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24

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Analysis of fatal traumatic intracranial haemorrhage: a retrospective medico-legal autopsy study

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ABSTRACT

Background and aims*: Head injuries, particularly those caused by road traffic accidents (RTA) and falls, constitute a significant public health concern in India, leading to over 100,000 fatalities annually. The mortality rate associated with traumatic brain injuries remains critically high, with a substantial proportion of victims succumbing during the crucial "golden hour" post-injury.* ***Materials and methods****: This study provides a comprehensive analysis of traumatic brain injuries based on data from 156 medico-legal autopsy cases conducted between November 2022 and December 2023. The investigation focuses on categorising various types and locations of intracranial haemorrhages.* ***Results****: Subarachnoid haemorrhage (SAH) emerged as the most prevalent type, observed in 40.37% of cases, followed by subdural haemorrhage (SDH) in 11.01%. Combinations of haemorrhages were detected in 21.10% of cases, with the left frontal region being the most frequently affected site.* ***Conclusions****: The findings highlight an urgent need to strengthen emergency response systems, including strategically placing emergency contact numbers and hospital information along highways. Furthermore, the study emphasises the importance of public health initiatives to enhance awareness of first-aid measures, the criticality of rapid transport for trauma victims, and the necessity of legislative measures to encourage and protect bystanders offering assistance.*

Keywords*: Traumatic brain injury; Glasgow Coma Scale; Road traffic accidents.*

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INTRODUCTION

Head injuries resulting from falls and road traffic accidents represent a significant public health challenge, particularly in India, which accounts for over 100,000 deaths and approximately 1 million severe cases annually. The mortality rates associated with traumatic brain injuries in India are substantially higher than those in the United States, with nearly half of fatalities occurring within the first two hours of injury, underscoring the critical need for prompt medical intervention. Road traffic fatalities have escalated to almost 100,000 per year in India, with 95% of trauma victims unable to access timely care during the crucial "golden hour." Young adults constitute most victims, compounding socio-economic challenges such as poverty. On a global scale, traumatic brain injuries account for 50 million cases and 1.2 million deaths annually, with 60%

of India's traumatic brain injuries attributable to road traffic accidents. The fatality rate for TBIs in India is 25 times higher than that in developed nations, and severe cases experience mortality rates of 38–43%, equating to one death approximately every 6 to 10 minutes.[1]

Head injury is described as a "morbid state resulting from gross or subtle structural changes in the scalp, skull, and/or contents of the skull, produced by mechanical forces."[2] Traumatic brain injury refers to an injury caused by an external mechanical force that is not associated with degenerative or congenital conditions. It can result in permanent or temporary disabilities that affect cognitive, physical, and social functioning, with or without changes in consciousness.[3]

Head and neck injuries are categorised into impact and acceleration/deceleration injuries. Impact injuries- result from the head colliding with an external object, leading to injuries such as scalp lacerations, skull fractures, and hematomas. In contrast, acceleration/deceleration injuries arise from sudden head movements that cause rapid shifts in intracranial pressure and shear forces, often leading to conditions such as subdural hematomas or diffuse axonal injuries. Notably, these injuries may occur with or without a direct physical impact. Lateral impacts are particularly severe, as they generate significant shear strains within the brain, increasing the risk of extensive neural damage.[4]

INTRACRANIAL HAEMORRHAGE

Extradural haemorrhage (EDH)

EDH is a relatively uncommon form of brain injury, occurring in approximately 2% of head trauma cases. It is typically caused by arterial bleeding associated with skull fractures, though up to 15% of cases may occur in the absence of fractures. EDH can expand rapidly, necessitating surgical intervention when the hematoma volume exceeds 30 cm^3. Although a characteristic lucid interval—a temporary period of regained consciousness—is often observed, it is not universally present. Early computed tomography (CT) imaging detection is critical for accurate diagnosis and prompt treatment. However, delayed diagnosis, particularly in the presence of concurrent injuries such as cerebral contusions, increases medico-legal risks. EDHs can be identified during the autopsy by their anatomical location and distinct volume, differentiating them from contrecoup injuries. Their precise recognition is essential for understanding the mechanism of injury and for medico-legal investigations.[5]

Subdural haemorrhage (SDH)

SDHs are more common than epidural haemorrhages and often occur without skull fractures. They can be acute, caused by torn bridging veins, or chronic. These are common in fatal child abuse cases and in older adults, where they may be misdiagnosed as strokes or dementia. Symptoms vary depending on associated brain injuries. Chronic subdural hematomas in elderly autopsies can be gelatinous or firm. In forensic cases, accurately dating these injuries is challenging due to varying healing rates and the potential for repeated bleeding.[5]

Subarachnoid haemorrhage (SAH)

SAH is a brain bleed resulting from traumatic injury, often due to cortical lacerations. It occurs due to shearing forces, causing blood to mix with cerebrospinal fluid, which prevents clotting and complicates forensic analysis. The severity of SAH varies and may be overshadowed by other injuries, but in rare instances, it can be the sole fatal injury, especially with rapid onset. A massive SAH, particularly involving the brainstem, can lead to rapid death.[5]

Intraventricular haemorrhage (IVH)

IVH occurs when bleeding enters the brain's ventricles. Primary IVH is rare, accounting for 3% of spontaneous intracerebral haemorrhage, and is associated with hypertension, coagulopathies, aneurysms, and tumours. Secondary IVH, more common, usually follows intracerebral or SAH and often complicates these cases. Bleeding typically originates from the choroid plexus and septum pellucidum vessels.[6]

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MATERIALS AND METHODS

This retrospective study examines 156 autopsy cases of fatal cranio-cerebral injuries from November 2022 to December 2023 at a tertiary care hospital's forensic department. It involves document review, consent for research use, and detailed external and internal examinations focusing on head injuries. Samples are preserved for neuropathological analysis. Data is collected and presented in tables and graphs. Autopsy findings are reviewed, and the body is returned with all relevant documents. Ethical clearance is taken from the institutional ethics committee.

RESULTS

The survival time against the severity of head injury based on the Glasgow coma scale in cases with a history of hospitalisation is shown in **Table 1**.

Table 1 Survival time vs severity of head injury based on Glasgow coma scale in case with history of hospitalisation (N=130)

		Severe Head Injury	Moderate head injury	Mild head injury
< 2 HRS	N	1	0	0
	%	1.00%	0.00%	0.00%
3-5 HRS	N	3	0	0
	%	3.00%	0.00%	0.00%
6-9 HRS	N	11	0	0
	%	11.10%	0.00%	0.00%
10--15 HRS	N	4	0	0
	%	4.00%	0.00%	0.00%
16-24 HRS	N	11	1	0
	%	11.10%	5.90%	0.00%
24-48 HRS	N	12	0	0
	%	12.10%	0.00%	0.00%
48-72 HRS	N	11	0	0
	%	11.10%	0.00%	0.00%
72-120 HRS	N	13	0	0
	%	13.10%	0.00%	0.00%
>/= 5 Days	N	33	16	14
	%	33.30%	94.10%	100.00%
Total	N	99	17	14
	%	100.00%	100.00%	100.00%

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The distribution of the cases against the manner of injury is shown in **Figure 1** and **Figure 2**.

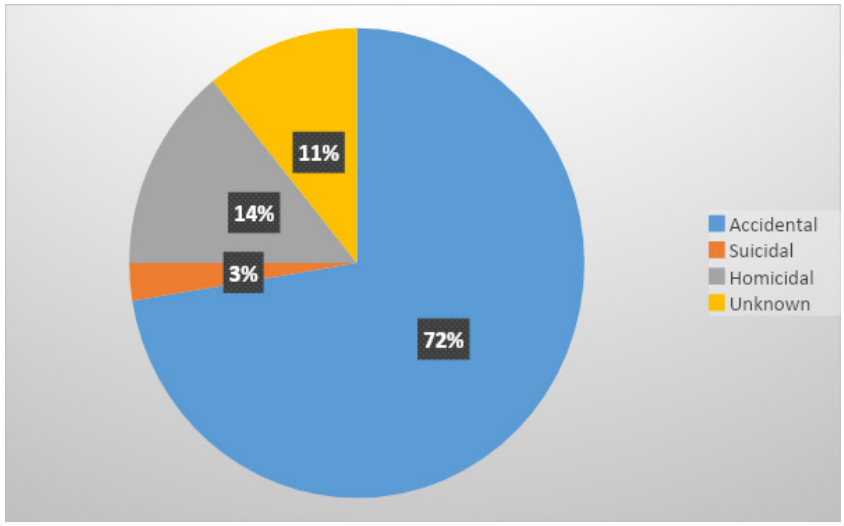

Figure 1 Manner of injury (N=156)

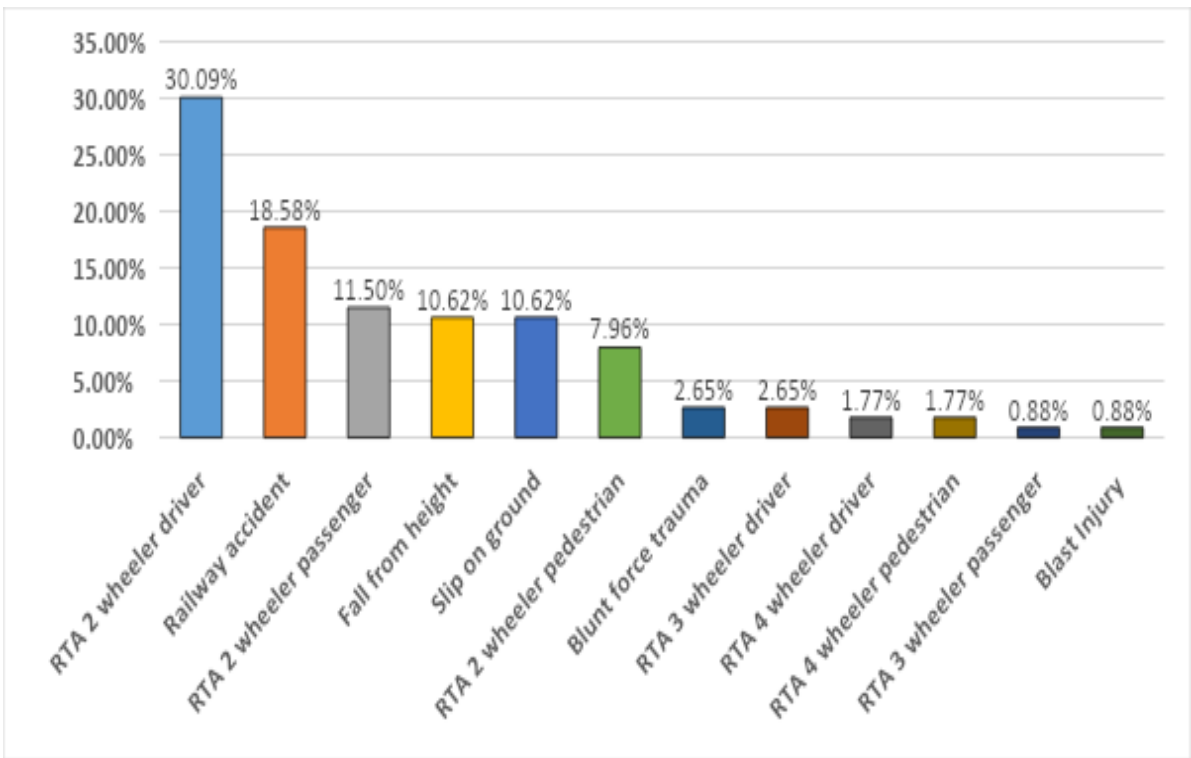

Figure 2 Accidental manner of injury (n=113 Cases)

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Table 2 Distribution of intracranial haemorrhage

SAH	44	40.37%
SDH	12	11.01%
EDH + SDH + SAH + HBT	4	3.67%
SDH + SAH + IPH	4	3.67%
SAH + IPH	4	3.67%
SDH + SAH	23	21.10%
SDH+EDH	4	3.67%
EDH	2	1.83%
IPH + SDH	1	0.92%
EDH+SAH	6	5.50%
EDH+SAH+SDH	4	3.67%
SDH+SAH+IPH+EDH	1	0.92%
Total	109	100%

EDH-Extradural haemorrhage, SDH-Subdural haemorrhage, SAH-Subarachnoid haemorrhage, IPH-Intraparenchymal haemorrhage

Table 3 Distribution of intracranial haemorrhage with location

Location	EDH	SDH	SAH	IPH	IVH	HBT	Total
Right Frontal	5	8	25	1	0	4	43
Left Frontal	1	12	36	3	0	4	56
Right Parietal	3	14	33	1	0	4	55
Left Parietal	1	13	34	3	0	4	55
Right Temporal	1	6	29	2	0	4	42
Left Temporal	2	14	29	3	0	4	52
Right Occipital	5	9	20	2	0	4	40
Left Occipital	3	12	23	1	0	4	43
Lateral Ventricles	0	0	0	0	10	0	10
3rd Ventricle	0	0	0	0	7	0	7
4th Ventricle	0	0	0	0	4	0	4
Midbrain	0	0	0	0	0	2	2
Pons	0	0	0	0	0	2	2
Right Cerebellum	1	7	11	2	0	2	23
Left Cerebellum	1	10	9	2	0	2	24

EDH-Extradural haemorrhage, SDH-Subdural haemorrhage, SAH-Subarachnoid haemorrhage, IPH-Intraparenchymal haemorrhage, IVH-Intraventricular haemorrhage, HBT-Haemorrhagic bullet tract

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Figure 2 A case of SAH following an assault with hard and blunt weapons

Figure 3 A case of SDH following two two-wheeler accident

DISCUSSION

The WHO defines an accident as an unexpected event that can cause injury. Head injuries account for over 25% of trauma-related deaths and nearly two-thirds of traffic fatalities.

Age and gender distribution

A study of 156 fatal head injuries revealed a significant gender disparity, with 84.6% of cases in males (132) and 15.4% in females (24). The highest incidence was observed in the 21-30 age group (23.7%), followed by the 31-40 age group (21.2%). A similar study by Pate et al., involving 391 cases, showed 67.26% male and 32.74% female fatalities, with the highest incidence in the 21-30 (36.57%) and 31-40 (22.25%) age groups. This reinforces the trend of higher fatality rates among younger males.[7]

Survival period after hospitalisation and correlation with severity of head injury (Table 1)

The present head injury study based on Glasgow Coma Scale (GCS) scores found that the most common score was 3 (43.85%), followed by scores of 5, 4, and 15, reflecting a broad spectrum of injury severities. 76.15% of cases were classified as severe, 13.08% as moderate, and 10.77% as mild. In an autopsy study, severe injuries predominated due to their higher fatality rates. In the study of 130 cases, 43.45% (63 individuals) survived more than five days post-accident, with the following most common survival durations being 72-120 hours (8.97%) and 48-72 hours (8.28%). Survival times of 6-9 hours and 24-48 hours were similar, each at 8.28%. The shortest survival time (less than 2 hours) was rare, occurring in only one case. Severe head injuries were the most prevalent, especially after five days (33.3%), while moderate and mild injuries were less common. Severe injuries generally resulted in poorer outcomes, whereas mild and moderate injuries had a better prognosis, leading to slower fatalities. A similar study by Patil and Vaz showed that 16.9% of victims died instantly, 23.76% within 24 hours, 6.34% within 1-3 days, and 47.7% between 3-15 days, with only 5.3% surviving more than 15 days.[8] Another study by Goel et al. found that 63% of patients had minor injuries (GCS 13-15), 21% had moderate injuries (GCS 9-12), and 16% had severe injuries (GCS 8 or below), with a 17% mortality rate. Outcomes worsened as injury severity increased.[9]

Manner of injury and the most typical cause of head injury (Figures 1 and 2)

The present study found that 72.44% of cases were accidental, with traffic accidents being the leading cause of death. Two-wheeler drivers (30.1%) were the most frequent victims, followed by falls from height (10.6%) and railway accidents (18.6%). Suicidal deaths were rare, with 75% involving firearms and 25% resulting from falls. Homicidal cases were predominantly due to blunt force trauma in 54.55%, firearm deaths observed in 18.18% and sharp force trauma observed in 13.64% of cases. Among the 113 road traffic accident cases, 63.72% occurred in urban areas, with alcohol consumption being a significant contributing factor, especially among two-wheeler drivers (86.36%). The study emphasises the need for

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stricter traffic safety measures, particularly in developing countries. A similar study by Udoh et al. found that road traffic accidents were responsible for 90.9% of traumatic brain injuries, in line with the global trend of road traffic accidents being the primary cause of traumatic brain injuries, particularly among young males.[3]

Haemorrhage distribution (Tables 2 and 3)

The present study concluded that Subarachnoid haemorrhage is the most common type of intracranial haemorrhage, observed in 40.37% of cases, most frequently observed in the left frontal, left parietal, and right parietal areas. SDH followed this in 11.01%, mainly observed in the left temporal and right parietal regions. Combined haemorrhages, such as (SDH + SAH), accounted for 21.10%. In contrast, rare combinations, including (EDH + SDH + SAH + Haemorrhagic bullet tract) and (SDH + SAH + Intraparenchymal haemorrhage), contributed 3.67% each. Groupings involving four haemorrhage types were the least frequent, each representing less than 1% of cases. The left frontal region showed the highest number of injuries (56 cases), primarily involving SAH (36 cases). Significant injury counts were also reported in the right and left parietal regions (55 each), with SAH as the predominant type. A study by Pate et al. of 391 cases found SAH in 15.09% of cases, SDH in 12.02%, and combinations like SDH + SAH in 42.97%. EDH was rare, and 6.91% of cases showed no haemorrhage.[7] In a study by Soni et al. of 200 cases, 82.5% showed intracranial haemorrhages, the most common being SDH at 19.4% and SAH at 18.8%. Intracerebral haemorrhage was rare (1.8%), and no cases of EDH were observed. The most frequent combination was SDH and SAH (53.3%). The parieto-temporal region was the most affected (30.9%), followed by fronto-parietal (23.6%) and parieto-occipital regions (9.1%). This study highlights the prevalence and distribution of different intracranial haemorrhages.[10]

CONCLUSION

The present study found that traumatic intracranial haemorrhage was the leading cause of death in 69.87% of cases, predominantly affecting men (84.6%) aged 21-40. Severe injuries, often resulting from traffic accidents, were associated with two-wheeler drivers, alcohol consumption, and blunt trauma. Most cases (72.44%) were accidental. Many patients had severe head injuries, with 43.85% in deep coma. Survival rates were low, with only 43.45% surviving more than five days. SAH was the most common injury. These findings underscore the need for improved traffic safety, first aid education, and better infrastructure.

REFERENCES

1. Traumatic brain injury. Indian Head Injury Foundation. [Internet]. [cited 2024 Nov 12]; Available from: URL: https://indianheadinjuryfoundation.org/traumatic-brain-injury/
2. Kumar L, Agarwal S, Singh T, Garg R. Patterns of Head Injury at Tertiary Care Hospital. International J Sci Study. 2014;1(5):5-8.
3. Mo U, Ee U. A retrospective autopsy-based survey of fatal traumatic brain injuries in Benin City, Nigeria. Ibom Med J. 2023 Jan 1;16(1):62–9.
4. DiMaio VJM, DiMaio D. Forensic Pathology. 3rd ed. Boca Raton: CRC Press; 2021.
5. Knight B, Saukko P. Knight's Forensic Pathology. 4th ed. Boca Raton: CRC Press; 2015.
6. Aggrawal A. Textbook of Forensic Medicine and Toxicology. 2nd ed. Delhi: APC Press; 2021.
7. Pate RS, Hire RC, Rojekar MV. Pattern of head injury in central India population. Int J Res Med Sci. 2017 July 26;5(8):3515–9.
8. Patil AM, Vaz WF. Pattern of fatal blunt head injury: a two-year retrospective/prospective medico-legal autopsy study. J Indian Acad Forensic Med. 2010;32(2):144-149.
9. Goel A, Bansal A, Rawat K. Head injury patients at a tertiary health care center. Int Surg J. 2022 Sep 28;9(10):1706–9.
10. Soni S, Tomar JS, Thakur PS, Singh BK. A study of pattern and distribution of intracranial haemorrhages in fatal road traffic accidents at a tertiary care centre in Indore region of Madhya Pradesh. IP Int J Forensic Med Toxicol Sci.2020;5(1):11–3.

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