

Research Article**A Cross-Sectional Study of Thoracoabdominal Injuries Pattern in Road Traffic Accidents Among Autopsies****Rudresh Y.C**

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(Received: 21-09-2024**Revised: 19-10-2024****Accepted: 10-11-2024)**Corresponding Author: **Rudresh Y.C** Email: rudreshyc3@gmail.com**ABSTRACT**

Introduction and Aim: Road traffic accidents (RTAs) are becoming more common owing to factors such as increased vehicle usage, daily changes, traffic law violations, anarchic systems, and risky driving practices. Thoracoabdominal injuries are a major cause of mortality in fatal traffic accidents. This study aimed to investigate thoracoabdominal injury patterns in fatal accidents.

Materials & Methods: A cross-sectional analysis was carried out on 100 post-mortem autopsies from road traffic accidents, focusing on the prevalence of injuries occurring in the thoracoabdominal region, particularly in the organs and wounds. Data were compiled to understand the epidemiological factors related to victims, sites of impact, and vehicles. This study also examined features pertaining to road users, vehicles, and environmental conditions as well as their survival period.

Results: The proportion of males to females noted was 3.5:1. Additionally, most victims were between 21-30 years of age range. The thoracic region's most common injury was rib fracture, which accounted for approximately 84% of the cases. Most victims died within 6 hours (48%), and 67% of the total number of victims died in the hospital. The lungs were the most injured organ (75%). Shock and hemorrhage (62%) were the commonest leading causes of death, followed by multi-organ dysfunction syndrome (22%).

Conclusion: Human error is a significant contributor to deadly road traffic accidents and can be mitigated through stricter licensing policies, increased traffic knowledge, reduced drug abuse, and constructing network of road that aligns with the volume of traffic.

Keywords: Thoraco-abdominal injuries, Road traffic accidents, Lungs, Rib fracture, Liver

INTRODUCTION

An accident is an unexpected event that occurs unintentionally and suddenly and is a counter product of a busy lifestyle; modernization is considered a modern-day epidemic. Road traffic accidents (RTAs) are considered one of the most serious global transportation issues and are a counter product of fast life and modernization (1). Accidents are caused not only by ignorance but also by thoughtlessness, carelessness, and overconfidence. Human, environmental, and vehicular elements are involved in road traffic accidents before, during, and after their occurrence (2). Road traffic accidents are responsible for the maximum number of accidents globally, resulting in more than a

million fatalities and approximately 20–50 million injuries each year. Despite this, fatalities and injuries can occur in all transportation forms. If the existing trend persists, road traffic injuries are projected to rank fifth commonest death cause by the year 2030. Injury-related deaths account for a quarter of the total deaths in Southeast Asia, which is among the top five causes of mortality and morbidity in Southeast Asian countries (3).

In India, the fatality rate of road traffic accidents is reportedly 20 times greater than that in developed countries, making it one of the highest globally (4). Defective and narrow roads are the major causes of RTA. WHO (World Health Organization) emphasized the significance of comprehensive data regarding traffic injuries

during its international conference on road traffic accidents. According to recent statistics, road traffic injuries now claim more lives than AIDS/HIV, diarrheal illnesses, or tuberculosis. Currently, RTA (Road Traffic Accidents) is the major death cause, especially in young adults and children between 5 to 29 years of age. This highlights the necessity for a change in the current agenda for adolescent and child health (5). This ever-expanding epidemic, targeting productive generations, is likely to have a significant impact on the socioeconomic growth and quality of life of the region.

The injury pattern, whether non-fatal or fatal, differs substantially based on whether the individual is a motorcyclist, vehicle occupant, pedestrian, or pedal cyclist (6). The third most common area of the body frequently injured is the abdomen, particularly in cases of civilian trauma. BAT (Blunt abdominal trauma) is one of the primary death causes in patients with trauma. It is the primary cause of mortality among individuals below 35 years of age (7). In India, the most common causes of BAT are road traffic accidents, abdominal blows, pedestrian accidents, and falls from heights. Given that the thoracoabdominal cavity houses crucial organs, including the lungs, heart, liver, stomach, spleen, major blood vessels, and kidneys, as well as the ribs, any injury to this area poses a significant threat to the individual's integrity and viability. This study examined thoracoabdominal injury patterns in autopsied patients with a history of fatal RTAs, by considering age, sex, mode of travel, and internal injuries.

MATERIALS AND METHODS

A cross-sectional investigation was conducted utilizing autopsy results and correlating them with pertinent clinical reports and records from the investigating agencies. A purposive sampling method was utilized to choose a sample of hundred post-mortem autopsies conducted between August 2017 and September 2018 on individuals who had died as a result of RTAs (road traffic accidents) and underwent medico-legal autopsies at the K R Hospital Mortuary, Department of Forensic Medicine and Toxicology, Mysore Medical College and

Research Institute, Mysore, India. Written consent was obtained from all concerned relatives. An RTA is defined as an accident that occurs on a roadway, where two or more objects, at least one of which is a moving vehicle, are involved. A detailed dissection and examination of the abdomen and thorax were performed as per standard autopsy techniques, as described in Otto Sapphire (8). The injuries present in the abdomen and thorax were noted in detail and entered into a pro forma, and photographs were taken when necessary.

The data collected were specifically intended for the examination of injuries sustained in the thoracoabdominal area, with a particular emphasis on the nature of the wound and organs that are mostly affected by RTAs. Furthermore, the data were intended to provide insights into epidemiological factors related to the sites of impact, vehicles, and victims. In addition, features related to hosts (road users), agents (vehicles), environmental conditions (time, seasons, road, etc.), and survival periods were studied. All RTA cases involving thoracoabdominal injuries were included in this study. Decomposed bodies, dead bodies that sustained thermal injuries over the thoracoabdominal region, unknown bodies, and cases without a clear history of RTAs were not involved in the research. Data analysis was performed using SPSS Software Version 22.0 and Microsoft Excel. Descriptive statistics, including standard deviation and mean, were calculated for continuous variables, while categorical variables were summarised using appropriate measures.

RESULTS

This investigation examined 100 cases from August 2017 to September 2018 at the KR. Hospital Mortuary, Mysore, involving thoracoabdominal injuries from road traffic accidents.

The vulnerable age group for sustaining thoracoabdominal injuries in RTAs (road traffic accidents) was 21-30 years (25%) followed by 41-50 years (24%). The mean age groups were 41.1 ± 16.2 . In relation to the victim profile for RTAs that were fatal involving

thoracoabdominal region, there is preponderance of males 74 (74%) than females 26 (26%), ratio was found to be 3.5:1. Motor bike riders (40%) constituted the majority part of victims of thoracoabdominal injuries in RTA, followed by pedestrians 23 (23%) and passenger 20(20%). The majority of thoracoabdominal injuries in RTA occurred on highway road 77(77%), followed by village road 13 (13%) and city road 10 (10%) (Table 1).

Table 1: Road traffic accident (RTA) victim distribution of based on age group, sex, mode of travel and place of accident (n=100)

Category	Frequency (%)
Age groups	
≤ 20	8 (8%)
21-30	25 (25%)
31-40	19 (18%)
41-50	24 (24%)
51-60	13 (13%)
61-70	9 (9%)
>70	2 (2%)
Gender	
Male	74 (74%)
Female	26 (26%)
Mode of travel	
Rider	40 (40%)
Pedestrian	23 (23%)
Passenger	20 (20%)
Pillion Rider	13 (13%)
Driver	4 (4%)
Place of accident	
Highway Road	77 (77%)
Village Road	13 (13%)
City Road	10 (10%)

Table 2: Distribution of road traffic accident (RTA) victims on the responsible vehicles, survival period and time of the day (n=100)

Category	Frequency (%)
Vehicles	
Motor Bike	57 (57%)
Light Motor Vehicle	35 (35%)
Heavy Motor Vehicle	22 (22%)
Bicycle	2 (2%)
Survival period (hrs.)	
0	13 (13%)
6	48 (48%)
12	7 (7%)
24	4 (4%)
48	28 (28%)
Place of death	
Hospital Dead	67 (67%)
Brought Dead	18 (18%)
Spot Dead	15 (15%)
Time of day	
Morning	33 (33%)
Evening	27 (27%)
Noon	18 (18%)
Night	16 (16%)
Midnight	6 (6%)

Motorcycles were the most frequently involved vehicles in accidents, with 57% of victims, followed by light motor vehicles (LMV), with 35% of the victims dying. Majority of the victims expired within 6 hours (48%), followed by more than 48 hours (28%) with a mean time of 18.12±19.25 hrs ranging from range 0 to 48 hrs. Most victims succumbed to death in the hospital (67%), followed by 18% of the victims who passed away on way to hospital and 15% who passed away on the spot. The highest number of RTA cases occurred in the morning (33%), followed by evening (27%), noon (18%), night (16%), and midnight (6%) (Table 2).

The majority of RTA cases occurred in the winter (61%), followed by the rainy season (31%), and the lowest in the summer season (8%). A combination of different body parts was involved; the chest alone was majorly involved in 61 cases (61%), followed by the chest with the adjacent abdomen (24%) and the abdomen (15%). The most common bony structure involved was the rib fracture (84%), followed by the pubic symphysis (7%). Approximately 81% of the victims had hemothorax and 19% had normal pleura (Table 3).

Table 3: Distribution of road traffic accident (RTA) victims based on the season, type of injury, type of bone injury and injury to pleura (n=100)

Category	Frequency (%)
Season	
Winter	61 (61%)
Rainy	31 (31%)
Summer	8 (8%)
Injury pattern	
Chest Alone	61 (51%)
Chest with Adjacent Abdomen	24 (24%)
Abdomen	15 (15%)
Bone Fractures	
Rib	84 (84%)
Pubic Symphysis	7 (7%)
Clavicle	3 (3%)
Sternum	3 (3%)
Vertebrae	2 (2%)
Normal	14 (14%)
Pleura	
Hemothorax	81 (81%)
Normal	19 (19%)

The lung was the most commonly injured organ, accounting for 75% of the cases, followed by the liver (27%) and the spleen (12%). In 62% of the RTA victims, shock and hemorrhage were the

most common leading causes of death, followed by multiorgan dysfunctional syndrome (MODS) in 22% of the victims (Table 4).

Table 4: Distribution of road traffic accident (RTA) victims based on the type of injury to the organs, death cause and (n=100)

Category	Frequency (%)
Organs	
Lung	75 (75%)
Liver	27 (27%)
Spleen	12 (12%)
Peritoneum	14 (14%)
Bladder	8 (8%)
Intestine	6 (6%)
Heart	3 (3%)
Major Blood Vessels	2 (2%)
Kidney	1 (1%)
Mesentery	4 (4%)
Cause of Death	
Shock & Hemorrhage	62 (62%)
MODS	22 (22%)
Coma	16 (16%)

DISCUSSION

Road traffic deaths are alarmingly high, with an estimated 1.35 million deaths annually. Road accidents are the primary reason for deaths among kids and young individuals of age between 5 to 29 years, accounting for over half of the fatalities among susceptible road users.⁴ In our research, a total of 100 cases that met the exclusion and inclusion criteria were included. It was found that most participants were male, accounting for 74 individuals (74%) compared with 26 females (26%). The male-to-female ratio was 3.5: 1. The results generally align with those previously reported by Reddy et al. Singh and Dhatarwal, Rao and Mukerjee, Verma *et al.*, (1, 9, 10).

In RTAs, people between 21-30 years were the age group were most affected (25%), followed by those between 41-50 years of the age group (24%). People aged ≤ 20 years (8%) of the age group, 61-70 years (9%), and >70 years (2%) were the least affected. The growing number of fatalities may be attributed to a lack of knowledge about traffic safety measures. Certain age groups are more vulnerable to accidents and have more severe outcomes. Studies have indicated that young adults and the elderly are particularly at risk (11, 12). The highest number of road traffic accident victims (34.20%) were between 21-30 years of age (12). However,

children under 6 years and adults over 65 years have significantly higher risks of dying in road traffic accidents than other age groups (11). This suggests that, while younger adults may be involved in more accidents, the severity and fatality rates are higher for very young children and older adults.

It was also noticed that the majority of cases (65.4%) were within the economically productive age group of 21-50 years. These results are in agreement with those reported by Reddy et al. and Singh (9). In 40% of the cases, riders of motorcycles and scooters, pedestrians (23%), and passengers (20%) were the most commonly impacted by RTAs. Most victims in this investigation were scooters or motorcycle riders, which is understandable considering that many Indian households favor travelling using these modes of transportation. As this area is primarily used by pedestrians and two-wheeler riders, it is common for individuals to travel along the roads. The general agreement of the present research findings aligns with the studies carried out by Reddy *et al.*, Dagar *et al.*, and Chourasia *et al.*, (9, 13, 14). However, these findings contradict those of Khan et al. (15), who reported that pedestrians were the most common victims of deadly RTAs.

Motorcycles were the most frequently involved vehicles in accidents, with 57% of victims, followed by light motor vehicles (LMV), with 35% of the victims dying in the current research. The data from Poudel et al. (2021) particularly support our findings, with two-wheelers being involved in 77% of accident cases (16). Bhimrao et al. found that a rider/driver of a 2-wheeler (51.66%) was the most common victim, followed by pedestrians (23.22%) which is comparable to the results of the present study (17). Pillions and occupants of 4 -and 3-wheelers were seen in 5.21% and 10.43% respectively. However, these results are at odds with those of other researchers, who found pedestrians to be the most common type of victim in an accident (18,19). The reason for this difference could lie in the higher level of traffic awareness among pedestrians on the road, as well as the presence of effective traffic management measures in the area of study.

Reddy et al. reported that individuals riding 2-wheelers often sustain thoracoabdominal injuries, which are the most frequent type of injuries among them (9).

The current research findings showed that 48% of victims succumbed within 6 h following a deadly RTA, while another 28% survived for more than 48 h. The increased frequency of early deaths could be attributed to a shortage of timely transportation and trauma patient management. The severity of the injury was reflected in the findings as most victims succumbed in the early hours. The general findings of this study align with those reported by Verma *et al.*, and Reddy et al. (1, 9). However, this study's findings differ from those of Anebonam *et al.*, who reported that out of 1,141 RTAs recorded in Anambra State between 2010-2014, 652 were classified as serious cases. This suggests that a significant proportion of victims require extended medical care, potentially battling their lives for more than a day (20). Strengthening prehospital care capacities and emergency departments is necessary to reduce the health burden associated with RTAs (21). Implementing efficient public transport systems, improving road engineering, and creating awareness of road safety precautions could help mitigate the impact of RTAs and improve overall patient outcomes (22).

In the current research, the majority of victims passed away in the hospital, followed by 18% who were brought in for treatment, and 15% expired at the spot of the incident. Singh *et al.*, reported that the commonest outcome was the hospital death (54.8% cases), trailed by deaths on spot (29.96%) and deaths occurring in route to the hospital at 17.17percent (23). Most casualties (50%) perished before they could reach the hospital. All the above study outcomes, including the current one, indicate that approximately half of the victims passed away because of delay in seeking hospital treatment beyond the "Golden Hour". The Golden Hour is vital for victim survival, and other factors also contribute to the occurrence and severity of road traffic accidents. These include driver behaviour, road conditions, time of day, and vehicle type. Certain illegal

driver behaviours, such as refusal to give way, illegal reversal, illegal parking, drunk driving, and speeding, have been identified as high-risk behaviours that contribute to accidents (24).

The risk of fatal accidents increases significantly during certain hours, particularly between midnight and 15:59, with the highest risk occurring between 4:00 to 7:59 (25). This pattern suggests that a daily rhythm in traffic volume influences accident occurrence (26). In this study, it was noted that the morning was the time when the highest proportion of road traffic accidents occurred, accounting for 33% of the total number of accidents, followed by the evening (27%), and only the fewest road traffic accidents occurred at midnight (6%). The cause of the increased incidence during morning hours might be attributed to traffic rush, which is likely because many individuals commute to work, schools, and offices. These results were consistent with those reported by Reddy *et al.*, (9). However, our findings contradict those of Madhuvardhana *et al.*, who discovered that the highest RTAs occurred in the evening (27). These findings highlight the need for targeted interventions and safety measures during high-risk periods to reduce the incidence of RTAs and improve overall road safety.

The relationship between the time of day and RTAs varies across seasons. In spring and summer, fatalities are more pronounced during nighttime hours (20:00 to 3:59), while in fall and winter, they peak during daytime hours (12:00 to 15:59) (25). This seasonal variation highlights the complex interplay between time of day, weather conditions, and accident risk. In the current investigation, the majority of RTA cases occurred during winter (61%), followed by the rainy season (31%), and the lowest occurred in summer (8%). According to statistics, the ratio of traffic accidents occurring on icy, wet, and dry road surfaces is approximately 4.2:1.6:1 (28). This shows the increased risk associated with icy and wet conditions compared with dry roads. Winter weather conditions, including icy, snowy, slushy, and wet road surfaces, reduce tire friction and affect vehicle stability, potentially leading to dangerous crashes (29). The presence of snow

and ice on roads can pose serious risks to driving conditions, with heavy snow and freezing temperatures resulting in slippery road pavement (30). In particular, icing reduces the friction between tires and pavement surface, significantly increasing the risk of accidents. Moreover, reduced directional control, longer braking distances, earlier night falls, and obstacles, such as branches and fallen trees, can increase the risk of accidents. Finally, the expansion of frozen soil under roadways or frost heaving can cause uneven or buckled road surfaces, which can also contribute to accidents. The development of road surface condition classification systems and sensors (28, 31) can help improve traffic safety by providing real-time information on road conditions to drivers and autonomous vehicles. The severity of injuries in RTAs is influenced by various factors, and some studies have highlighted specific correlations. Head injuries are the most common and severe type of injury in RTAs, particularly among pedestrians (32). Skull fractures were present in 95.78% of victims who died from head injuries (32). The weight of the vehicle involved in the collision is a principal determinant of death, with injuries to all body regions increasing with the vehicle weight. Advanced predictive models, such as the Light Gradient Boosting Machine-Tree-structured Parzen Estimator (LightGBM) combined with SHapley Additive exPlanation (SHAP) analysis, have shown promise in identifying and interpreting risk factors for injury severity (33). The majority of cases involved the chest, followed by the chest with the adjacent abdomen (24%) and abdomen (15%) in the present study, which correlates well with prior research findings. Slovic *et al.*, (34) reports that chest injuries were identified in 77.7% of fatal RTA victims, with rib fractures being the most common type of injury, observed in two-thirds of the sample and Zhang *et al.*, (31) notes that rib fractures and pulmonary contusion were the most common injuries in fatal RTAs. The most common injury to the thoracic region was rib fracture (84%), followed by normal fractures (14%), and hemothorax (81%). In research carried out by Reddy *et al.*, it was found that 71

percent of the case had sustained bony cage injuries, while 63.3 percent had rib fractures. Additionally, 19.7 percent of the victims experienced clavicle fractures and 8.4 percent experienced vertebral and sternal fractures (9). Chest injuries, including those affecting the lungs, are prevalent in fatal RTAs. A study found that chest injuries were identified in 77.7% of subjects who died from road traffic accidents (34). These injuries can lead to death due to complications, such as pneumothorax or exsanguination. The severity of chest injuries, including lung trauma, is often correlated with the weight of the vehicle involved in a collision. The most common injuries were to the lungs (75%), liver (27%), peritoneum (14%), spleen (12%), and kidney (1%). According to Tambuzzi *et al.*, thoracic injuries are among the most frequent causes of death in car, motorcycle, and truck fatalities. Aortic injuries account for 15 percent of fatalities resulting from road traffic accidents (35). The high prevalence of chest injuries in fatal accidents indicates the need for improved safety measures and emergency medical care focused on protecting and treating the thoracic region, including the lungs, in RTA victims. The incidence of diaphragmatic rupture in hospitalized patients with blunt trauma is reported to be between 0.8 percent and 1.6 percent. The spleen is the intra-abdominal organ that is most commonly injured following blunt trauma. In their research, the incidence of bowel and mesenteric injuries following BAT (blunt abdominal trauma) was reported to be 1.3%. A study on blunt abdominal trauma patients by Nair and Rajesh reported that motor vehicle accidents were the most common cause of trauma (77%), and the liver was the most frequently injured solid organ (77%) (36). In the current study, shock and haemorrhage were the leading causes of death in approximately 62% of the RTA cases, followed by multiorgan dysfunction syndrome in 22% of the victims.

CONCLUSION

Our study found that young adults and the elderly are particularly vulnerable to severe outcomes in road traffic accidents, with males being disproportionately affected. The findings

emphasise the importance of improving prehospital care, enhancing public transport systems, and raising awareness about traffic safety to mitigate the impact of RTAs. Additionally, targeted interventions during high-risk periods and adverse weather conditions are crucial for reducing accident incidence and improving overall road safety.

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None

CONFLICT OF INTEREST

Nil

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