 38.7%). Of the 111 victims of fatal RTA, 76 (68.5%) had cranio-cerebral injuries. Out of these 76 victims, 74 (97.3%) died due to cranio-cerebral injuries. Commonest type of scalp injury seen in our study was laceration (16 cases; 21.1%). Combination of skull fracture, intra-cranial haemorrhages and cerebral injury was seen in maximum number of victims (29 cases; 38.2%). If we consider injuries individually, most commonly present injury was intracranial haemorrhage (69 cases; 90.7%). No case of isolated cerebral injury was present (Table 2). Commonest type of intracranial haemorrhage observed in this study was subarachnoid haemorrhage (54 cases; 78.3%) followed by subdural haemorrhage (52 cases; 75.4%). In majority of the cases (49 cases; 71%) was seen combination of intracranial haemorrhages (Table 3). Fracture of the skull (60 cases; 78.9%) was the second commonest type of cranio-

Table 1: Age and sex wise distribution of RTAs (n = 111)

Age (in years)	Sex		Total	
	Male	Female	Number	Percentage
≤ 10	00	02	02	1.9
11-20	08	03	11	9.9
21-30	23	01	24	21.6
31-40	17	05	22	19.8
41-50	20	00	20	18.0
51-60	04	03	07	6.3
61-70	11	01	12	10.8
71-80	06	03	09	8.1
81-90	02	01	03	2.7
91-100	01	00	01	0.9
Total	**92 (82.9%)**	**19 (17.1%)**	**111**	**100**

Table 2: Distribution of Cranio-cerebral injuries (n = 76)

Type	Number	Percentage
Skull fracture	04	5.3
Intra-cranial haemorrhages	07	9.2
Cerebral injury	00	00
Skull fracture + Intra-cranial haemorrhages	24	31.6
Skull fracture + Cerebral injury	03	3.9
Intra-cranial haemorrhages + Cerebral injury	09	11.8
Skull fracture + Intra-cranial haemorrhages + Cerebral injury	29	38.2
Total	**76**	**100**

Table 3: Intra-cranial haemorrhages (n=69)

Type	Number	Percentage
EDH	02	2.9
SDH	07	10.1
SAH	09	13.0
Intra-cerebral Haemorrhage	02	2.9
EDH + SDH	01	1.5
EDH + SAH	01	1.5
EDH + Intra-cerebral Haemorrhage	01	1.5
SDH + SAH	23	33.3
SDH + Intra-cerebral Haemorrhage	01	1.5
SAH + Intra-cerebral Haemorrhage	02	2.9
EDH + SDH+ SAH	04	5.8
EDH + SDH + Intra-cerebral Haemorrhage	01	1.5
EDH + SAH + Intra-cerebral Haemorrhage	00	00
SDH + SAH + Intra-cerebral Haemorrhage	13	18.7
EDH + SDH + SAH + Intra-cerebral Haemorrhage	02	2.9

cerebral injuries seen. Fracture of vault was seen in majority of the victims (51 cases; 85%). In 34 cases (56.7%) combination of fracture of vault and base was observed (Table 4). In the skull vault, linear fracture was the commonest type (25 cases; 49%) and in the base of skull, middle cranial fossa (28 cases; 68.3%) was the most commonly fractured fossa (Table 5). Among the cerebral injuries, contusion

Table 4: Distribution of skull fractures (n=60)

Site	Number	Percentage
Vault alone	17	28.4
Base alone	07	11.6
Vault & base	34	56.7
Facial bones	02	3.3
Total	**60**	**100**

Table 5: Fractures of vault and base of skull

Vault of Skull (n=51)		Base of Skull (n=41)			
Type	**Number**	**Type**	**Linear**	**Comminuted**	**Total**
Linear	25 (49%)				
Comminuted	21 (41.2%)	**ACF**	10	12	22 (53.4%)
Depressed	05 (9.8%)	**MCF**	20	08	28 (68.3%)
Sutural	03(5.9%)	**PCF**	05	02	07 (17%)

*ACF – Anterior Cranial Fossa; MCF – Middle Cranial Fossa; PCF – Posterior Cranial Fossa.

Table 6: Cerebral injuries (n=41)

Region	Type		Total	
	Contusion	**Laceration**	**Number**	**Percentage**
Frontal lobe	16	11	27	65.8
Parietal lobe	02	05	07	17.1
Temporal lobe	15	12	27	65.8
Occipital lobe	02	00	02	04.9

of the brain tissue was the commonest injury seen. Frontal and temporal lobes (27 cases each; 65.8%) were the most commonly injured parts of the cerebrum (Table 6). Contusion of cerebellum and brain stem was seen in 6 cases (14.5%) and 20 cases (48.8%) respectively.

4. Discussion:

Death due to vehicular accidents is occupying the top rank in the list of unnatural deaths in majority of the places in India. Maximum number of vehicular accident victims die due to the head injuries. 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 mechanical forces". To be complete, however, it should take into account that the impact, responsible for the injury, need not be applied directly to the head (5).

In the present study, more than 50% of unnatural deaths were due to vehicular accidents. Male victims were significantly more than the female victims. Male preponderance was also observed in other studies (6-11). Majority of the victims were in the age group 21-30 years and in total more than 50% of victims were between 21–50 years.Our result is in concurrence with the studies done by Kumar A *et al* (7) Jha S *et al*(8), Menon A *et al* (10) and Tandle RM *et al* (11). Highest number of fatalities in this age group may be due to the fact that persons of this age group lead more active life, more mobile and go out for work and keep themselves outdoors most of the time. People in extremes of age comprised the minimum number of fatalities.

Our study shown 69% of victims of RTAs had cranio-cerebral injuries. This is

comparable to studies done by Menon A *et al* (82%) (10), Tandle RM *et al* (74%) (11).It was also observed in this study that 66% of victims died due to head injuries. In the study done by Ganveer GB *et al* (12) to know the pattern of injuries among non-fatal cases of road traffic accidents, most commonly injured part of the body was lower extremities and most common type of injury was fracture. This indicates that incidence of fatal outcome is more if vital body regions like head, thorax and abdomen are injured.

In the present study, most commonly observed cranio-cerebral injury was intracranial haemorrhage which indicates its association with high fatality. Among the intracranial haemorrhages, most common was subarachnoid haemorrhage and least common was extradural haemorrhage. Subarachnoid haemorrhage was the commonest intracranial bleed observed by Chandra J *et al* (67%) in their study (13). Whereas, subdural haemorrhage was most common in the studies by Jha *et al* (51%) (8), Menon *et al* (53%) (14), Sharma *et al* (62%) (15), Kumar *et al* (89%) (7), Chavan *et al* (40%) (9). In the our study, combination of haemorrhages was seen in 2/3rd of the cases and combination of subdural haemorrhage with subarachnoid haemorrhage was the most common (33%). This is in accordance with the study by Tandle *et al* (11). In the present study, though subarachnoid haemorrhage was seen in majority of the victims, no significant difference was observed in the incidence of subdural and subarachnoid haemorrhage.

Literature says that in one of four fatal head injuries, skull escapes fracture (5). The presence of skull fracture is an indication of the severity of force applied. In contrast to the vault, the base of the skull presents many jagged areas. The relative movement of the brain against the skull results in more damage to its inferior surface or base. In our study, fracture of the skull was present in about 79% of cases. Incidence of skull fracture observed in other studies were, Jha *et al* (86%) (8), Menon *et al* (62%) (10), Tandle *et al* (69%) (11), Chandra *et al* (80%) (13) and Kumar *et al* (69%) (7). Fracture of the cranial vault (85%) was more than the base (68%) in the present study. This is similar to the studies done by Jha *et al* (94%) (8), Chavan *et al* (99%) (9) and Tandle *et al* (84%) (11). Whereas, Menon *et al* (10) observed fracture of vault and base in equal number of cases. In the our study, linear fracture was the commonest type of vault fracture (49%) and similar result was observed in the Chavan *et al* study (52%) (9) and Tandle (50%) (11). Middle cranial fossa (68%) was the most commonly fractured fossa in this study. Similar findings were also observed by Jha et al (45%) (8) and Menon *et al* (26%) (10) in their studies.

In the present analysis, we observed that more than half of the victims (54%) had injury to the brain. Contusion was the commonest cerebral injury seen. Jha *et al* and Chandra *et al* observed laceration as the commonest form of brain injuries. However, Menon *et al* (10) found contusion and laceration in equal number of cases.

5. Conclusion:

This study shows that 69% of the victims of vehicular accident deaths had head injuries. In about 38% of cases combination of skull fracture, intra-cranial haemorrhages and cerebral injury was present. Intracranial haemorrhage was found in 91% of victims and subarachnoid haemorrhage was the commonest. Frontal and temporal lobes were the most commonly injured parts of the cerebrum and brain stem contusion was also seen in significant number of cases.

Morbidity and mortality due to vehicular accidents though cannot be completely stopped, definitely can be reduced. Strict implementation of traffic rules is one of the main factors required to bring down the incidence of vehicular accidents. At the same time, users of the vehicle and road should also realise their responsibility of

following the traffic rules. Awareness programmes regarding use of proper protective measures and effect of intoxicating substances on one's driving ability help in preventing accidents and injuries. Last but not the least; better healthcare facilities are required for the effective treatment of victims of vehicular accidents.

References

1. WHO. ICD-10 'International Statistical Classification of Diseases and Related Problem'. 10th revision. Volume 1. Geneva: World Health Organisation; 891-943.
2. Delhi Traffic Police. Available from: http://www.delhitrafficpolice.nic.in/traffic-history.htm (Accessed on: 25th February 2014).
3. India leads world in road deaths: WHO. The Times of India. Aug 17, 2009. Available from: http://timesofindia.indiatimes.com/india/India-leads-world-in-road-deaths-WHO/articleshow/4900415.cms?referral=PM (Accessed on: 25th February 2014).
4. National Crime Records Bureau Report – 2012. Available from: http://ncrb.nic.in/CD-ADSI-2012/table-1.6.pdf (Accessed on: 26th February 2014)
5. Vij K. Text book of Forensic Medicine and Toxicology. 4thed. New Delhi: Elsevier; 2008.
6. Farooqui JM, Chavan KD, Bangal RS, Syed MMA, Thacker PJ, Alam S, Sahu S, Farooqui AAJ, Kalakoti P. Pattern of injury in fatal road traffic accidents in a rural area of western Maharashtra, India. Australas Med J. 2013;6(9):476-82.
7. Kumar A, Lalwani S, Agrawal D, Rautji R, Dogra TD. Fatal road traffic accidents and their relationship with head injuries: An epidemiological survey of five years. Ind J Neuro Trauma. 2008;5(2):63-7.
8. Jha S, Yadav BN, Agrawal A, Thakur D, Karna A, Subedi N, Gurung S. The Pattern of Fatal Head Injury in a Teaching Hospital in Eastern Nepal. J ClinDiagn Res. 2011;5(3):592-6.
9. Chavan KD, Devaraj P, Karaddy SS, Santosh SG. Study of patterns of cranio-cerebral injuries in deaths due to fatal vehicular accidents. Indian J Forensic Med Path. 2009;2(2):73-9.
10. Menon A, Nagesh KR. Pattern of fatal head injuries due to Vehicular accidents in Manipal. J Indian Acad Forensic Med. 2005:27(1):19-22.
11. Tandle RM, Keoliya AN. Patterns of head injuries in fatal road traffic accidents in a rural district of Maharashtra- Autopsy based study. J Indian Acad Forensic Med. 2011;33(3):228-31.
12. Ganveer GB, Tiwari RR. Injury pattern among non-fatal road traffic accident cases: a cross-sectional study in central India. Indian J Med Sci. 2005;59(1):9-12.
13. Chandra J, Dogra TD, Dikshit PC. Pattern of Cranio-Intracranial injuries in Fatal Vehicular Accidents in Delhi 1966-76. Med Sci Law. 1979;19(3):186-94.
14. Menon A, Pai VK, Rajeev A. Pattern of fatal head injuries due to vehicular accidents in Mangalore. J Forensic Leg Med. 2008;15(2):75-7.
15. Sharma BR, Harish D, Singh G, Vij K. Patterns of Fatal Head Injury in Road Traffic Accidents. Bahrain Med Bull. 2003;25(1):22-5.