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Original Research Article

Original Research Article- Cranio-Thoracoabdominal Trauma in Railway Track Fatalities: Forensic Insights from Central Haryana

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Abstract:

Background: Railway track fatalities constitute a significant portion of accidental deaths in India due to the extensive railway network and high human–train interaction. These incidents often produce severe multisystem trauma, necessitating detailed medicolegal evaluation. This study analyzes the pattern and distribution of cranio-thoracoabdominal injuries in railway accident victims over four years.

Material and Methods: A retrospective analysis of 78 fatal railway track cases autopsied at the Department of Forensic Medicine, PGIMS Rohtak, from January 2018 to December 2021 was conducted. Data regarding body condition, skull fractures, and intracranial hemorrhages, thoracic and abdominal injuries were obtained from autopsy records and police documents. Findings were compared with previously published studies.

Results: Most victims (58.97%) were brought with the body intact while 41.03% showed varying degrees of dismemberment. Cranial vault fractures were present in 89.74% of cases with depressed fractures being the most common (37.17%). Intracranial hemorrhages were documented in 78.21% of victims, predominantly combined subdural and subarachnoid hemorrhage (48.71%). Thoracic injuries showed rib fractures alone in 43.5% and rib plus lung injuries in 21.79%. Abdominal injuries most frequently involved the liver, either alone (11.53%) or in combination with spleen and kidney (32.04%).

Conclusion: Head injury is the principal fatal component in railway track deaths, accompanied by significant thoracic and abdominal trauma. The injury patterns reflect high-energy blunt impact typical of railway incidents. Detailed autopsy examination remains crucial for accurate medicolegal interpretation and differentiation of accident, suicide or other manners of death.

Keywords: Forensic, Railway fatalities, Autopsy, Cranio-thoracoabdominal injuries, Head injury, intracranial hemorrhage, Thoracic trauma, abdominal trauma.

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Introduction

India's railways form one of the largest railway networks in the world operating under a single management.

With millions of people depending on trains every day accidents though relatively infrequent which carry significant medical and legal importance.

They not only highlight the severity of trauma associated with such incidents but also emphasize the need for careful evaluation and understanding of injury patterns. [1]

Railway accidents do occur and for which both human error and mechanical failures have always been blamed. [2] The increased railway traffic and its distribution over wide area of network across thousands of kilometers across the country covering, urban, rural and forest sectors pose a major contributing factor for the railway related accidents fatalities. [3] A train accident is defined as "Collision, Derailment or any other event involving the operation of n- track equipment". Author Bernard knight classified the Railway Accidents into three groups:

a. Movement Accident- Accidents to people caused by the movement of railway vehicles, excluding those due to train accidents

b. Train Accident- Accidents to trains and rolling stock and

c. Non-movement Accident- Accidents to people on railway premises but not connected with the movement of railway vehicles. [4]

Accidental deaths are tragic occurrences that often arise from unawareness, ignorance, or simple moments of carelessness, usually happening without warning and under unforeseen circumstances. In the present study, movement-related railway accidents have been emphasized, as they account for a significantly higher number of fatalities. In contrast, non-movement accidents refer to incidents that take place within railway premises but are not directly related to the movement of trains or railway vehicles. [5]

Trains because of their easy accessibility and the high fatality associated with collisions are unfortunately also used as a means for committing suicide. In some instances, railway accidents may even be staged to conceal homicidal deaths making them appear accidental or suicidal deaths. Therefore, deaths involving railway injuries hold significant medico-legal importance as a thorough investigation is essential to determine the final cause and manner of death.

Craniocerebral damage (commonly known as head injury) has been recognized since ages. [6] Brain damage as a result of head injury constitutes a major problem worldwide, and head injury is the most common emergency encountered in emergency and trauma departments. Multiple injuries in which head injury plays an important role is also the leading cause of death in any given population, especially in people less than 45 years of age. [7]

Fatal railway track injury is characterized by extensive disruption of more than one body part. Hence, to accurately understand the epidemiology of railway accident deaths and the pattern and distribution of injuries produced, a four-year retrospective analytical study has been undertaken at PGIMS, Rohtak, and Haryana.

Aims and Objectives: To assess the pattern and distribution of Cranio-Thoracoabdominal injuries occurring in railway accidents.

Material and Methods

This retrospective study examined 78 fatal railway accident cases autopsied in the Department of Forensic Medicine and Toxicology, Pt. B. D. Sharma PGIMS, Rohtak, Haryana.

The study spanned a four-year period from 1 January 2018 to 31 December 2021. Essential details including cause of death, types of cranio-thoracoabdominal injuries and relevant background information were obtained from police investigation records, statements from relatives and autopsy documentation. During the autopsy review, particular emphasis was placed on evaluating the type, pattern and anatomical distribution of injuries. After data compilation, the findings were systematically analysed and compared with observations from similar studies to derive meaningful interpretations and conclusions.

Inclusion Criteria: All cases in which death was directly attributed to injuries sustained on the railway track.

Exclusion Criteria

a. Cases where no railway track related injuries were identified during postmortem examination.
b. Decomposed bodies in an advanced state that hindered proper evaluation of injuries.
c. Deaths due to natural causes occurring in or near railway premises, even if the body was found on railway property.

Observations and Results

Total 5606 postmortems conducted in mortuary of Department of Forensic Medicine, PGIMS, Rohtak, and Haryana in the period of four years from dated 01-01-2018 to 31-12-2021. The total number of cases of rail-way track accident were 78. Various parameters like residence mentioning rural or urban, pattern and distribution of injuries were noted.

1. Condition of Body during Autopsy (Table 1): Most victims (58.97%) were brought with the body in an intact condition. However, a considerable proportion showed dismemberment with 17.94% found in two parts, 15.38% in three parts and 7.69% presenting as fragmented body parts. This reflects the high-impact mechanical forces involved in train-related trauma.

2. Type of fracture of Skull bone (Table 2): Severe cranial trauma was a prominent finding. De-pressed skull fractures were the most common (37.17%) followed by crushed fractures (23.07%) and comminuted fractures (17.94%). Only 10.25% of victims had an intact skull highlighting the dominance of head injuries in railway fatalities.

3. Fracture of Base of Skull (Table 3): Fracture of the base of the skull was documented in 30.76% of victims while 69.24% had an intact skull base. These findings suggest substantial impact forces leading to displacement or crushing of the cranial vault.

4. Intracranial Hemorrhages (Table 4): Intracranial hemorrhages were common: Subdural + sub-arachnoid hemorrhage (SDH+SAH) was seen in 48.71% of cases, Combined hemorrhages (SDH + SAH + intracranial) in 23.07%, only SAH in 6.41%. Only 21.79% of victims showed no

intracranial bleeding. This underscores the pivotal role of head injury in mortality.

5. Thoracic Injuries (Table 5): Thoracic trauma was also a major component of fatal railway impacts. 42.30% had rib fractures alone, 21.79% had rib fractures associated with lung injuries, 7.69% showed involvement of sternum, ribs, and lungs, 5.12% had additional cardiac injury. Only 23.07% had no thoracic region involvement.

6. Abdominal Organ Injuries (Table 6): Abdominal involvement varied among victims. Injury to the liver alone was found in 11.53%, Liver + spleen injuries in 21.79%, Spleen alone in 11.53%, Liver + spleen + kidney involvement in 10.25% of cases. Nearly half (44.87%) had no abdominal organ injury.

Table 1: Distribution of cases as Condition of the Body

Condition of the Body	Number	%
Body Intact	46	58.97%
Two Parts	14	17.94%
Three Parts	12	15.38%
Fragmented Body Parts	6	7.69%
Total	78	100%

Table 2: Type of fracture of Skull Vault

Type of Skull Fracture	Number	%
Intact	8	10.25%
Fissure	9	11.53%
Depressed	29	37.17%
Communited	14	17.94%
Crushed	18	23.07%
Total	78	100%

Table 3: Fracture of Base of Skull

Fracture of Base of Skull	Number	%
Intact	54	69.24%
Fracture	24	30.76%
Total	78	100%

Table 4: Intracranial hemorrhages among the victims

Type of Hemorrhage	Number	%
Subdural+ Subarachnoid	38	48.71%
Subarachnoid	5	6.41%
Combined (SDH+SAH+Intracranial)	18	23.07%
None	17	21.79%
Total	78	100%

Table 5: Injuries to Thoracic Region

Involvement Region	Number	
Ribs Fractured	33	42.30%
Ribs+ Lungs	17	21.79%
Sternum+ Ribs+ Lungs	6	7.69%
Sternum+ Ribs+ Lungs+ Heart	4	5.12%
None	18	23.07%
Total	78	100%

Table 6: Abdominal Organs Involved among the victims

Organ Involved	Number	%
Liver	9	11.53%
Liver+Spleen	17	21.79%
Spleen	9	11.53
Liver+Spleen+Kidney	8	10.25%
None	35	44.87%
Total	78	100%

Discussion

In the present study of 78 railway-related fatalities, the condition of the body at the time of autopsy varied considerably. A majority of victims i.e. 46 cases (58.97%) were found with the body intact suggesting that the trauma sustained was predominantly blunt in nature. In 14 cases (17.94%) the body was divided into two distinct parts while 12 cases (15.38%) showed fragmentation into three parts. The most severe form where the body was found in multiple fragments was noted in 6 cases (7.69%). Findings from previous literature show a similar pattern but with wider variations. Valsala K. [8] reported that most victims (62.5%) were brought with the body as a whole whereas 19.2% showed mutilation and 18.2% were in a mangled state. Sabale P.R. [9] and colleagues also highlighted that railway fatalities often involve severe mutilation, reflecting the high-impact forces involved. Basu R. et al. [10] reported 68% of cases with transected bodies underscoring the devastating effects when a moving train runs over an individual. In contrast, our study recorded a higher proportion of in-tact bodies. This may be attributed to the predominance of accidental incidents such as being hit while crossing the tracks or falling from a moving train, where the mechanism of injury is mainly blunt force trauma rather than run-over injuries. Such scenarios are less likely to produce extensive mutilation, explaining the relative intactness observed in many cases.

Type of fracture of cranial vault among the victims: In our series of 78 railway fatalities, fractures of the cranial vault were strikingly common. The most frequent type was depressed fractures documented in 29 cases (37.17%). This was followed by crush injuries of the cranial vault in 18 cases (28.3%) and comminuted fractures in 14 cases (17.94%). Fissure fractures were noted in 9 cases (11.53%) while 8 cases (10.25%) showed no fracture of the cranial vault. Overall, skull fractures occurred in 89.74% of all cases, reflecting the significant force involved in railway trauma. Comparing our findings with earlier literature, Tirpude B.H. et al [11] reported 12.16% of cases with skull vault fractures with 22.97% presenting fissure fractures and 13.51% showing crushed vaults. Valsala K8 noted skull fractures in 66.6% of cases whereas Malick S. et al12 found skull fractures in 21.7% of their series. Similarly, Sabale P.R. [9] and colleagues documented fissure fractures alone in 23.25% of cases. In contrast to these studies, our findings demonstrate a substantially higher overall incidence of skull fractures (89%) in railway fatalities. This higher proportion may indicate more severe impact forces or differing mechanisms of injury in the region where the present study was con-ducted.

Fracture of cranial base: With regard to fractures of the skull base, the majority of victims in our study showed no involvement of this structure. In 54 cases (69.24%), the cranial base remained intact while 22 cases (28.3%) demonstrated crushing of the cranial base indicating significant impact in a smaller proportion of individuals. Sabale P.R. et al [9] reported a comparatively higher frequency with 58.67% of cases showing fractures of the skull base in their study. When compared with their findings, the lower incidence in our study may reflect variations in the mechanism and direction of force during impact in different railway accident scenarios.

Intracranial hemorrhages among the victims: In the present study of 78 railway fatalities, intracranial hemorrhages were frequently observed. A total of 18 cases (23.07%) showed mixed patterns of bleeding, including subdural hematoma, subarachnoid hemorrhage, and intracerebral hemorrhage. The most common combination was subdural and subarachnoid hemorrhage seen in 38 cases (48.71%). Isolated subarachnoid hemorrhage occurred in 5 cases (6.41%) while 17 cases showed no evidence of intracranial bleeding. Similar observations have been reported in earlier studies. Tyagi S et al. [12] found intracranial hemorrhage to be the leading cause of death (47.05%) among head-injury victims. Tirpude B.H. et al [11] also noted that the combination of subdural and subarachnoid hemorrhage was the most frequent pattern in railway fatalities, appearing in 21.62% of cases, followed by involvement of all three types of hemorrhage in another group of victims. Ruatji R. et al [13] reported subdural hematoma as the most common intracranial bleed, occurring in 61.42% of their cases. Patil A. et al [14] documented 56% subarachnoid and 30% subdural hemorrhages while Sabale PR et al [9] observed 52.52% subarachnoid and 38.1% subdural hemorrhage with 23.25% showing both types together. Amit P et al [15] similarly identified combined subdural and subarachnoid hemorrhage as the predominant finding in 59% of their cases.

Overall, the pattern in our study aligns with previous literature, with mixed intracranial hemorrhages particularly the SDH + SAH combination being the most frequently encountered in railway-related head injuries.

Internal injuries to thorax: Turning to thoracic injuries, a wide range of trauma patterns was observed among the 78 railway fatality cases. The most frequent finding was isolated rib fractures, documented in 33 cases (43.5%). Another 17 cases (21.79%) showed a combination of rib fractures with lung lacerations. More severe injuries involving the ribs, lungs, and heart were seen in 6 cases (7.69%), while 4 cases (5.12%) demonstrated extensive thoracic trauma affecting the ribs, lungs,

sternum, and heart. In 18 cases, the thoracic cavity was free from any appreciable injury.

Comparative analysis with previous studies shows similar trends. Malick S. et al. reported rib fractures as the most common thoracic injury, seen in 69.56% of their cases. Patil et al. found 46% rib and sternum fractures, 6% lung injuries, and 3% heart injuries. Similarly, Sabale P.R. et al. documented 42% rib fractures, 6.64% sternum fractures, 33.76% lung injuries, and 5.35% heart injuries.

Overall, the pattern observed in the present study reinforces that rib fractures, whether isolated or associated with internal thoracic organ injury, remain a predominant feature in railway-related thoracic trauma.

Abdominal Organs Involved among the victims: In the present series of 78 railway fatalities, abdominal injuries showed considerable variation. In 35 cases (44.87%), no internal abdominal injuries were detected. Nine cases (11.53%) demonstrated injuries limited to the liver and spleen, while 17 cases (21.79%) showed simultaneous involvement of both organs. More extensive trauma affecting the liver, spleen, and kidney was observed in 8 cases (10.25%).

Previous studies also identify the liver as the organ most frequently affected in blunt abdominal trauma associated with railway accidents. Sabale et al. reported liver injury in 22.69% of cases, followed by spleen injury in 14.2%. Patil A. et al. similarly found the liver to be the most commonly injured organ, present in 36% of their cases.

In the present study, isolated liver injury accounted for 11.79% of cases. However, when combined injury patterns are considered—liver with spleen (21.79%) and liver with spleen and kidney (10.25%)—the liver was involved in a total of 30.4% of all cases. These findings reaffirm the liver as the most frequently affected abdominal organ in railway-related blunt force trauma.

Conclusion

The present four-year retrospective study of 78 railway track fatalities provides a detailed understanding of the cranio-thoracoabdominal injury patterns seen in victims of train-related trauma in Haryana. Railway accidents continue to represent a major medicolegal concern due to their sudden nature, varied mechanisms, and the extensive injuries they produce.

In this study, the majority of victims were found with the body intact, suggesting that most incidents resulted from blunt force impact rather than complete run-over events.

Head injuries emerged as the most dominant and fatal component, with nearly 90% of cases showing fractures of the cranial vault and a significant proportion demonstrating mixed intracranial hemorrhages, particularly the subdural–subarachnoid combination. These findings reinforce the fact that craniocerebral trauma remains the leading cause of death in railway accidents.

Thoracic and abdominal injuries also contributed substantially to mortality. Rib fractures, with or without associated lung involvement, were the most frequent thoracic findings, while the liver was the most commonly affected abdominal organ either alone or in combination with the spleen and kidneys. The distribution and severity of injuries in this study reflect the high-energy transfer involved in railway impacts and the unpredictable biomechanics of falls, collisions, and run-over incidents.

Comparison with previous national and international studies shows both similarities and regional variations, which may be attributed to differences in accident mechanisms, train speed, track design, and victim behavior (track crossing, falling from trains, etc.).

Overall, the study highlights that: Head injury remains the principal determinant of fatality, followed by thoracic and abdominal trauma. Most deaths result from accidental mechanisms, though suicidal and staged incidents cannot be disregarded. Injury patterns are highly variable, underscoring the need for meticulous autopsy examination and comprehensive documentation.

The findings emphasize the importance of preventive measures such as improved public awareness regarding safe track-crossing practices, installation of protective barriers, strengthening of safety surveillance near railway premises and timely medical response. From a medicolegal standpoint, understanding the characteristic injury patterns aids in distinguishing between accidental, suicidal and homicidal railway deaths and ensures accurate determination of the cause and manner of death.

References

1. Sheikh MI, Shah JV, Patel R. Study of death due to railway accident. JIAFM. 2008;30(3): 122-7. DOI:10.1177/0971097320080304.
2. Das G, Choudhury NM, Phukon S, Talukdar J. Railway fatalities- a five-year retrospective study of the cases at medicolegal autopsy in silchar medical college, Silchar, Assam. Medplus. International Medical Journal August 2014;1(8):377-80. DOI: 10.47009/jamp.2025. 7.5.34.
3. Indian Railways Yearbook 2019-20" (PDF). Ministry of Railway. Retrieved 17 March 2021.
4. Knight B. Medical Jurisprudence and toxicology. Allahabad: The Law book Co(P)Ltd. Sardar Patel Marg; 1987:309-20.

5. Ranjan R, Chatterjee P, Chakraborty S. Performance evaluation of Indian Railway zones using DEMATEL and VIKOR methods. Benchmarking: An International Journal. 2016 Feb 1;23(1):78-95. DOI:10.1108/BIJ-03-2015-0026.
6. Tedeschi CG, Eckert WG, Tedeschi LG. Forensic Medicine: A Study in Trauma and Environmental Hazards. Vol. I: Mechanical Trauma. Section 1: Mechanical Injury. Chapter 3: Head Injury. Philadelphia: WB Saunders;1977. p. 30.
7. Skerr R, Maartens NF. Bailey & Love's Short Textbook of Surgery. 23rd ed. London: Arnold; 2001. p. 548-52.
8. Valsala K, C.S. Sreedevi, Sreelekshmi J. Analysis of Railway Track Deaths- an autopsy-based study; Int J Res Med Sci. 2017 Mar; 5(3):935-39. DOI: 10.18203/2320-6012.ijrms20170639.
9. Sabale PR, Mohite SC. Railway Fatalities in Southwest Mumbai. Medico-Legal Update - An International Journal. 2010; Volume, Issue, Print ISSN: 0971-720X.
10. Basu R, Bose TK, Batabyal S, Paul PB. Railway Fatalities - A retrospective study. J Indian Acad Forensic Med. 2002;24(3):89-90.
11. Tirpude B.H,Sachin Kumar Meena, PN Murkey, Rajesh Ramteke, Vishal B. Surwade. A Study of pattern of Craniocerebral Injuries in cases of Railway Traffic Accidents brought to the post-mortem Centre, Journal of Indian Medico Legal and Ethics Association;2015. 03 (02):43-49. DOI: https://doi.org/10.37506/ijfmt.v14i4.11525.
12. Tyagi S, Sukhdev R.B, Parchake M.B, Pathak H.M. Mumbai local: Lifeline or Life Stealing. J Indian Acad Forensic Med 2015July-september; 37(3):246-248. DOI: 10.5958/0974-0848.2015.00062.7.
13. Rautji R, Dogra TD. Rail traffic accidents: a retrospective study. Med Sci Law, Jan 2004; 44(1):67-70. doi: 10.1258/rsmmsl.44.1.67.
14. Patil A, Apte V. An autopsy Study of cases of Fatal Railway Injuries. Mumbai University dissertation; Mumbai: 2000.
15. Patil, Dr Amit & Vaz, Walter. Pattern of fatal blunt head injury: A two-year retrospective / prospective medico legal autopsy study. Journal of Indian Academy of Forensic Medicine. 2010. 32. Doi;10.1177/09710973201002 15.
16. Malick S, Goswam AK. Pattern of Fatal Railway Injuries in Sealdah (South) Section, Kolkata-An Autopsy Based Study. IOSR Journal of Dental and Medical Sciences, Volume 16, Issue 10 Ver. XII (Oct. 2017):17-21. DOI: 10.9790/0853-1610121721.