RESEARCH PAPER

Clinical Spectrum, Severity, and Outcomes of Traumatic Neck Injuries: A Comprehensive Analysis

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ABSTRACT
Background- Traumatic neck injuries (TNIs) are relatively uncommon but potentially life-threatening due to the presence of vital vascular, aerodigestive, and neurological structures in a confined anatomical space. Prompt diagnosis and management are crucial to reduce morbidity and mortality.
Aim- To evaluate the clinical spectrum, severity, management, and outcomes of traumatic neck injuries in a tertiary care setting.
Materials and Methods- This prospective observational study was conducted over one year at LLRH hospital & GSVM Medical College Kanpur , UP and included 95 patients with traumatic neck injuries requiring admission and intervention. Data regarding demographic profile, mechanism and type of injury, clinical presentation, anatomical zones, injury patterns, management strategies, and outcomes were collected and analyzed using SPSS version 25.0. A p-value <0.05 was considered statistically significant.
Results- The majority of patients were in the 31–45 years age group (35.8%), with a male predominance (71.6%). Road traffic accidents (44.2%) were the most common mechanism, and blunt trauma (60.0%) predominated. The most frequent presenting feature was visible neck wound (75.8%), followed by bleeding (61.1%). Zone II involvement (54.7%) was most common, and soft tissue injuries (51.6%) were the predominant pattern. A total of 62.1% patients required surgical intervention, and 43.2% required ICU admission. Overall, 67.4% recovered, while 20.0% developed complications, and 12.6% mortality was observed. The most common hospital stay was 4–7 days (48.4%), with a mean duration of 6.2 ± 2.8 days. A statistically significant association was found between type of injury and outcome (p = 0.047) and between mechanism of injury and management/hospital stay (p = 0.027).
Conclusion- Traumatic neck injuries predominantly affect young males and are most commonly caused by road traffic accidents. Early recognition, prompt airway and vascular management, and timely surgical intervention are critical in improving outcomes. Penetrating injuries and RTA-related trauma are associated with increased severity, complications, and prolonged hospitalization.
Keywords: blunt trauma, clinical outcomes, penetrating trauma, road traffic accidents, Traumatic neck injury, Zone II injury
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INTRODUCTION

Traumatic neck injuries (TNIs) represent 5-10% of all severe trauma cases. Particularly, neck injuries related to motor vehicle crashes (MVCs), suicide, and homicide accounted for 3500 deaths annually.[1] Both blunt and penetrating neck injuries (PNIs) are associated with poor outcomes. Blunt trauma causes around 5% of all neck injuries which are mainly associated with M MVC-related neck injuries usually occur due to the sudden collision of the neck with the steering wheel or dashboard which might cause tracheal crush at the cricoid ring or esophageal compression against the cervical vertebrae.[1,2] Other injuries are penetrating neck injuries (PNIs) caused by gunshot wounds, stab wounds, or penetrating debris such as shrapnel.

In blunt trauma patients, injuries of the laryngotracheal (0.04%) and pharyngoesophageal (0.3%) region are relatively infrequent as compared to the aerodigestive injuries caused by penetrating neck trauma (5-15%).[3-5] Though, injuries to the vertebral column (0.7%) and carotid (0.9%) arteries are rare; they often proves fatal in blunt trauma.[6,7]

PNIs, defined by platysma violation, comprise a significant number of traumatic injuries in adults and their treatment is trick.[8] Approximately 15 to 20 percent of PNI cases required treatment. The management of a hemodynamically stable patient is still debatable.[9,10] Penetrating neck trauma may present with unpredictable signs and symptoms in the emergency. Around 5% to 10% of all neck injuries comprises of penetrating neck trauma and 30% of patients

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present with multiple injuries. Thorough knowledge of the anatomy of the neck, physical assessment, and current recommendations for diagnostic and therapeutic interventions are necessary for appropriate management. Express decision making is often required to prevent catastrophic airway, vascular, or neurologic sequelae.[11]
Patients can present in the Emergency Department (ED) with a cut injury over the neck, bleeding from the neck wound (mild or profuse), hoarseness of voice, breathing difficulty, or dysphagia. Some of the patients can present in haemorrhagic shock and need immediate resuscitation and bleeding control. Management of neck injury depends on the anatomical level of injury, type of injury, severity, and time since injury. Neck injuries are not frequent; however, the morbidity and mortality rates are high.[12]
The purpose of this study was to assess the many demographic characteristics and causes of neck injuries in our area, as well as the types and patterns of injuries, their outcomes, and their implications.

MATERIAL AND METHODS

The prospective observational study was conducted at LLRH hospital & GSVM Medical College Kanpur , UP among patients with traumatic injury during the study period of one year. Ethical clearance for conducting the research was taken institutional ethics committee of college & hospital before commencement of study. Patients were asked to sign an informed consent form after explaining them about procedure of study.
Through consecutive sampling a total of 95 patients were selected for the study on the basis of inclusion and exclusion criteria. Patients who required admission and intervention due to TNIs were only included in this study. Patients with minor neck injuries who were managed and discharged from ED and patients with isolated cervical spine injuries were excluded from the study. Patients with minor TNIs needing admission due to major trauma in other parts of the body were also excluded.
Patient characteristics were noted, such as age, sex, mechanism, pattern and zone of neck injury, type, and level of tissue damage. Instable patients underwent diagnostic tests such as computed tomography angiography (CTA) to assess the vascular injury, contrast-enhanced computed tomography (CT) neck and chest for any aerodigestive injuries (with or without oral contrast), and chest radiography. Patients with superficial wounds underwent duplex ultrasonography. Patients with suspected esophageal injuries underwent esophagography. The type of injury, the clinical state, and the results of radiological investigations were the basis for management. Initially, all patients were treated in the ED in accordance with the Advanced Trauma Life Support (ATLS) protocol. Endotracheal intubation, either transorally or through the site of injury, was used to manage patients with damaged or endangered airways because to current bleeding or poor Glasgow community size of less than 9. When required, blood and blood products (packed blood cells, plasma, and platelets) are supplied in a 1:1:1 ratio. Patients experiencing hemorrhagic shock were brought to the operating room (OR) without additional radiological testing. Results such as morbidity, mortality, the need for emergency surgery, and hospital stays were recorded.
Data were entered & analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data & median with interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequencies & percentages. A two-sided p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 95 patients were included in the study. The age distribution showed that 34 patients (35.8%) belonged to the 31–45 years age group, making it the most affected category. This was followed by 28 patients (29.5%) in the 18–30 years group and 21 patients (22.1%) in the 46–60 years group. The least affected group was patients aged >60 years, comprising 12 patients (12.6%). Gender distribution revealed a clear predominance of males, with 68 patients (71.6%), while females accounted for 27 patients (28.4%). (Table 1)

Table 1. Demographic Characteristics of Study Participants

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	28	29.5
	31–45	34	35.8
	46–60	21	22.1
	>60	12	12.6
Gender	Male	68	71.6
	Female	27	28.4

Among the mechanisms of injury, road traffic accidents (RTA) were the most common, accounting for 42 patients (44.2%), followed by assault in 26 patients (27.4%), self-inflicted injuries in 15 patients (15.8%), and fall/other causes in 12 patients (12.6%). Regarding the type of injury, 57 patients (60.0%) sustained blunt trauma, while 38 patients (40.0%) had penetrating injuries. In terms of clinical presentation, visible neck wounds were present in 72 patients (75.8%), making it the most common sign. Bleeding from the wound was observed in 58 patients (61.1%). Airway-related symptoms included hoarseness of voice in 34 patients (35.8%) and breathing difficulty in 29 patients (30.5%). Dysphagia was reported in 26 patients (27.4%), while subcutaneous emphysema was noted in 18 patients (18.9%). Hemorrhagic shock was present in 14 patients (14.7%), indicating severe injury in a subset of patients. With respect to anatomical zones, Zone II was the most commonly involved, affecting 52 patients (54.7%), followed by Zone III in 25 patients (26.3%) and Zone I in 18 patients (18.9%). Injury pattern analysis showed that soft tissue injuries were most frequent, seen in 49 patients (51.6%). Aerodigestive injuries were present in 27 patients

(28.4%), while vascular injuries were identified in 19 patients (20.0%). (Table 2)

Table 2. Mechanism, Type, Symptoms and Signs, Anatomical Zone, and Injury Pattern

Variable	Category	Frequency (n)	Percentage (%)
Mechanism of Injury	Road Traffic Accidents	42	44.2
	Assault	26	27.4
	Self-inflicted	15	15.8
	Fall/Other	12	12.6
Type of Injury	Blunt Trauma	57	60.0
	Penetrating Trauma	38	40.0
Symptoms and Signs at Presentation	Neck wound/visible injury	72	75.8
	Bleeding from wound	58	61.1
	Hoarseness of voice	34	35.8
	Breathing difficulty	29	30.5
	Dysphagia	26	27.4
	Subcutaneous emphysema	18	18.9
	Hemorrhagic shock	14	14.7
Zone of Injury	Zone I	18	18.9
	Zone II	52	54.7
	Zone III	25	26.3
Injury Pattern	Vascular Injury	19	20.0
	Aerodigestive Injury	27	28.4
	Soft Tissue Injury	49	51.6

Regarding management, 59 patients (62.1%) underwent surgical intervention, while 36 patients (37.9%) were managed conservatively. A total of 41 patients (43.2%) required ICU admission, whereas 54 patients (56.8%) were managed without ICU support. In terms of outcomes, 64 patients (67.4%) recovered, while 19 patients (20.0%) developed complications. Mortality was observed in 12 patients (12.6%). Analysis of hospital stay revealed that 46 patients (48.4%) had a stay of 4–7 days, which was the most common duration. 28 patients (29.5%) required hospitalization for more than 7 days, while 21 patients (22.1%) stayed for 3 days or less. The mean hospital stay was 6.2 ± 2.8 days, indicating a moderate overall duration of admission. (Table 3)

Table 3. Management, Clinical Outcomes, and Length of Hospital Stay

Variable	Category	Frequency (n)	Percentage (%)
Management	Conservative	36	37.9
	Surgical Intervention	59	62.1
ICU Admission	Yes	41	43.2
	No	54	56.8
Outcome	Recovered	64	67.4
	Complications	19	20.0
	Mortality	12	12.6
Length of Hospital Stay	≤3 days	21	22.1
	4–7 days	46	48.4
	>7 days	28	29.5
	Mean ± SD	6.2 ± 2.8 days	

Among patients with blunt trauma (n = 57), 44 patients recovered, 8 developed complications, and 5 died. In contrast, among those with penetrating trauma (n = 38), only 20 patients recovered, while 11 developed complications and 7 died. The proportion of complications and mortality was higher in penetrating injuries compared to blunt trauma. The association between type of injury and outcome was found to be statistically significant ($\chi^2 = 6.12$, $p = 0.047$), indicating that penetrating injuries are associated with poorer clinical outcomes. (table 4)

Table 4. Association Between Type of Injury and Outcome

Type of Injury	Recovered (n)	Complications (n)	Mortality (n)	p-value
Blunt Trauma	44	8	5	0.047
Penetrating Trauma	20	11	7	

Among patients injured in road traffic accidents (n = 42), 30 required surgical intervention, while 12 were managed conservatively. Additionally, 16 patients had hospital stays of more than 7 days, while 20 stayed for 4–7 days and 6 for ≤3 days, indicating more severe injury patterns. In assault cases (n = 26), 15 patients underwent surgery, and 11 were treated conservatively, with most patients (14) staying for 4–7 days. Among self-inflicted injuries (n = 15), 9 patients required surgery, while 6 were managed conservatively, with 5 patients staying for more than 7 days. In the fall/other group (n = 12), 5 patients underwent surgery, and 7 were managed conservatively, with shorter hospital stays observed in most cases. The association between mechanism of injury and management/hospital stay was statistically significant ($\chi^2 = 9.18$, $p = 0.027$), suggesting that road traffic accidents are associated with increased severity, higher surgical rates, and prolonged hospitalization. (Table 5)

Table 5. Association Between Mechanism of Injury and Surgical Intervention / Length of Hospital Stay

Mechanism of Injury	Conservative (n)	Surgical (n)	≤3 days (n)	4–7 days (n)	>7 days (n)	p-value
Road Traffic Accidents	12	30	6	20	16	0.027
Assault	11	15	7	14	5	
Self-inflicted	6	9	3	7	5	
Fall/Other	7	5	5	5	2	

Figure 1- Patient with traumatic neck injury at hospital

Figure 2 – Angiography of Blunt vascular injuries of neck

DISCUSSION

Despite the fact that TNI can cause potentially life-threatening complications, the exact incidence, management, and outcome of TNI remain underreported. Moreover, there are limited studies on neck injuries from the rapidly developing countries with a diverse population.[13] To the best of our knowledge, this is a unique study from our region that describes the injury pattern, management, and outcome of TNI.

In our study 34 patients (35.8%) belonged to the 31–45 years age group, making it the most affected category. Gender distribution revealed a clear predominance of males, with 68 patients (71.6%), while females accounted for 27 patients (28.4%). This indicates that males were more than twice as frequently affected as females. Our findings consistent with earlier reports showing a high incidence of TNI among young males.[14,15]

Among the mechanisms of injury, road traffic accidents (RTA) were the most common, accounting for 42 patients (44.2%), followed by assault in 26 patients (27.4%), self-inflicted injuries in 15 patients (15.8%), and fall/other causes in 12 patients (12.6%). Akhtar and Awan [16] observed 15 cases of TNI; of which 33% sustained MVCs, 20% had GSW, 7% had machinery injury. However, Aich et al.[17] reported 67 cases; 48 (71.6%) had homicidal injury, 12 (17.91%) sustained injuries due to accidents, and 7(10.44%) cases were involved in the suicidal attempt. The authors reported political conflict and land dispute to be significantly associated with homicide. Whereas, MVC is the primary cause of accidental cut throat injuries caused either by broken glass or by the insertion of sharp projection of the vehicle after distortion.

In our study injury pattern analysis showed that soft tissue injuries were most frequent, seen in 51.6% patients. Aerodigestive injuries were present in 28.4% patients, while vascular injuries were identified in 20.0% patients. In a research conducted by Dar PM et al., laryngopharyngeal injury was present in 13.8%, tracheal injury in 28.5%, vascular injury in 13.8%, and esophageal injury in 4.6% of patients.[18] Larynx, thyroid gland, trachea, jugular veins, and carotid were the commonly injured structures in study conducted by Al-Thani H et al.[19]

Though, the incidence of neck injury is infrequent, proper management of TNI is crucial to avoid major complications. Operative management is indicated in patients with persistent signs of major injury such as active hemorrhage, hoarseness, stridor, respiratory distress.[20] Particularly, the appropriate selection of diagnostic approach for TNI cases remains controversial. Since, long-time management of TNI patients with platysma injury advocates mandate surgery. However, this concept has been changed in many trauma centers to support selective nonoperative management.[21] Present study showed that regarding management, 62.1% patients underwent surgical intervention, while 37.9% patients were managed conservatively. In terms of outcomes, 67.4% patients recovered, while 20% patients developed complications. Mortality was observed in 12.6% patients. The overall mortality of neck injuries ranges from 3% to 13%.[22] The mortality in the case series of Dar PM et al., is 6.9% which is comparable to the available literature.[18]

In our study it was found that the association between type of injury and outcome was found to be statistically significant, indicating that penetrating injuries are associated with poorer clinical outcomes. The management of the patient with penetrating neck trauma depends on the clinical presentation, hemodynamic stability, and the neck zone involved. Determining the zone of injury will help the evaluation of neck injuries and management strategies; however recent studies have proposed a no-zone approach to neck trauma and advised CT/CTA in all stable patients to decide whether exploration should be done or not, irrespective of the zone involved. Since the ligation of internal carotid arteries causes significant neurological deficit and death, repair should be attempted in all penetrating injuries unless the patient is unstable.[23-26]
The association between mechanism of injury and management/hospital stay was statistically significant, suggesting that road traffic accidents are associated with increased severity, higher surgical rates, and prolonged hospitalization. Aich et al.[17] reported lower injury severity in the majority (81%) of the TNI patients who were discharged from the hospital within 2 weeks of admission. Study conducted by Dar PM et al., found that the mean hospital stay was 4.5 days; however, the majority of the patients (41.5%) were discharged within 3 days. [18]

CONCLUSION

Traumatic neck injuries predominantly affect young and middle-aged males, with vehicular accidents as the principal cause. Blunt trauma occurred more frequently; nevertheless, penetrating injuries resulted in more severe results, including elevated rates of morbidity and mortality. In most instances, surgical intervention was required due to the severity of the injuries. The majority of patients achieved recovery; however, the elevated mortality rate underscores the perilous nature of these injuries. The duration of hospitalisation indicates that the healthcare system is experiencing significant strain. To enhance patient outcomes, early diagnosis, prompt airway and vascular management, and timely surgical intervention are crucial. To reduce the frequency and severity of accidents, it is essential to enhance preventative measures, particularly those that ensure road safety

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