BMC Emergency Medicine

RESEARCH

Open Access

Evaluation of stabbing assault injuries in a tertiary emergency department: a retrospective observational study

Nil Deniz Kartal Yeter[1*], Mehmet Ali Karaca[2], Ahmet Sefa Yeter[3], Elif Öztürk İnce[2] and Bülent Erbil[2]

Abstract

Background Approximately 458,000 victims were deceased from intentional violence in 2021. A stabbing assault causes 25% of homicides. The study aims to evaluate injury patterns, trauma scores, radiological findings, types of treatment, and outcomes of stab assault patients admitted to a tertiary emergency department (ED).

Methods This is a retrospective observational study of stabbing injury patients in the ED of Hacettepe University, Turkey. The sites and patterns of injury, radiological findings, treatment methods, consultations, and complications are acquired from the patient's files. Trauma scores and frequency of outcomes, such as the need for surgery, hospitalization, or mortality, were calculated for all patients.

Results Among the 648 patients, 564 (87%) were male. The median age was 28 (interquartile range [IQR]:13). The commonly injured body parts were the extremities (75%), thorax (21.9%), and abdomen (16.9%). The median RTS was 7,84 (IQR:0), and the median ISS was 2 (IQR:3). The fluid was detected in 13 of 88 patients by FAST, solid organ injuries in 21 patients, and gastric and intestinal injuries in 11 patients by abdominal CT. One hundred sixty-one patients underwent moderate and major surgery. Complications developed in 13 patients. 74,4% of the patients ($n=482$) were treated in ED and 21.8% ($n=141$) of patients were hospitalized in wards, 2.3% ($n=15$) in intensive care unit and 1.5% ($n=10$) patients died. GCS, RTS, and probability of survival (Ps) were significantly lower, and ISS was significantly higher in deceased patients and patients who needed erythrocyte replacement.

Conclusion The majority of stab wounds were detected in extremities, but severe and lethal stabbing injuries were on the thorax and abdomen. In thoracoabdominal stabbing injuries, x-rays and FAST can be ineffective in detecting critical and fatal injuries. Therefore, thoracic and abdominal CT should be planned early to detect possible causes of death and make a timely and accurate diagnosis. Lower GCS, RTS, and Ps or higher ISS scores were related to the need for erythrocyte replacement.

Keywords Penetrating trauma, Emergency department, Trauma scores, FAST, Stab wound

*Correspondence:
Nil Deniz Kartal Yeter
nildekarster@gmail.com
[1]Vocational School of Health Services, First and Emergency Aid Program, Hacettepe University, Ankara, Turkey
[2]Faculty of Medicine, Department of Emergency Medicine, Hacettepe University, Ankara, Turkey
[3]Emergency Service, Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital, Ankara, Turkey

Background

Trauma is the leading cause of death in healthy young adults aged 5–29 years. The most common factors that cause death are traffic accidents, falls from height, gunshot wounds, and penetrating or stab wounds [1]. In 2021 approximately 458,000 victims were deceased from intentional violence. A stabbing assault causes 25% of homicides [2].

Stab trauma by a sharp object (knives, arrows) is classified as a low-velocity wound, and damage is related to depth and angle of attack. The importance of penetrating injuries varies according to the body part, and findings of some penetrating injuries may be initially obscured. Many of these patients could spend the golden hours of trauma in the admission process. Therefore, early evaluation and intervention in patients with penetrating injuries are crucial. This study aimed to evaluate injury patterns of patients admitted to the emergency department with stab wounds, results of the imaging studies, treatment modalities, outcomes, trauma scores, mortality ratios, and complications.

Methods

Study type and design

This retrospective observational study was conducted as a 10-year survey on 648 patients with stabbing assault admitted to Hacettepe University Emergency Department (ED), Turkey. The hospital is in a city with approximately 5,5 million population and contains all radiological facilities and surgical specialties.

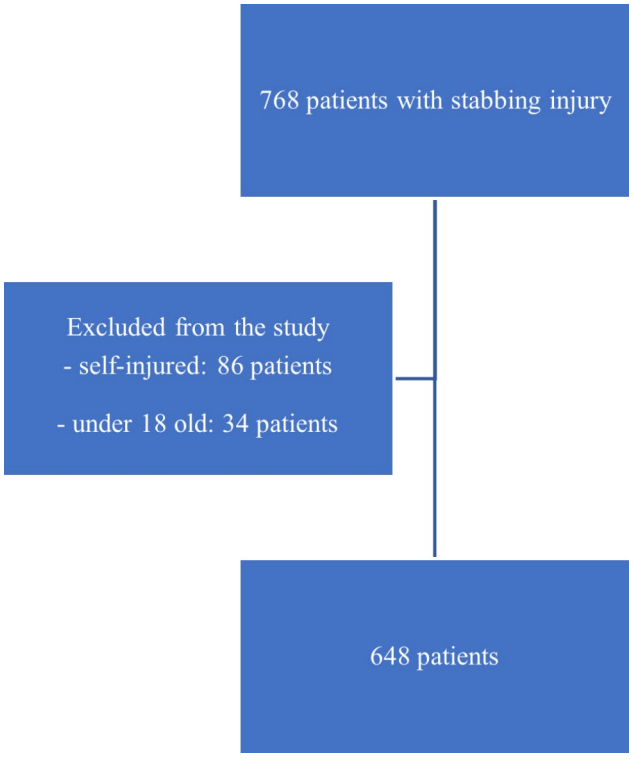

Fig. 1 Flow chart of the study

All patients with stabbing assault injuries admitted to ED were reviewed. The data were derived from patient files. Patients under 18 or self-injured were excluded from the study. Demographic features of the patients, the mechanism of injury, results of computed tomography and extended focused assessment with sonography for trauma (FAST), modality of treatment (surgical intervention/suturing/follow up), consultations, hospitalization ratio, length of stay, and complication rate in one month and type were evaluated from the patient's files. The Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), Injury Severity Score (ISS), and Probability of survival (Ps) derived from Trauma and Injury Severity Score (TRISS) were calculated for all patients.

Data analysis and ethical issue

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 21 for Windows, and $p<0.05$ was considered significant. The mean values were used, and an independent t-test was applied in normally distributed variants. Median and interquartile range (IQR) values were used, and the Mann-Whitney U test was applied in non-normally distributed variants. The relations of categorical variants were evaluated with a Chi-Square test.

Results

Seven hundred sixty-eight patients were examined for the study. Eighty-six patients with self-injury and 34 patients under 18 years old were excluded from the study. (Fig. 1) 564 (87%) of the 648 patients in the study were male. The median age was 28 (IQR:13) years. The most common mechanism was stabbing injuries with a knife ($n=348$, 54%). When the injuries were ranked according to their location in the body, the most common injuries were detected in the upper extremities ($n=301$, 46.5%), while the remaining injuries were in the lower extremities ($n=185$, 28.5%), thorax ($n=142$, 21,9%), head and neck ($n=107$, 16,5%) and abdomen ($n=106$, 16,9%) and genital area ($n=3$, 0.5%). On admission, hypotension in 57 (8.8%) patients and tachycardia in 168 (26%) patients were detected. (Table 1) Four patients were hypotensive and tachycardic on admission, systolic/diastolic blood pressures could not be measured in 16 patients, and seven patients had cardiac arrest on admission. The median GCS score was 15 (IQR:0). The Glasgow Coma Scale score was lower than 13 in 14 (2.3%) patients. The median RTS was 7.84 (IQR:0). The median ISS was 2(IQR:3). The median Ps was 99.4% (IQR:0.28).

FAST was performed on 88 patients, and fluid was detected in 13. The fluid was detected mostly in the perihepatic region ($n=6$). Other areas in which the fluid was

Table 1 Characteristics of patients

	n **(%)**
Male sex	564 (87)
Injury Site*	
Head and neck	107 (16.5)
Thorax	142 (21.9)
Abdomen	106 (16.9)
Upper extremity	301 (46.5)
Lower extremity	185 (28.5)
Genital area	3 (0.5)
Hypotension on admission	57 (8.8)
Tachycardia on admission	168 (26)
FAST performed	88 (13.6)
Needed ER	48 (7.4)
Outcomes	
ED-discharge	482 (74.4)
Ward-discharge	141 (21.8)
ICU-discharge	15 (2.3)
Deceased	10 (1.5)

*: some patients had concomitant areas of trauma, ER: erythrocyte replacement, ED: emergency department, ICU: intensive care unit

detected were the pelvis ($n=5$), perisplenic region ($n=5$), hemithorax ($n=4$), pericardium ($n=3$), and perirenal region ($n=1$). Abdominal computed tomography (CT) was performed in 77 patients. Intra-abdominal solid organ injury in 17 and bowel injury in 10 patients were seen. Abdominal CT was superior to FAST in detecting intra-abdominal injury ($p<0.001$). Thorax CT was performed in 58 patients, and pneumothorax, hemothorax, and lung or pericardium injuries were detected in 30 of them. Cranial CT was performed in 24 patients, and significant intracranial injuries were detected in 3 patients. Maxillo-facial CT was performed on four patients, and no pathological finding was found except soft tissue injury. Cervical CT was performed in 8 patients, and cervical vertebra injuries were detected in 3. Extremity CT angiography was performed in 7 patients, and vascular injuries were seen in 3. The findings of the diagnostic imaging are summarized in Table 2.

Patients were mainly consulted for plastic surgery (32.9%), thoracic-cardiovascular surgery (21.8%), general surgery (18.8%), and orthopedics (6.6%), respectively. One hundred sixty-one patients (24.8%) underwent surgical treatment, local wound care and suturing were performed in 114 (17.6%) by the consulted department, and tube thoracostomy was performed in 29 (4.5%) patients. The consulted departments and the procedures are summarized in Table 3.

Among the 648 patients in the study, blood transfusions were performed in 48 (7.4%) of them. In patients who needed erythrocyte replacement, ISS and RTS were significantly higher ($p<0.01$), and Ps and GCS were found to be significantly lower ($p<0.01$).

482 (74.4%) patients were treated and discharged from ED. 141 (21.8%) patients were hospitalized and discharged from various in-patient wards, 15 (2.3%) patients were hospitalized in the intensive care unit (ICU), and 10 (1.5%) patients died in ED. The average length of stay in the hospital was 30 h. The average lengths of stay in the ED, in-patient wards, and the ICU were 7 h, 133 h, and 81 h, respectively.

Of the patients that died, four patients had isolated severe thoracic injuries, two patients had thoracic injuries

Table 2 Injury area and imaging studies

Injury site	**FAST-CT/CTA numbers**	**FAST findings (*n*) *n* = 88**	**CT/CTA findings (*n*) *n* = 174**
Head and neck	0 vs. 32	n/a	Cranial fracture and pneumocephalus (1) Cranial fracture and intracranial bleeding (2) Soft tissue injury (8) Cervical vertebra fracture (3) Normal findings (18)
Thorax	88 vs. 58	Pleural fluid (5) Pericardial fluid (3) Normal (80)	Hemopneumothorax (15) Isolated pneumothorax (8) Isolated hemothorax (5) Hemopericardium (1) Hemopneumothorax with hemopericardium (1) Soft tissue injury (13) Normal findings (15)
Abdomen	88 vs. 77	Fluid (13) Soft tissue injury (8) Liver injury (4) Splenic injury (1) Renal injury (3) Normal (59)	Skin and subcutaneous injury (28) Solid organ injury (17) Bowel injury (10) Solid organ and bowel injury (1) Diaphragmatic injury (3) Normal findings (18)
Extremities	0 vs. 7	n/a	Vascular injury (3) Soft tissue injury (2) Normal findings (2)

FAST: Focused assessment with sonography for trauma, CT: computerized tomography, CTA: Computerized tomography angiography

Table 3 Consulted departments and interventions

Department	*n** (%)	Conservative follow-up	Surgery	Dressing/suturing
Plastic & Reconstructive Surgery	213 (32.9)	19	99	95
Thoracic-Cardiovascular Surgery	141 (21.8)	98	46**	7
General Surgery	122 (18.8)	90	31	1
Orthopedic	43 (6.6)	28	7	8
Ear-Nose-Throat	14 (2.2)	8	4	2
Brain Surgery	13 (2.0)	13	0	0
Urology	12 (1.9)	8	3	1
Gynecology	1 (0.2)	1	0	0

*n=648, some patients were consulted by more than one department, **: including tube thoracostomy

Table 4 Outcome and trauma scores

Outcome	*n*	%	GCS Median (IQR)	ISS Median (IQR)	RTS Median (IQR)	Ps Median (IQR)
ED-discharge	482	74.4	15 (0)	1 (3)	7.84 (0)	99.4(0.1)
Ward-discharge	141	21.8	15 (0)	9(7)	7.84 (0)	99.1(0.9)
ICU-discharge	15	2.3	15 (0)	4(11)	7.84(1.47)	99.3(3.8)
Deceased	10	1.5	3(7.25)	22.5(11.5)	0 (5.15)	2.7(49.43)
Total	648	100	15(0)	2(3)	7.84(0)	99.4(0.28)

GCS: Glasgow Coma Scale; RTS: Revised Trauma Score; ISS: Injury Severity Score; Ps: probability of survival rate IQR: interquartile range. ED: Emergency Department; ICU: Intensive Care Unit

with abdominal injuries, one patient had thoracic injuries with the abdomen and head&neck injuries, one patient had thoracic injuries with lower extremity injuries, one patient had thoracic injuries with upper- extremity injuries, and one patient had lower extremity injuries (femoral artery laceration). Seven patients were brought to the ED in cardiopulmonary arrest. Thoracotomy could not be applied to these seven patients. The patients' outcomes and trauma scores are summarized in Table 4.

Complications, such as replantation failure, microcirculation disorder, motor dysfunction, wound infection, suture reaction, suture opening, and Richter hernia, developed in 13 (2%) patients. The most frequent complication was peripheral nervous system injury (motor dysfunction) seen in 4 patients.

Discussion

Trauma is one of the leading causes of death between the ages of 5 and 29 [1]. Penetrating trauma cases is increasing nowadays in parallel with the increase in violence [3]. Injuries due to sharp tools constitute a significant majority of patients in emergency services, which may cause serious health problems in society. Our study aims to examine the results of stab injuries, trauma scores, treatment, and outcomes.

Penetrating injuries are more common in men and young-middle age groups, up to 90% [4–7]. As in other studies in the literature, the majority of the cases (87%) in our study were male patients, and the median age was 28 years for males and 27 years for females. Regarding injury sites, the extremities are most frequently affected in stab injuries, while the thorax, abdomen, and head and neck regions are less frequently affected, respectively [6, 7]. Similarly, our study found the extremities to be the most common injury site. This was followed by thorax, abdomen, and head and neck injuries.

Even though mortality increases with higher scores of ISS, as proposed in 1974, the predictive value of ISS for blood transfusion requirements remained unclear [8]. In many studies, there has been a correlation between ISS and blood transfusion [9–11]. As the ISS increases, the need for blood transfusion will also increase [12]. Furthermore, Komori et al. and Reppucci et al. said a decrease in GCS will increase the need for blood transfusion in childhood trauma [13, 14]. Like in the other trauma scoring system, as RTS decreases, blood transfusion rates, even massive transfusion protocol, increase

[15]. In our study, while ISS values were significantly higher, Ps, RTS, and GCS values were significantly lower in patients undergoing blood transfusion. Although all trauma scoring systems have a good mortality predictive value, Ps -as TRISS in original research- was selected as the most efficient scale for predicting mortality [16, 17]. Parallel to the literature, Ps and RTS were lower in deceased patients in our study.

FAST ultrasonography is a quick, cost-effective imaging method used in trauma patients [18]. The sensitivity and specificity of FAST ultrasonography are quite high [19, 20]. Similar to the study of Smith et al., our study found that the number of patients who underwent FAST increased significantly in the last 3–4 years [20]. This shows that FAST imaging is performed more frequently by emergency physicians. FAST ultrasonography, performed after a primary survey and combined with physical examination, provides an opportunity for early diagnosis in patients without vital sign changes. A positive finding is useful. However, it is inadequate to exclude all significant injuries, and in a stable patient, more definitive imaging may be appropriate before deciding on intervention.

CT is a practical and required method for evaluating stabbing injuries [21]. CT imaging is one of the most critical facilities for managing trauma patients. The short processing time and ability to provide clear and high-quality images are among the most important advantages of CT imaging. In some examinations, high radiation dosage and opaque substances can be considered disadvantages of CT imaging. In our study, soft tissue injury, cranial fracture, intracranial bleeding, and pneumocephalus were the most common findings in brain CT of the patients. The neck region contains vital structures such as major vessels, the spinal canal, and the trachea, so stabbing trauma in the neck requires careful examination. Therefore, CT angiography is often preferred in penetrating neck injuries and is used as an initial diagnostic method for carotid arterial injuries [22]. In the present study, the most common findings in cervical CT were soft tissue injuries and cervical fractures. Thoracic CT provides detailed information about lung, heart, major vascular structures, and diaphragm injuries in penetrating thoracic injuries. Hemothorax, pneumothorax, and rib fractures are the main pathologies detected in many patients who underwent thoracic CT, as in the study [23]. Although FAST provides rapid data on intra-abdominal injuries in stabbing injuries, it is insufficient to detect retroperitoneal, luminal organ, and diaphragm injuries [24]. Therefore, abdominal CT requests should be planned early in cases with stabbing injuries to the abdomen. Using extremity CTs in stabbing traumas provides a great advantage, especially in detecting vascular injuries. Extremity CT is a non-invasive imaging method with high sensitivity and rapid application in detecting vascular injuries [25–27]. In our study, vascular injury was observed in 3 of 7 patients with extremity injuries by extremity CT.

Treatment of stab wounds may differ depending on the trauma's location, size, and severity. However, most patients are discharged with primary suturing [7, 28]. In our study, in parallel with the literature, the majority of the patients were treated with simple treatments such as primary suturing and dressing, including suturing by consulted departments in the emergency room.

Surgery is frequently applied to patients admitted to the emergency department with stab wounds. Surgery is needed for diagnostic or therapeutic purposes, especially in trunk and neck injuries [4, 7, 29]. In our study, 25% of the patients required surgery. The most common surgical procedures were performed by Plastic and Reconstructive Surgery, General Surgery, and Thoracic Surgery, respectively.

The most common complications in stab injuries after discharge are wound infections, followed by other potentially fatal complications [30]. In the present study, complications developed in 13 patients. Examination of the outcome of the patients shows that the majority of patients with penetrating trauma are discharged after their treatment in the emergency department as in the other studies [31], and the mortality rate due to penetrating stab injury is less than 10% in most studies [4, 6]. In our study, while most patients were discharged from the emergency department, the mortality rate associated with penetrating stab injury was 1.5%. Most of the deceased patients were brought to the emergency department for cardiac arrest.

Limitations

Since this study was planned as a retrospective study in a single center, the data are limited to patient records. Complications might be overlooked in the period after discharge. The population size could be more significant.

Conclusion

In our study, the majority of stab wounds were detected in extremities, but severe and lethal stabbing injuries were on the thorax and abdomen. In thoracoabdominal stabbing injuries, x-rays and FAST can be ineffective in detecting critical and fatal injuries. Therefore, although patients are hemodynamically stable, thoracic and abdominal CT should be planned early to detect possible causes of death and make a timely and accurate diagnosis. Lower GCS, RTS, and Ps or higher ISS scores were related to the need for erythrocyte replacement.

Abbreviations

GCS Glasgow Coma Scale
RTS Revised Trauma Score

ISS	Injury Severity Score
TRISS	Trauma and Injury Severity Score
SPSS	Statistical Package for Social Sciences
FAST	Focused Assessment with Sonography for Trauma
CT	Computed Tomography
ED	emergency department
ICU	intensive care unit
Ps	Probability of survival

Acknowledgements
Not Applicable.

Author contributions
NDKY and MAK have set up the main idea and hypothesis of the study. NDKY and MAK developed the theory and organized the material and method section. EOİ and BE evaluated the data given in the conclusion. NDYK and ASY wrote the discussion part of the article, after MAK reviewed it, made necessary regulations, and approved it. All authors discussed the entire study and approved the final version of the manuscript.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability
The datasets generated and/or analysed during the current study are not publicly available due the patients' files were derived from archives of Hacettepe University but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethics Committee approval was obtained before the study to derivate the patient files from the Ethics Committee of Hacettepe University. (GO 141 49 – 45). The need for consent to participate was also waived by the ethics committee.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

Received: 11 July 2024 / Accepted: 26 August 2024
Published online: 16 September 2024

References

1. Preventing injuries and violence: an overview: World Health Organization. 2021. https://www.who.int/publications/i/item/9789240047136
2. United Nations Office on Drugs and Crime. Global Study on Homicide 2023. 2023. Available from: https://www.unodc.org/documents/data-and-analysis/gsh/2023/GSH23_ExSum.pdf
3. Ateşçelik M. Acil Servise Penetran Travma Ile Başvuran Hastaların İncelenmesi. Konuralp Med J. 2014;6(1):40–6.
4. Bieler D, Kollig E, Hackenberg L, Rathjen J-H, Lefering R, Franke A. Penetrating injuries in Germany–epidemiology, management and outcome an analysis based on the TraumaRegister DGU®. Scand J Trauma Resusc Emerg Med. 2021;29(1):1–14.
5. Ajayi B, Guthrie H, Trompeter A, Tennent D, Lui DF. The rising burden of penetrating knife injuries. Inj Prev. 2021;27(5):467–71.
6. Pallett J, Sutherland E, Glucksman E, Tunnicliff M, Keep J. A cross-sectional study of knife injuries at a London major trauma centre. Annals Royal Coll Surg Engl. 2014;96(1):23–6.
7. Kharytaniuk N, Bass G, Salih A, Twyford M, O'Conor E, Collins N, et al. Penetrating stab injuries at a single urban unit: are we missing the point? Ir J Med Sci (1971-). 2015;184(2):449–55.
8. Rotondo M, Fildes J, Brasel K, Kortbeek J, Al Turki S, Atkinson J. ATLS Advanced Trauma Life support for doctors—student Course Manual. Chicago, IL: American College of Surgeons; 2012.
9. Krstić S, Alempijević T, Popović N, Jovanović D, Mihailović V, Šijački A. Nadoknada krvi kod teško povređenih bolesnika. Acta Chir Iugosl. 2010;57(1):107–13.
10. Morrison JJ, Dubose JJ, Rasmussen TE, Midwinter MJ. Military application of tranexamic acid in trauma emergency resuscitation (MATTERs) study. Arch Surg. 2012;147(2):113–9.
11. Eksert S, Ünlü A, Aydın FN, Kaya M, Aşık MB, Kantemir A, et al. Analysis of anatomical localization and severity of injury in patients with blood transfusion in urban terrain hospital. Ulus Travma Acil Cerrahi Derg. 2020;26(6):937–42.
12. Kotwal RS, Scott LL, Janak JC, Tarpey BW, Howard JT, Mazuchowski EL, et al. The effect of prehospital transport time, injury severity, and blood transfusion on survival of US military casualties in Iraq. J Trauma Acute Care Surg. 2018;85(1S):S112–21.
13. Komori A, Iriyama H, Aoki M, Deshpande GA, Saitoh D, Naito T, et al. Assessment of blood consumption score for pediatrics predicts transfusion requirements for children with trauma. Medicine. 2021;100(9):e25014.
14. Reppucci ML, Pickett K, Stevens J, Nolan MM, Moulton SL. Outcomes in pediatric trauma patients who receive blood transfusion. J Surg Res. 2023;282:232–8.
15. Yang S, Mackenzie CF, Rock P, Lin C, Floccare D, Scalea T, et al. Comparison of massive and emergency transfusion prediction scoring systems after trauma with a new bleeding risk index score applied in-flight. J Trauma Acute Care Surg. 2021;90(2):268–73.
16. Yadollahi M, Kashkooe A, Rezaiee R, Jamali K, Niakan MH. A comparative study of injury severity scales as predictors of mortality in trauma patients: which scale is the best? Bull Emerg Trauma. 2020;8(1):27.
17. Jojczuk M, Nogalski A, Krakowski P, Prystupa A. Mortality prediction by 'Life threat index'compared to widely used trauma scoring systems. Ann Agric Environ Med. 2022;29(2):258–63.
18. Sheng AY, Dalziel P, Liteplo AS, Fagenholz P, Noble VE. Focused assessment with sonography in trauma and abdominal computed tomography utilization in adult trauma patients: trends over the last decade. Emergency medicine international. 2013;2013.
19. Maurer M, Winkler A, Wichlas F, Powerski M, Elgeti F, Huppertz A, et al. Costs and role of ultrasound follow-up of polytrauma patients after initial computed tomography. Rofo: Fortschr auf dem Gebiete Der Rontgenstrahlen Und Der Nuklearmedizin. 2011;184(1):53–8.
20. Smith ZA, Wood D. Emergency focussed assessment with sonography in trauma (FAST) and haemodynamic stability. Emerg Med J. 2014;31(4):273–7.
21. Subcommittee A, Group IAW. Advanced trauma life support (ATLS®): the ninth edition. J Trauma Acute care Surg. 2013;74(5):1363–6.
22. Wang G, Li C, Piao J, Xu B, Yu J. Endovascular treatment of blunt injury of the extracranial internal carotid artery: the prospect and dilemma. Int J Med Sci. 2021;18(4):944.
23. Arvind M, Yahya Z, Ibrahim R, Hussein H. Computed tomography of the thorax with 3D reconstruction in penetrating chest injury. Med J Malaysia. 2017;72(1):75.
24. Federle M, Goldberg H, Kaiser J, Moss A, Jeffrey R. Evaluation of Abdominal Trauma by Computed Tomography. 50 Landmark papers every Trauma Surgeon should know. CRC; 2019. pp. 85–8.
25. Gakhal MS, Sartip KA. CT angiography signs of lower extremity vascular trauma. Am J Roentgenol. 2009;193(1):W49–57.
26. Wallin D, Yaghoubian A, Rosing D, Walot I, Chauvapun J, de Virgilio C. Computed tomographic angiography as the primary diagnostic modality in penetrating lower extremity vascular injuries: a level I trauma experience. Ann Vasc Surg. 2011;25(5):620–3.
27. Kelly SP, Rambau G, Tennent DJ, Osborn PM. The role of CT angiography in evaluating lower extremity trauma: 157 patient case series at a military treatment facility. Mil Med. 2019;184(9–10):e490–3.
28. Schreyer N, Carron P-N, Demartines N. Stab wounds in a Swiss emergency department: a series of 80 consecutive cases. Swiss Med Wkly. 2010(33).
29. Cocco AM, Bhagvan S, Bouffler C, Hsu J. Diagnostic laparoscopy in penetrating abdominal trauma. ANZ J Surg. 2019;89(4):353–6.
30. Jacob AO, Boseto F, Ollapallil J. Epidemic of stab injuries: an Alice Springs dilemma. ANZ J Surg. 2007;77(8):621–5.

31. Orhon R, Eren Ş, Karadayi Ş, Korkmaz İ, Coşkun A, Eren M, et al. Comparison of trauma scores for predicting mortality and morbidity on trauma patients. Ulusal Travma VE Acil Cerrahi Dergisi-Turkish J Trauma Emerg Surg. 2014;20(4).

Publisher's note