



Original Research Article

AN AUTOPSY BASED RETROSPECTIVE STUDY ABOUT PATTERN OF HEAD INJURY IN ROAD TRAFFIC ACCIDENT CASES.

Name of Author:	Abstract: Road traffic accident (RTA) is one of the major causative factors of death among Indian population and also a major cause of burden over Autopsy surgeon due to rise in number of Autopsy cases. Among all the injuries caused by RTA, Head injuries are the most serious injuries in terms of both morbidity and mortality. Hence the aim of our present study is to understand the pattern of Head injuries in Road traffic accident cases. This study was conducted in the Department of Forensic Medicine & Toxicology, M.G.M. Medical College, Indore (M.P.) over the period of six months from 1st September 2023 to 29th February 2024. A total of 70 postmortem cases of road traffic accident were selected for our present study. Contusion/Ecchymosis is the major scalp injury present in 45.71% cases. Linear fracture is the most common type of skull fracture present over both skull vault as well as skull base. Subdural and Subarachnoid intracranial haemorrhage was present in majority of the cases of head injury due to RTA.
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INTRODUCTION

Head injury 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]. Since Head is the prominent and exposed vital part of body it is very much vulnerable to injuries, especially due to RTA. Road Traffic Accidents with blunt force trauma to the head may results in various types of head injuries such as abrasion, contusion/ecchymosis, laceration over the scalp, different types of skull fractures and various intracranial haemorrhages.

A Road Traffic Accident (RTA) can be defined as “an event that occurs on a way or street open to public traffic; resulting in one or more persons being injured or killed, where at least one moving vehicle is involved

[2]. Thus, RTA is a collision between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles.” Road traffic accidents are a human tragedy. They involve high human suffering and socioeconomic costs in terms of premature deaths, injuries, loss of productivity and so on [2].

A total number of 4,46,768 cases of ‘Road accidents’ were reported in the year 2022, which rendered 4,23,158 persons got injured and death to 1,71,100 persons. 45.5% victims of road accidents were riders of ‘two-wheelers’ followed by cars, trucks/orlorries and three-wheeler like auto rickshaw have accounted for 14.1%, 8.8% and 4.5% respectively of road accidental deaths. 59.7% and 40.3% of road accidents were

reported in rural areas (2,66,707 cases) and urban areas (1,80,061 cases) respectively [3].

The thickness of scalp over the skull is variable ranging from a few mm to about 15mm. Most of the wounds in RTA are caused by blunt force to the head (results from falls or blows), such wounds are contusions or lacerations. The skull has outer and inner tables in which outer table of skull has twice the thickness of inner. The thickness of frontal and parietal bones are 6 to 10mm and thickest part of skull is Occipital bone, which has thickness about 15mm. The Temporal bone is thinnest part of the skull, which has thickness approximately 4mm. Skull is thicker in its Midfrontal, Midoccipital, Parieto-sphenoid and Parieto-petrous regions [1].

The most common type of skull fracture is Linear (Fissured) fracture, that is produced by general deformation of skull and consists of 70% of skull fractures. Other major types of skull fractures are Depressed skull fracture, Comminuted fracture, Hinge fracture and Diastatic fracture. Depressed fractures are produced over the skull with an object having comparatively small surface of striking area and has relatively large amount of kinetic energy. Comminuted fractures over the skull are produced by significant force that has striking over a broad region of skull causing two or more intersecting lines of fracture which divide the skull bone into three or more fragments [1]. Hinge fractures are involved over the skull base, that usually seen over petrous part of temporal, temporal or occipital bones by which more or less effectively separating them from the Cranial vault. Diastatic fractures are produced by the separation of skull suture lines, usually the sagittal suture is involved and which is particularly common in young person's met with road traffic accidents [1,4].

Injuries to the meninges as a result of head trauma that may cause various types of intra cerebral haemorrhages, namely the Extradural, Subdural, Subarachnoid and Intracerebral haemorrhages and their various

combinations. Blow over the lateral convexity of the head may produce fracture of squamous temporal bone and could injure the middle meningeal artery that leads to the formation of Extradural haemorrhage, which is the least common type of cerebral haemorrhage is seen in 1-3% cases of head injury. Subdural haemorrhage is commoner than extradural haemorrhage and may produce as a result of relatively slight trauma. It is a venous type of haemorrhage, which may contribute to death if the haemorrhage is about 100 to 150ml. Most common form of traumatic intracranial haemorrhage is Subarachnoid haemorrhage [1]. It is associated with almost all cases of traumatic brain injury and may present in different combinations with other types of haemorrhages also.

Reckless driving contributed to 24.7% road accidents which rendered 45,161 deaths and 1,00,901 persons injured and 2.2% of road accidents were due to poor weather conditions [3]. Other contributing factors include faulty road design and infrastructure, driving under the influence of alcohol, violating traffic rules and regulations, using mobile phones while driving, avoiding the use of seat belt and use of securely strapped quality helmet.

MATERIALS AND METHODS

The present study is a Retrospective study, which was conducted in the mortuary of Department of Forensic Medicine & Toxicology of M.G.M. Medical College, Indore, (M.P.) over a period of 6 months from 1st September 2023 to 29th February 2024. During this period, total 70 postmortem cases of RTA were conducted and analysed by the Authors of this study.

The data regarding 70 postmortem cases of RTA in present study were collected from Postmortem Reports and Department Records, which includes the Road traffic accident cases of both Hospitalised and Brought dead to hospital cases. A Proforma has been framed to collect data, compiled the collected data on Excel sheet, observed it and the Results has been drawn.

RESULTS

The present study has been conducted in the mortuary of Department of Forensic Medicine & Toxicology of M.G.M. Medical College, Indore, (M.P.) over a period of 6 months from 1st September 2023 to 29th February 2024. During this period, total 70 postmortem RTA cases conducted by the Authors of this study were analysed. Out of 70 RTA cases, Contusions/Ecchymosis injury over the scalp was the most common type of injury found in 32 cases (45.71%), followed by Abrasions which was seen in 17 cases (24.28%) and least common type of scalp injury was lacerations, which was present in 13 cases (18.57%). There were no scalp injuries in 8 cases (11.42 %) out of 70cases. (Table1).

Table 1. Pattern of scalp injuries in RTA cases (n = 70)

Pattern	Number of Cases	Percentage
Abrasion	17	24.28%
Contusion/Ecchymosis	32	45.71%
Laceration	13	18.57%
No scalp injury	8	11.42%
Total	70	100%

In present study, scalp injuries such as Abrasion, Contusion/Ecchymosis & Laceration were most commonly involved Frontal region of scalp that is present in 20 cases (28.57%), followed by Temporal region in 8 cases (11.42%), and then over the Parietal region in 7 cases (10.00%). Least common region involved was Occipital region in 2 cases only (2.85%). Most common combined region with scalp injury is Fronto-Parietal region 6 cases (8.57%), followed by Fronto-Temporal (5cases,7.14%) and there is no injury present over scalp involving temporo-occipital region combinedly (0.00%). Scalp injury involving whole scalp was seen in 04 cases (5.71%). **(Table2).**

Table.2 Distribution of Scalp injuries as per location (n = 70)

Site of Injury	Abrasion	Contusion / Ecchymosis	Laceration	Total	Percentage
1) Frontal region	11	6	3	20	28.57%
2) Parietal region	0	2	5	7	10.00%
3) Temporal region	2	5	1	8	11.42%
4) Occipital region	0	1	1	2	2.85%
5) Fronto-Parietal region	2	3	1	6	8.57%
6) Fronto-Temporal region	2	3	0	5	7.14%
7) Parieto-Occipital	0	1	1	2	2.85%
8) Parieto-Temporal region	0	2	0	2	2.85%
9) Temporo-Occipital region	0	0	0	0	0.00%
10) Fronto-Parieto-Temporal region	0	2	1	3	4.28%
11) Parieto-Temporo-Occipital region	0	3	0	3	4.28%
12) All over (FPTO)	0	4	0	4	5.71%
13) Total	17	32	13	62	88.57%

In 70 cases of RTA, fracture of cranial vault was noted in 43 cases (61.42%) and in remaining 27 cases (38.57%) there were no skull vault fracture observed. Linear fracture present over the different regions of the skull vault, was observed in majority of the cases that is in 21 cases out of 70 cases (30.00%). Second most common type of skull vault fracture was Depressed fracture, that is seen in 11cases (15.71%); followed by Comminuted fracture over different regions of skull vault that is in 7cases (10.00%). Least common type of skull vault fracture observed in our study is Diastatic sutural fracture which account for 5.71 %. **(Table3).**

Table.3 Type of skull vault fracture in RTA cases (n = 70)

Type of skull fracture	Number of cases	Percentage
Linear fracture	21	30.00%
Depressed fracture	11	15.71%
Comminuted fracture	7	10.00%
Diastatic fracture	4	5.71%
No skull fracture	27	38.57%
Total	70	100%

In skull vault fractures, Temporal bone is the single most common bone to be involved in fracture that is present in 12cases (17.14%) in which linear fracture (11 cases) is predominant type because Temporal bone is the thinnest bone in skull vault, followed by Frontal bone fracture that is present in 5 cases (7.14%) and then Parietal bone that is present in 4 cases (5.71%). In our study, there was no fracture which only confined to Occipital bone. Parieto-temporal bones are the most common combined bone fracture that has involved in skull vault, that is present in 8 cases (11.42%), followed by Fronto-parietal bones fracture present in 3 cases (4.28%) and Parieto-temporo-occipital bones fracture also present in 3 cases (4.28%). Least commonly involving combined fracture sites are Fronto-temporal, Temporo-occipital Parieto-occipital and Fronto-parieto-temporal bones, each involving 2 cases (2.85%) **(Table.4).**

Table.4 Distribution of skull vault fracture as per location in RTA Cases (n = 70)

Site of Fracture	Linear fracture	Depressed Fracture	Comminuted Fracture	Diastatic fracture	Total	Percentage
1) Frontal region	2	3	0	0	5	7.14%
2) Parietal region	0	2	0	2	4	5.71%
3) Temporal region	11	1	0	0	12	17.14%
4) Occipital region	0	0	0	0	0	0.00%
5) Fronto- Parietal region	0	0	2	1	3	4.28%
6) Fronto-Temporal region	2	0	0	0	2	2.85%
7) Parieto-Occipital	0	2	0	0	2	2.85%
8) Parieto-Temporal region	4	3	0	1	8	11.42%
9) Temporo- Occipital region	2	0	0	0	2	2.85%
10) Fronto- Parieto-Temporal region	0	0	2	0	2	2.85%
11) Parieto- Temporo-Occipital region	0	0	3	0	3	4.28%

Fractures involving the base of skull was present in 31 cases out of 70 cases that is in 44.28% cases. Again, Linear fracture is the most common type of skull base fracture, that is present in 20 cases (28.57%), including anterior, middle and posterior cranial fossa. Regarding the base of skull, second most common type of skull base fracture is the Comminuted fracture, which is present in 8 cases (11.42%). Least common type of skull base fracture was Hinge fracture, which was present in 3 cases (4.28%). Considering the distribution of skull base fracture in head injury cases, Middle cranial fossa is found to be most commonly affected, that is 19 cases (27.14%) which includes Linear, Comminuted and Hinge fractures, followed by Anterior cranial fossa that is present in 7 cases (10.00%) which includes Linear and Comminuted fractures. The least common skull base fractures site is Posterior cranial fossa, that is involved in 5 cases (7.14%) and having only linear fracture. (Table 5).

Table.5 Distribution of skull base fractures in RTA Cases (n = 70)

Type of skull base fracture	Anterior Cranial Fossa	Middle Cranial Fossa	Posterior Cranial Fossa	Total	Percentage
Linear fracture	06	09	05	20	28.57%
Comminuted fracture	01	07	0	08	11.42%
Hinge fracture	0	03	0	03	4.28%
Total	07	19	05	31	44.28%

In the present study, Subdural haemorrhage was the single most common type of Intracranial haemorrhage which is present in 16 cases (22.85%) followed by Subarachnoid haemorrhage noted in 11 cases (15.71%). There were no cases having Extradural Haemorrhage and Intracerebral haemorrhage individually in our study. Most common Intracranial haemorrhages present in combination to each other was Subdural and Subarachnoid haemorrhages, present in 36 cases (51.42%) followed by combination of Extradural, Subdural and Subarachnoid haemorrhages, which were present in 6 cases (8.57%) followed by the combination of Subarachnoid and Intracerebral haemorrhage, that was noted in 1 case (1.42%). There are no cases having extradural haemorrhage and Subdural Haemorrhage in combination. (Table 6).

Table.6 Types of Intracranial Haemorrhage in RTA Cases (n = 70)

(EDH – Extradural haemorrhage, SDH – Subdural haemorrhage, SAH – Subarachnoid haemorrhage, ICH – Intracerebral haemorrhage).

Types of Haemorrhage	No. of Cases	Percentage
EDH	0	0.00%
SDH	16	22.85%
SAH	11	15.71%
ICH	0	0.00%
EDH+SDH	0	0.00%
EDH+SDH+SAH	6	8.57%
SAH+ICH	1	1.42%
SDH+SAH	36	51.42%
Total	70	100%

DISCUSSION

In our study scalp injury is present in 62 cases (88.57%) in 70 cases, out of which Contusion/Ecchymosis is the most common type of scalp injury that is present in 32 cases (45.71%). This finding is consistent with the study conducted by Soni SK et al [5] and Nair SS et al [6] in which contusion was seen in 61.5% and 70.7% cases respectively. Abrasion is the second most common scalp injury that is present in our study found in 17 cases (24.28%), this is not consistent with study done by Soni SK et al [5] and Nair SS [6] in which laceration injury is the second most common injury over scalp seen in 10.5% and 60.7% cases respectively. laceration injury over scalp is least common which were found in 18.57% of the total study population. This finding in present study is contrary to the studies conducted by Soni SK et al [5] and Nair SS [6] in which abrasion injury is the least common scalp injury found in 3.5% and 54.5% of the study population respectively.

In our present study, scalp injuries are most commonly involving the Frontal region of scalp (28.57%) and it is consistent with the study conducted by Soni SK et al [5] and Nair SS et al [6] in which scalp injuries over frontal region was observed in 18% and 92.4% out of their total study population respectively. Temporal region is the second most common region involved that is in 11.42% cases and it is consistent with the study conducted by Soni SK et al [5] and Nair SS et al [6], which states scalp injury involving temporal region to be 10.0% and 60.37% of the total cases under study respectively. Least common region involving scalp injury is occipital region in 2.85% of cases. This pattern is similar with the study conducted by Nair SS et al [6], in which occipital region of scalp is least affected i.e., 18.86% of total cases. But, in contrast Soni SK et al [5], found that parietal region is least commonly involved (2.0%).

In view of combined region involvement over scalp, scalp injuries are most commonly distributed over fronto-parietal region in 06 cases (8.57%) in our present study. But, in contrast Soni SK et al [5], found that most commonly involved scalp region is parieto-temporal region (22.0%). Second most common combined scalp region involved as per our study was fronto-temporal region (7.14%). But, in contrast Soni SK et al [5], found that second most common combined scalp region involved is Fronto-Parietal region (16.5%).

In present study, skull vault fracture present in 43 out of 70 cases that is in 61.4%. Linear (Fissured) fracture over the skull is the most common type of skull vault fracture which was found in our study that is seen in 21 cases out of 70 cases (30%) of total study population and it is consistent with study conducted by Nair SS et al [6] in which linear fracture over the skull vault were seen in 73 cases (62%). But in contrast to our study, Singh G. et al [7] study finds depressed fracture over skull vault is the commonest in 31% cases. Second most common type of skull vault fracture seen in our study

was depressed fracture seen in 15.71% cases. But the study conducted by Nair SS et al [6] and Singh G. et al [7], comminuted fracture over skull vault is the second most common skull fracture observed in 28% and 16% cases of their study population respectively. Least common type of skull vault fracture found in our study is diastatic sutural fracture accounting for 5.71%. But, in contrast the study conducted by Nair SS et al [6] finds depressed fracture and Singh G. et al [7] finds linear fracture over skull vault to be the least common type of skull vault fracture involving 8% and 14% cases of their study population.

Among skull vault fractures, Temporal bone was the single most common bone involved (17.14% cases) in our study followed by frontal bone (7.14% cases) and parietal bone (5.71% cases) because temporal bone is the thinnest bone in skull vault. In the study conducted by Nair SS et al [6] found unilaterally Temporal bone was most common bone involved (88.7% cases) followed by parietal bone (75.4% cases) and frontal bone (30.18% cases).

In present study, fractures involving the base of skull was present in 39 out of 70 cases (44.28%). Linear fracture was the most common type of skull base fracture found in 28.57% cases followed by comminuted fracture in 11.42% cases in our study which was consistent with study conducted by Nair SS et al [6] shows commonest type skull base fracture is linear fracture (38.7%) followed by comminuted fracture (11.3%). Considering the distribution of skull base fracture in present study, middle cranial fossa was found to be the most commonly affected (27.14%) which includes Linear, Comminuted and Hinge fractures. This finding is consistent with study conducted by Nair SS et al [6] show middle cranial fossa is the most common region involved in skull base fracture (25.4% cases).

In the present study, Subdural haemorrhage was the single most common type of intracranial haemorrhage that is present in 22.85% cases followed by Subarachnoid haemorrhage seen in 15.71% and this finding consistent with study conducted by Soni SK et al [5], Sharma BR et al [8], Ravikumar R [9] and Kumar A et al [10] finds Subdural haemorrhage in 16.0%, 62.0%, 90.83% and 89.11% of cases respectively followed by Subarachnoid haemorrhage present in 15.5%, 23.0%, 70.53% and 72.98% of cases respectively. However, this finding is inconsistent in study conducted by Nair SS et al [6] and Pate RS et al [11] in which Subarachnoid haemorrhage is the most common intracranial haemorrhage that is present in 84.9% cases and 15.09% cases respectively followed by Subdural haemorrhage present in 74.5% and 12.02% cases. In our study, most common intracranial haemorrhages present in combination to each other was subdural and subarachnoid haemorrhage (51.42%)

which is similar in study conducted by Soni SK et al [5] and Pate RS et al [11] presents in 44.0% and 42.97% of cases respectively. Least common intracranial haemorrhage in our study is combination of Extradural haemorrhage and Intra-Cerebral haemorrhage present in 1.42% cases which is similar in study conducted by Soni SK et al [5] Present in 1.0% of cases.

CONCLUSION

Taking our study and other related study findings into consideration, head injury is the major cause of death and disability among Road Traffic Accidents victims in Indian population. A multidisciplinary approach is needed to strengthen safety standards of the automobiles, improving the infrastructure of roads, creating awareness among public, strengthening the enforcements and to streamline the trauma care assistance. The Government should frame strict rules and regulations for the implementation of road safety measures ensuring the safety of drivers and pedestrians. Government should also think about involving traffic safety rule and regulation to be included in school study syllabus so to make them aware about basic traffic rules, advantages of following and disadvantages of not following traffic rules before reaching up to driving licence age.

REFERENCES

1. Reddy KSN, Murty OP. The essentials of forensic medicine and toxicology. 35th Edition. New Delhi: Jaypee Brother Medical Publishers Ltd; 2022.p.185-9.
2. Transport Research Wing, Ministry of Road Transport and Highways. Road Accidents in India 2023. New Delhi. Ministry of Road Transport and Highways, Government of India; 2023. Available from:

- http://morth.nic.in/sites/default/files/RA_2023.pdf. Accessed on 20/03/2024.
3. National Crime Records Bureau, Ministry of Home Affairs. Accidents in India. New Delhi. Ministry of Home Affairs, Government of India;2023. Available from: <http://ncrb.gov.in/uploads/files/AccidentalDeathsSuicidesinIndia2022v2.pdf>. Accessed on 19/03/2024.
4. Vij K. Textbook of forensic medicine and toxicology: Principles and practice. 5th ed. New Delhi: Elsevier.2014:270.
5. Soni SK, Dadu SK, Singh BK, Pandey D. Pattern and distribution of head injuries in fatal road traffic accidents in Indore region of central India. *Sch J App Med Sci*, May 2016;4(5D):1711-6.
6. Nair SS, Lakshmanan N. Pattern and distribution of head injuries in victims of fatal road traffic accidents-an autopsy-based study. *Indian J Forensic Community Med* 2017; 4(1):42-5.
7. Singh G, Joshi R, Kumar A. Assessment of Pattern Head Injury, Skull Fractures in Road Traffic Accidents Cases. *Int J Res Health Allied Sci* 2019; 5(1): 28-31.
8. 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.
9. Ravikumar R. Patterns of head injuries in road traffic accidents involving two wheelers: An autopsy study. *Journal of Indian Acad Forensic Med* 2013;35(4):349-52.
10. Kumar A, Lalwani S, Agarwal D, Rautji R, Dogra TD. Fatal Road Traffic Accidents and their relationship with head injuries: An Epidemiological survey of Five years. *Indian J Neurotrauma* 2008, 5(2): 63-7.
11. Pate RS, Hire RC, Rojekar MV. Pattern of head injury in central India population. *Int J Res Med Sci.* 2017 Aug;5(8):3515-9.