

A Cross-Sectional Study on Pattern and Injury Severity Score in Thoracoabdominal Trauma Among Medicolegal Autopsy Cases in North India

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Abstract

Background: The World Health Organization defines an accident as an unanticipated, unplanned event that may result in injury. A post-mortem investigation of the Injury Severity Score (ISS) can reveal what types of injuries are life-threatening as well as their severity, so this study was carried out to determine the pattern of thoraco-abdominal injuries and period of survival, with a special focus on Injury Severity Score (ISS). **Subjects and Methods:** This cross-sectional study was carried for a duration of two years in a Hospital of Delhi, India among 231 cases of thoraco-abdominal injuries brought for medico-legal autopsies. Post-mortem examination was carried out to record external and internal findings on the body, and Injury severity score (ISS) was derived for the injuries. All tests were performed at a 5% level of significance; thus, an association was significant if the p value was less than 0.05. **Results:** The most usually impacted age group was 31-40 years (31.2%). Road traffic accidents (71.4%) were the most common mode of injury in the current study. Half of the victims (55.8%) died in hospital, and haemorrhagic shock was the cause of death in 33.9% of the victims. The rib fractures accounted for 75.3% of total visceral injuries. The Spearman Correlation analysis showed as the Injury Severity Score (ISS) increases, the survival time decreases significantly. **Conclusion :** According to the findings of this study, the most prevalent cause of thoraco-abdominal trauma is a road traffic accident and victims with a low ISS had a longer survival period than those with a higher ISS.

Keywords: Thoracoabdominal Trauma

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Introduction

The World Health Organization defines an accident as an unanticipated, unplanned event that may result in injury. Accident can also be defined as an unplanned injury, death, or property damage that occurs as a result of a series of events. Accidental injury is one of the primary causes of death and disability globally, with low- and middle-income nations accounting for about 90% of all injury-related deaths.^[1-3]

According to a number of research on various elements of non-natural deaths, road traffic accidents are the leading cause of mortality due to non-natural causes in various parts of India. Accidents are the fourth most common cause of death. Road traffic injuries take 1.2 million lives each year, accounting for the majority of deaths caused by non-natural causes. South East Asia Region (SEAR) accounts for more than a quarter of all global accidental deaths.^[2,4,5]

Accidents have always been a main cause of blunt trauma around the world, with blunt thoraco-abdominal injuries being one of the most common causes of unnatural fatalities. Road traffic accidents, falls from great heights, railway accidents, industrial accidents, agricultural accidents, domestic accidents, homicides, suicides, or any sort of piercing or blunt trauma to the thoraco-abdominal areas are all causes of thoraco-abdominal injuries.^[6]

The thoracic and abdominal walls may show abrasions or bruises as a result of severe trauma, but the abdominal wall normally resists major harm by transferring the force of the impact to more resistant organs within the abdominal cavity, which are injured. Blows from a blunt weapon or compression of the chest can cause contusions or lacerations of the lungs and heart without damaging any thoracic bones or displaying evidence of external injuries. As a result, fatal thoracoabdominal injuries may go undetected, resulting in

their late identification and lethal outcomes. Many of these victims' lives can be saved if the injury is detected early and treated immediately.^[7]

The Injury Severity Score (ISS), derived from the Abbreviated Injury Scale (AIS) by Bekar et al., is an anatomical grading system that provides an overall score for cases involving multiple injuries.^[8] As a result, a post-mortem investigation of the Injury Severity Score (ISS) can reveal what types of injuries are life-threatening as well as their severity. Accidental deaths are preventable and can be avoided by putting in place preventive measures. In order to understand the causes of such events, research is needed, particularly in the conditions that exist in and around Delhi. In order to determine the future outcome and prognosis in a tertiary care hospital, it is also vital to understand the pattern of thoraco-abdominal injuries that occur in fatal accidents of various scenarios and their Injury Severity Scoring (ISS).

As a result, this study was carried out to determine the pattern of thoraco-abdominal injuries according to age, sex, manner, and period of survival, with a special focus on Injury Severity Score (ISS), which will be useful in future planning to reduce morbidity and mortality, as well as to develop preventive strategies for thoraco-abdominal injury.

Subjects and Methods

Study setting and Design

The present descriptive cross-sectional study was carried for a duration of two years (May 2019 to April 2021) in the Department of Forensic Medicine of a tertiary health care teaching Institute Delhi, India.

Study subjects and sample size

The present study included 231 cases of mechanical trauma with thoraco-abdominal injuries with or without injuries to other parts of the body, brought for medico-legal autopsies to the mortuary of the Institute. All decomposed, putrefied, completely mutilated bodies; unclaimed, unidentified bodies with no proper history; and those cases where the nature of sustenance of injury was not known were not included in the study. Written informed consents were obtained from the relatives of the victims and approval from the Institutional Ethical Committee was sought (IEC/IRB No.; LHMC, Delhi).

Study tool and data collection

Particulars of the victims and the relevant history were obtained in detail from the investigating police officer and relatives in proforma sheet. The hospital records of the victims who did not die at the spot and survived for some times were thoroughly assessed. A meticulous post-mortem examination was carried out and the external and internal findings on the body were recorded.

For the establishment of injury severity score (ISS), the injuries were ranked on a scale of 1 to 6 as per AIS (Abbreviated Injury Scale) where 1=Minor, 2=Moderate, 3=Serious, 4=Severe, 5=Critical, and 6=Unsurvivable. Each injury is assigned an Abbreviated Injury Scale (AIS) score and is allocated to one of six body regions such as Head and neck injuries - include any injury of the cervical spine, cervical spinal cord, skull, brain and ears; Face injuries - include mouth, eye, nose and facial bone injuries; Chest injuries - include injuries to all of the internal chest cavity organs, the diaphragm, thoracic spine and rib cage; Abdominal injuries - include injuries to all of the internal abdominal organs, the pelvis and the lumbar spine; Extremities injuries - include all sprains, fractures, amputations and dislocations; and External injuries - include all contusions, abrasions and lacerations independent of their location.

For the calculation of the ISS, only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score which ranges from 1 to 75. If the victim has any injury with an AIS value of 6, the ISS is assigned a value of 75.^[8]

Statistical analysis

The data obtained was entered in MS EXCEL spreadsheet and were analysed using Statistical Package for Social Sciences (SPSS Inc. Chicago, IL, USA) Windows based version 22.0. Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean \pm SD. Relationship of severity of injury based on Injury Severity Score (ISS) and survival time evaluated by correlation analysis. All tests were performed at a 5% level of significance; thus, an association was significant if the p value was less than 0.05.

Results

Out of the 231 cases studied, 79.2% (183/231) were males and 20.8 percent (48/231) were females. The most usually impacted age group was 31-40 years (31.2%), followed by 19-30 years (24.6%) and 41-50 years (19.5%), accounting for three-quarters of the victims [Table 1].

*Multiple Reponses

Road traffic accidents were the most common mode of injury in the current study, accounting for 71.4 percent of the victims. As a result, the majority of the victims (88.7%) died as a result of accidental injuries, with half of the accidents occurring in urban areas (54.9 percent). There was no external injury in 25.1 percent of thoracic injuries and 57.1 percent of abdominal injuries. When the time between the event and death is taken into account, half of the victims (55.8%) died in hospital, and haemorrhagic shock was the cause of death in 33.9 percent of

Table 1: Gender and age group distribution of autopsy subjects (N= 231).

Age group (in years)	Number (%)		
	Total (n=231)	Male (n=183)	Female (n=48)
<18	15 (6.5)	12 (6.6)	3 (6.3)
19-30	57 (24.6)	45 (24.6)	12 (25.0)
31-40	72 (31.2)	66 (36.1)	6 (12.5)
41-50	45 (19.5)	33 (18.0)	12 (25.0)
51-60	18 (7.8)	9 (4.9)	9 (18.8)
>60	24 (10.4)	18 (9.8)	6 (12.4)

the victims [Table 2].

*Multiple Reponses

The most prevalent type of external thoracic injury was contusion (74.1%), followed by abrasion (50.3%), complete transection (9.2%), and crush injuries (6.9 percent). Similarly, among the external abdominal injuries, contusion was the most common (96.2%), followed by abrasion (45.5%), and crush injury (34.1%). [Table 3].

[Table 4] shows that rib fractures accounted for the bulk of injuries, accounting for 75.3 percent of total visceral injuries, followed by lung injuries (31.4 percent) and heart injuries (9.9 percent). The liver and spleen were the most common visceral injuries, accounting for 89.1% of all injuries, followed by kidney injuries (26.4%), mesenteric injuries (23.9%), and vertebral injuries (22.6 percent).

[Table 5] shows the relationship between the victims' survival period and their Injury Severity Score. The mean Injury Severity Score of those who died on the spot was 72.1 ± 15.4 , followed by 44.6 ± 10.3 for those who died in less than 1 hour and 43.3 ± 11.2 for those who survived 1 to 2 hours. The average Injury Severity Score of all the victims who died as a result of combined thoraco-abdominal injuries was 44.2 ± 18.8 . The relationship of injury severity based on Injury Severity Score (ISS) and survival time was evaluated using the Spearman Correlation Coefficient, which yielded a value of ($r = -0.794$) and a p value of 0.001, indicating that as the Injury Severity Score (ISS) increases, the survival time decreases significantly, and there was a statistically highly significant correlation between Injury Severity Score (ISS) and the victims' survival period.

Discussion

The age distribution of victims in the current study revealed that the most frequently affected age group was 31-40 years (31.2 percent). Similar findings were found by Prajapati et al., and Srivastava et al.,^[9,10] indicating that persons in these most productive and active stages of life are more exposed to such forms of trauma because they choose to stay outside and

engage in dangerous jobs to earn their living.

Out of the 231 cases studied, 79.2% (183/231) were males and 20.8 percent (48/231) were females. Reddy et al., Prajapati et al., and Kumar et al. all found a male majority in their studies.^[7,9,11] Male dominance may be owing to the fact that males are more exposed to the unforeseeable hazards of roadways while travelling, as well as the reasons mentioned above.

According to Chandra et al., Bergvist et al., and Abbasi et al., road traffic accidents were the most common mode of injury in 71.4 percent of the victims in the current study.^[12-14] This discovery could be the result of poor road and automotive maintenance, a lack of effective traffic planning, driver violations of traffic rules, and the use of intoxicants while driving.

According to Kumar et al., the combination of chest and head injuries accounted for 34.4 percent of total injuries, with the chest alone accounting for 16.7 percent.^[15] The current study found similar results, with the head and neck (89.1%) being among the additional parts involved in thoracoabdominal injury. This pattern of injury could be attributed to the fact that the head, neck, and chest are the most exposed and susceptible body regions in vehicle accidents, and attackers target crucial organs like the brain, heart, and lungs, which are located in these body parts, in the case of homicidal trauma.

The majority of the injuries in our analysis were rib fractures, which accounted for 75.3 percent of all visceral injuries, followed by lung injuries (31.4 percent). In a study by Kumar et al., Kumar et al., and Lema et al., they discovered that ribs were the most commonly fractured bones and lungs were the most commonly wounded organs in thoracoabdominal trauma.^[11,15,16] This is due to the fact that the rib cage works as a protective mechanism in thoracic trauma, and fractured ribs are frequently accompanied with lung injuries.

Haemorrhagic shock was the cause of death in 33.9 percent of the victims in this study. According to the findings of Segers et al., and Vock et al., hemorrhagic shock combined with head injury was the leading cause of death in the majority of cases.^[17,18] The majority of the victims of thoracoabdominal

Table 2: Characteristics thoracoabdominal trauma among autopsy subjects (N= 231).

Characteristics	Number (%)
Modes of trauma	
Road traffic accident	165 (71.4)
Fall from height	45 (19.5)
Railway injury	15 (6.5)
Assault	3 (1.3)
Fall of debris (Wall, Tree, etc)	3 (1.3)
Manner of Injury	
Accidental	205 (88.7)
Suicidal	17 (7.4)
Homicidal	9 (3.9)
External thoracic injury	
Present	173 (74.9)
Absent	48 (25.1)
External abdominal injury	
Present	132 (42.9)
Absent	99 (57.1)
Other sites involved in thoracoabdominal injury *	
Head and neck	206 (89.1)
Upper limbs	133 (57.7)
Lower limbs	177 (76.6)
Place of trauma	
Urban	127 (54.9)
Rural	104 (45.1)
Place of occurrence of death	
On spot or unknown	64 (27.7)
On the way to hospital	38 (16.5)
Hospital death	129 (55.8)
Cause of death	
Hemorrhagic shock	78 (33.9)
Carnio-cerebral injury	32 (13.8)
Peritonitis	9 (3.8)
Septicemia	9 (3.8)
Combined	103 (44.7)

Table 3: Pattern of external thoracoabdominal trauma among autopsy subjects.

Injury pattern*	External thoracic injury (n=173)	External abdominal injury (n=132)
Abrasion	87 (50.3)	60 (45.5)
Contusion	128 (74.1)	127 (96.2)
Laceration	8 (4.6)	22 (16.7)
Complete transection	16 (9.2)	15 (11.4)
Crush injury	12 (6.9)	45 (34.1)
Stab injury	8 (4.6)	15 (11.4)

Table 4: Distribution of thoracoabdominal injuries on the basis of organ or bone involved (N=231).

Characteristics*	Number (%)
Thoracic	
Lungs and diaphragm	73 (31.4)
Hearts and vessels	23 (9.9)
Ribs	174 (75.3)
Clavicle	9 (3.8)
Sternum	103 (44.6)
Abdominal	
Liver and spleen	206 (89.1)
Kidney	61 (26.4)
Mesentery	55 (23.9)
Small intestine	46 (20.1)
Large intestine	32 (13.8)
Stomach and pancreas	23 (9.9)
Pelvis	44 (18.8)
Vertebrae	52 (22.6)

*Multiple Responses

Table 5: Correlation between survival periods of the victims and to the Injury Severity Score (N=231).

Survival time	Injury severity score (Mean±SD)
On spot death (n=52)	72.1±15.4
<1 hour (n=46)	44.6±10.3
1-2 hours (n=15)	43.3±11.2
3-6 hours (n=17)	42.4±12.8
7-12 hours (n=15)	40.2±7.2
13-24 hours (n=26)	33.6±5.2
1-7 days (n=48)	32.5±6.3
>1 week (n=12)	25.4±5.9
Overall ISS	44.2±18.8

injury cases in the study (55.8%) died in hospitals, with 16.5 percent dying on the way to the hospital and 27.7% dying on the spot. Most of the injured people survived for a while and died in hospitals, according to Nikolic et al. and Sahdev et al., who also believe that if patients were brought in early and given advanced medical treatment, they would have survived.^[19,20] Thus, autopsy of a trauma survivor discloses the most common damage consequences, clinical diagnoses, and preventable deaths.

The victims who died on the spot in this study had a mean Injury Severity Score of 72.1±15.4. The correlation between injury severity as measured by the Injury Severity Score (ISS) and survival time as measured by the Spearman Correlation Coefficient ($r=-0.794$, $p=0.001$) revealed that as the Injury Severity Score (ISS) increases, the survival time

decreases significantly, and there was a statistically highly significant correlation between Injury Severity Score (ISS) and the survival period. Srivastava et al., ($r=-0.472$) and Nikolic et al., ($r=-0.458$) found similar negative correlations between survival duration and ISS values.^[10,19] However, a victim's overall survival is dependent on an efficient emergency medical system, which includes rapid and accurate diagnosis, immediate assistance, and so on.

Limitations

In the current study, the majority of the crime scenes were not visited. As a result, secondary data on the crime scene was obtained from the police and, to a minor extent, from family, and this can be considered a study limitation.

Conclusion

According to the findings of this study, the most prevalent cause of thoraco-abdominal trauma in Delhi NCR is a road traffic accident. Victims with a low ISS had a longer survival period than those with a higher ISS, and the majority of the victims died on their way to hospitals, which could be due to a shortage of emergency medical services along the highways in Delhi NCR.

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