Prognostic factors of assault-induced stab wounds in the emergency department

Safia OTHMANI, Sarra JOUINI, Asma MELLOULI, Houyem ZOUARI, Mouna JEMAI, Hana HEDHLI

Emergency Department, Charles Nicolle University Hospital, Tunis; Tunisia
Corresponding author: *Safia OTHMANI; address: Emergency Department, Charles Nicolle University Hospital, Tunis; Tunisia;* ***email:*** *safia.othmani@gmail.com*

Abstract

Background: Stab wounds (SWs) represent one of the major components of trauma, especially in the emergency department (ED), and can have dreadful outcomes.
Aim: Our study aimed to assess the different epidemiological, clinical, and therapeutic features of SWs in the ED as well as prognostic factors determining short-term evolution (STE).
Method: A descriptive, cross-sectional single-center study was conducted in a polyvalent ED room of the Charles Nicolle hospital of Tunis, including patients presenting for assault-induced over ten months. Unfavorable STE was defined by: oxygen therapy needs, fluid expansion, catecholamine and/or tranexamic acid use, transfusion, thoracic drainage, intubation, and urgent surgery.
The statistical analysis concerned the study population (SP) subgroups who have penetrating stab wounds (PSWs) or superficial stab wounds (SSWs). The risk factors search of STE was carried out by a univariate analysis, binary logistic regression with Receiver Operating Characteristics curves (ROC) analysis.
Results: We included 130 patients, with male predominance and a sex ratio of 15. The median age was 30. The majority (90.8%) had no pathological medical history. Forty percent of the injuries were located on the torso (n=52). Initial clinical assessment showed that most of the patients were hemodynamically stable— Four patients (3.1%) had systolic blood pressure (SBP) ≤90mmHg and eight patients (6.2%) d a mean arterial blood pressure (MAP) <65mmHg. Seven patients (5.4%) were hypoxemic. Univariate analysis showed that respiratory rate (RR), and blood pressure (BP) were significantly associated with unfavorable STE. Receiving operating curve (ROC) analysis concluded a high discriminating ability for RR and BP. Logistic regression analysis showed that RR≥19cpm and SBP≤105 mmHg are independent risk factors with respective AORs of 8.64 and 14.29 IC.
Conclusion: Unfavorable STE can be predicted through clinical parameters such as RR≥19cpm and/or SBP≤105 mmHg in PSWs' victims.

Keywords: Trauma, Stab wounds, Blood pressure, Respiratory rate, Prognostic.

INTRODUCTION

Trauma has become a growing epidemic over the years, one of the major causes of presentation at the emergency department (ED) that medical physicians have to encounter daily (1). This incessantly growing phenomenon responsible for an increasing number of deaths throughout the years, causing an estimated five million deaths all over the world, which is almost equal to the number of deaths caused by HIV, malaria, and tuberculosis three combined (1). Blunt trauma occurring during road traffic accidents is the predominant cause of death (23%). However, penetrating trauma whether by gunshots or by stab wounds shots (SWs) has a major impact on the healthcare system in so many regions of the globe (2,3). SWs in particular are mostly most prevalent in most countries, the United States and Australia (2,4).

SWs are defined as sharp force injuries and happen when a sharp-edged or pointed object comes into contact with the skin and whether or not the underlying tissues (5). SWs can be penetrating or perforating. Penetrating stab wounds (PSWs) refer to an injury occurring when the weapon goes through the body cavity or attend muscles depending on location (6). The circumstances during which SWs occur, are by order of frequency, homicidal, suicidal, or accidental (5,7). Studies agree that thoracic and abdominal injuries are the most predominant sites (1,8). However, other studies agree that upper extremities injuries are to be more frequent (1,8,9). PSW can have dreadful consequences when located in the thoracic and abdominal area, causing shock, infection, and more dramatically death (2). A study conducted at Howard University Hospital has counted 11% of deaths caused SWs (10). To avoid such a high risk of mortality, rapid management of SWs must be ensured (9). This study aimed to assess the different epidemiological, and clinical features of SWs in the ED as well as prognostic factors determining short-term evolution (STE).

METHODS

This is a cross-sectional single-center study conducted in the polyvalent ED room**.** Patients presenting to the ED for assault-induced SWs for ten months, from March to December 2020, were enrolled. The inclusion criteria were: patients of both male and female genders, who are aged 14 years or more, patients must have at least one assault-induced SWs, and weapons used to inflict the injury can be stabbing or thrusting tools (knives, daggers, screwdrivers …). The non-inclusion criteria were: gunshot injuries, road accidents, and self-inflicted injuries. As for the exclusion criteria, they were: patients who left the ED without medical notice or who signed their release against medical advice before initial management, and patients who are already dead before they arrive at the ED.

The patients recruited in this study were identified during their presentation to the ED. They all went through the triage process and were all admitted to the ED. Clinical information was gathered using a well-established data sheet filled with information about each patient. This data sheet included the patient medical file's number, age, and gender, as well as anamnestic

data, physical examination data, laboratory blood tests, medical imaging results, as well as the prescribed treatments.

The STE is a composite variable that included seven items: oxygen therapy, volume expansion, noradrenaline use, transfusion, insertion of chest tube, intubation, and urgent surgery. If the patient presented one of these items, he would be considered as having an unfavorable STE.

Statistical analysis

All data were recorded and analyzed using SPSS 22.0. The threshold for statistical significance 'p' was determined to be at least 0.05. The descriptive study analysis concerned the study population (SP) and the subgroups of patients who have penetrating stab wounds (PSWs) and those who have superficial stab wounds (SSWs).

- The risk factors of the STE search were carried out by univariate analysis (Odds ratio, 95% *confidence interval (CI)*. Binary logistic regression was performed to analyze the association between risk factors and STE. The threshold of the quantitative variable was established by the Receiver Operating Characteristics curves (ROC).

RESULTS

We enrolled 130 patients admitted to the ED from March until December 2020 for having an assault-induced SW. Among these patients, 30 patients had penetrated SWs, and 100 had superficial SWs. Our study population included 122 males and 8 females. The gender ratio was equal to 15.25. The median age was at 30 years, ranging from 15 to 66 years, with respective 25th and 75th percentiles of 24 and 37 years.

Table 1. Demographic and clinical characteristics of the study population.

	PSW	SSW	SP
	N(%)	N(%)	N(%)
Gender			
Male	28(21.5)	94(72.3)	128(93.8)
Female	2(1.5)	6(4.6)	8(6.1)
SES medium	23(17.7)	75(57.7)	98(75.4)
Habits			
Smoking	26(20)	77(59.2)	103(79.2)
Alcohol consumption	15(11.5)	45(34.6)	60(46.1)
Drug use	7(5.3)	13(10)	20(15.3)
Past medical history			
Psychiatric disorders	2(1.5)	5(3.8)	7(5.3)
Renal failure	0(0)	0(0)	0(0)
Hepatic failure	0(0)	2(1.5)	2(1.5)
Chronic anemia	1(0.7)	2(1.5)	3(2.3)
No pathological history	27(20.8)	91(70)	118(90.8)
Site of wounds			
Scalp	0(0)	22(16.9)	22(16.9)
Face	0(0)	23(17.7)	23(17.7)
Neck	2(1.5)	3(2.3)	5(3.8)
Chest	25(19.2)	57(43.8)	82(63)
Pelvis	1(0.7)	1(0.7)	2(1.5)
Extremities	5(3.8)	33(25.4)	38(29.2)

Ninety-eight patients (75.4%) had a medium SES (n=98), and 30 patients (23.1%) had a good SES (n=30). A hundred and three patients (79.2%) were smokers, 60 patients (46.2%) were alcohol consumers, and 20 patients (15.4%) were drug users.

Twenty-seven patients (20.8%) were admitted on a Sunday and 23 patients (17.7%) on a Monday. Thirty-one SWs occurred during June (23.9%), and 66 (50.8%) during the night. Stab wounds occurred in 64.6% of the cases (n=84) at home or nearby, and in the rest of the cases, on the streets. Weapons used to inflict the injury were cutting and thrusting tools: knives (n=108,) sabers (n=8), and daggers (n=23), in all of the cases, except one patient who was stabbed by a screwdriver. Forty

percent of the injuries were located on the torso (n=52). The rest of the locations are by order of frequency: the extremities (n=38, 29.2%), the face (n=23, 17.7%), the scalp (n=22, 16.9%), and the pelvic (n=2, 1.5%). As for wounds that were located on the torso, they are consecutively and by order of frequency abdominal (20%), thoracic (12.3%), and thoracoabdominal (11.5%). One hundred and eight patients presented with only one SW (83.1%). (Table 1)

The mean RR was at 19±3cpm ranging from 16cpm to 28cpm. Seven patients (5.4%) were hypoxemic, three patients (2.3%) had signs of respiratory distress, and six patients had subcutaneous emphysema. The mean SBP was 121±17 mmHg. Four patients (3.1%) had a SanP≤90mmHg and eight patients (6.15%) had a SBP<65mmHg. Thirty-two patients (24.6%) had a HR>90 bpm on the initial physical examination. Two patients (1.5%) had an altered neurological status. Thirty-eight patients (29.2%) had SW located on the extremities. Among these patients, five had PSW (13.2%) of the extremities, and three among these five patients presented signs of acute limb ischemia. Fifty-three patients (40.8%) performed a chest x-ray (CXR). Two CXRs (1.5%) revealed a pneumothorax.

initiated. This patient was hemodynamically unstable due to an SW located on the cardiac box. This E-FAST revealed a hemothorax as well as a heart wound complicated by a hemopericardium. Among the 79 patients (60.8%) who were admitted to the RR, 58 underwent CT scans (44.6%) independently of the location. forty-four

Table 2. Imaging examination findings.

Imaging exploration	PSW n(%)	SSW n(%)	SP n(%)
Thoraco-abdominal CT scan			
Performed	23(17.7)	35(26.9)	58(44.6)
Normal	22(16.9)	22(16.9)	44(33.8)
Chest CT Scan			
Normal	5(3.8)	22(16.9)	27(20.7)
Hemothorax	2(1.5)	0(0.0)	2(1.5)
Pneumothorax	5(3.8)	0(0.0)	5(1.5)
Hemopneumothorax	2(1.5)	0(0.0)	2(125)
Pneumomediastinum	1(0.7)	0(0.0)	1(0.7)
Rib fracture	1(0.7)	0(0.0)	1(0.7)
Abdominal CT scan			
Normal	4(3.1)	18(13.8)	22(16.9)
Kidneys	2(1.5)	0(0.0)	2(1.5)
Liver	5(3.8)	0(0.0)	5(3.8)
Diaphragm	1(0.7)	0(0.0)	1(0.7)
Hemoperitoneum	5(3.8)	0(0.0)	5(3.8)
Emphysema	8(6.1)	4(3.1)	12(9.2)
Active bleeding	1(0.7)	0(0.0)	1(0.7)
Pelvic CT scan			
Normal	8(6.1)	22(16.9)	30(23.1)
Scrotal hematoma	1(0.7)	0(0.0)	1(0.7)
Brain CT scan			
Total	1(0.7)	13(10.0)	14(107)
Normal	1(0.7)	12(9.2)	13(10.0)
Extradural hematoma	0(0.0)	0(0.0)	0(0.0)
Acute subdural hematoma	0(0.0)	1(0.7)	1(0.7)
Normal cervical CT scan	1(0.7)	0(0.0)	1(0.7)
Chest X-ray			
Not performed	8(6.1)	26(20.0)	34(26.1)
Performed Normal	17(13.1)	34(26.1)	51(39.2)
Hemopneumothorax	2(1.5)	0(0.0)	2(1.5)
E-FAST	1(0.7)	0(0.0)	1(0.7)

***PSW**: Penetrating stab injuries, **SSW**: Superficial stab injuries, **SP**: Study population, **CT**: computed tomography.*

A bedside E-FAST was performed on one patient (0.8%) while a hemodynamic resuscitation was

CT scans were thoracoabdominal and/or pelvic and 14 were cerebral. Among the 58 performed, 23 CT scans (39.7%) showed abnormalities.

Thirty-eight injuries (29.2%) were located on the upper and/or lower limbs. Among these injuries, five were considered penetrating, and in which three had hard signs of vascular injury and underwent surgery, and two had soft signs and were performed an ACT. (Table 2)

To evaluate STE, and since in our population there was zero number of deaths in the ED, we created a composite variable indicating whether or not the patient received immediate life-saving therapeutic measures. Seventeen patients (13.1%) were considered as having unfavorable STE in the ED.

Gender and SES were not associated with an unfavorable STE. However, alcohol consumption and drug use were significantly associated with unfavorable STE with respectively crude OR of 3.25 and 3.85.

Unfavorable STE was significantly associated with RR, HR, and BP. The respiratory rate was significantly higher among patients who had unfavorable STE compared to those who had favorable STE (p<0.001). (Table 3)

The ROC curve analysis showed an AUC of 0.813, CI 95% [0.699-0.927], indicating a high discrimination ability based on RR (Figure 1).

The optimal cut-off value as an indicator of an unfavorable STE was at 19 CPM, with a sensibility of 82% and a specificity of 69%, p<0.001. Systolic blood pressure was significantly lower among patients who had unfavorable STE compared to those who had favorable STE (p<0.001). ROC curve analysis showed an AUC of 0.738, 95% CI [0.585–0.891] (figure 2).

Table 3. Univariate analysis of factors predicting unfavorable short-term evolution.

	Unfavorable STE	N	Mean	SD	p
Age (year)	No	113	31	10	0.43
	Yes	17	29	7	
Length of the wound (cm)	No	113	3.8	2.9	0.71
	Yes	17	4.1	3	
RR (CPM)	No	113	18	1	$<10^{-3}$
	Yes	17	20	2	
HR (bpm)	No	113	86	13	0.04
	Yes	17	94	21	
SBP (mmHg)	No	113	123	14	$<10^{-3}$
	Yes	17	104	23	
DBP (mmHg)	No	113	68	12	0.035
	Yes	17	61	15	
MAP (mmHg)	No	113	87	11	0.001
	Yes	17	76	17	
SI	No	113	0.71	0.13	$<10^{-3}$
	Yes	17	0.95	0.4	
Age SI	No	113	22.19	7.3	0.004
	Yes	17	28.95	15.6	
Modified SI	No	113	1.01	0.2	$<10^{-3}$
	Yes	17	1.30	0.4	
Lactate (mmol/l)	No	64	2.6	1.5	0.002
	Yes	16	4.2	2.9	
Hemoglobin (g/dl)	No	64	13.9	1.2	$<10^{-3}$
	Yes	16	12.3	2.2	
MGAP score	No	113	23.73	1.32	0.19
	Yes	17	22.58	3.10	
RTS score	No	113	7.84	0.00	$<10^{-3}$
	Yes	17	7.32	1.31	

STE: short-term evolution, RR: respiratory rate, HR: heart rate, SBP: systolic blood pressure, MAP: mean arterial pressure, SI: shock index

The optimal cut-off value of SBP as an indicator of an unfavorable STE was at 105mmHg, with a sensibility of 93% and a specificity of 53%, p=0.002.

After logistic regression, we determined two risk factors associated with unfavorable STE.

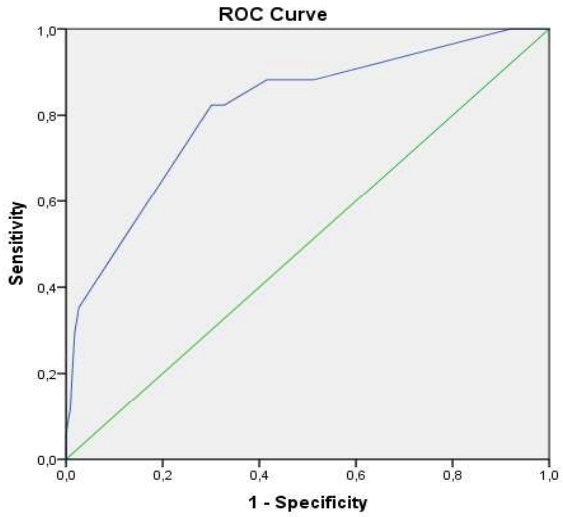

Figure 1. Receiving operating characteristics (ROC) curve for predicting short-term evolution based on respiratory rate

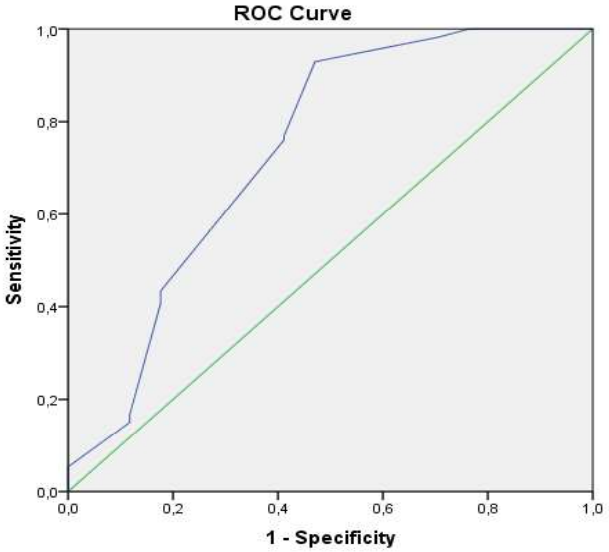

Figure 2. Receiving operating characteristics (ROC) curve for predicting short-term evolution based on SBP.

The first one was RR≥19cpm with p=0.018, OR=8.64, and the second one was SBP≤105mmHg, p<0.001, OR= 12.29.

DISCUSSION

Our results show male predominance with a gender ratio of 15.25. Patients were young, mostly in their twenties (n=54, 41.5%), and the median age was 30 years old. These results are in line with findings in the literature. In a population-based study conducted over 16 years, by Johannesdottir U et al., a total of 88 patients who had PSW were included, and 73 patients were admitted to the ED. Age-standardized incidence was at 1.54/100,000 inhabitants and the mean age was 32.6 years. In this study, a male predominance (90.4%) was noticed (8). Another study conducted by KA. Alenazi et al., over a period of 4 months in 2018 concerning 106 patients, showed that 72.6% of them were aged less than 40 years, and 87.7% were males (7). This male predominance found in our study as well as in numerous studies raises the idea of a study attempting to compare males and females in terms of demographic and circumstantial factors, clinical features, and outcomes. In our study, 46.2% of the patients were alcohol consumers (n=60) and 15.4% were drug users (n=20). This was commensurate with the literature. In a single-center study conducted by Jacob AO et al., 31% of the patients (n=481) were under the influence of alcohol (8). This could be explained by the fact that drug and alcohol use increased aggressiveness according to an article published in Alcohol Alert in 1997 (11). S. Manojkumar et al., mentioned in their study published in 2011, that 94% of stabbing victims who required surgical admission, 74% of them were admitted over the weekend. The same research mentioned that alcohol has 'been identified as one of the most pressing problems. Furthermore, in November 2005, alcohol was allowed to be consumed beyond 11.00 PM and during the weekends, aiming at reducing alcohol-induced violence. After that law was applied, a

gradual decline between 2006 and 2008 in the general rate of PSWs was noticed (11).

The locations of injuries, in our study, were by order of frequency: the torso, (40%), the extremities, (29.2%), the face (17.7%), and the scalp (16.9%). Torso SW was predominantly abdominal (20%). This is consistent with the literature. U. Johannesdottir et al. reported in their study that injuries to the chest, the abdomen, and the upper limbs were more common (26.4%, 21.5%, and 21.5%, respectively) (8). KA. Alenazi et al. reported that SW located on the head and the upper limbs (21.7% each) were more frequent, followed by the abdomen (17%) and the thorax (10.4%) (7). The predominance of SW inflicted on the extremities may be explained by the fact that victims attempted to protect the torso by exposing the upper extremities.

Most of the patients were hemodynamically stable. Four patients (3.1%) had an SBP<90mmHg and eight had a MAP≤65mmHg (6.2%). The mean heart rate was 87±14 bpm. Seven patients (5.4%) were hypoxemic, and six (4.6%) presented abolished breath sounds on auscultation. Only two patients (1.5%) had an altered neurological status on the initial physical examination. Cervical ACT and cerebral CT are eliminated as traumatic and ischemic causes in particular carotid injury. Our results were similar to findings in a study conducted by C. Heus et al. in a level I trauma center with over 159 patients. The mean HR in this study was 94±22 bpm, and 15.8% of the patients had an SBP below 90 mmHg. However, the median GCS was 14, and in 6.2% of the cases, the GCS was below 9 (12).

In our study, 38 injuries (29.2%) were located on the upper (76.3%) and lower limbs (n=9, 23.7%). Among these injuries, five were penetrated, and among these three (13.2%) had hard signs of a vascular injury, and two had soft signs (5.3%). This was in line with what was found in a study conducted by H. Warwick et al. and which showed that 71% of patients had a normal vascular exam, 22% had soft signs, and 6% had hard signs (13).

Chest x-ray was performed for 53 patients (60.9%), and showed a pneumothorax in two cases. However, 58 CT scans were performed. Forty-four were thoracoabdominal and/or pelvic and 14 were cerebral. Five pneumothorax, two hemothorax, two hemopneumothorax, and one pneumomediastinum were diagnosed. This led to conclude that CXR sensitivity was insufficient, that its interpretation should be cautious, and that its indication limited and optimized to include patients with respiratory or hemodynamic instability in case of penetrating trauma. A single-center study conducted by BM. Nguyen et al. over 10 years in California, found that CXR was associated with a high incidence of missed injury that was subsequently detected on CCT. It, therefore, concluded that in hemodynamically stable, asymptomatic patients, CCT was able to detect a large number of injuries in patients with thoracic SWs, allowing rapid diagnosis and disposition (14). Ct-scan is in consequence the primary imaging modality in the evaluation of hemodynamically stable patients (15). Extended-focused assessment with sonography for trauma has also proved its accuracy in detecting injuries

caused by PSW and could even help save time and expenses since it could be a more reasonable alternative to detect PNEUMOTHORAX s and hemothorax than CXR. In fact, according to an article published by K. Charles et al., CXR has a low sensitivity in detecting PNEUMOTHORAX and even lower sensitivity in detecting hemothorax, compared to E-FAST (16). Ultra-sonography has owned its place in the management of trauma patients especially those in critical status since its bedside availability and feasibility. It figures in multiple trauma guidelines (17).

We have chosen to evaluate STE based on therapeutic measures which were oxygen therapy, airway management, need for chest tube insertion, volume expansion, catecholamine and/or tranexamic acid use, urgent surgery, and death. In our study, 13.1% of the patients (n=17) had an unfavorable STE with no case of mortality occurring in the emergency setting. U. Johannesdottir et al. reported 30-day mortality at 4.1% compared to 2% in a small center in Norway and 15% in a major urban trauma center in Australia. They explained the divergent rate of death by the differences in severity, body parts, and types of injuries that were included in the studies (8).

After running logistic regression, we determined two risk factors associated with unfavorable STE, which were RR with a cut-off of 19cpm ($p=0.018$, OR=8.64) and an SBP cut-off of 105mmHg ($p<0.001$, OR=12.29). RM. Hasler et al. reported in their multicenter cohort study that mortality was doubled among patients with SBP between 90-109 mmHg compared to those with a SBP between 110-129 mmHg and therefore determined SBP <110mmHg as a new threshold —instead of the old SBP <90mmHg—to triage patients with penetrating trauma to resuscitation areas within dedicated high-level care trauma centers (18,19). However, the literature's findings concerning RR as a risk factor related to unfavorable STE were noticed in many prognostic scoring systems such as RTS and qSOFA with respectively a normal interval of (10,17), and a threshold of 22cpm. It figures in the recommendations related to thoracic trauma management which fixed a RR≥25cpm as a factor predicting the severity of penetrating trauma (18).

Some weak points have to be noted; it was a single-center study with a small sample size. We did not include the patients' follow-up after hospital discharge which can underestimate unfavorable evolution.

CONCLUSION

Unfavorable short-term evolution could be predicted through clinical parameters such as RR≥19cpm and/or SBP≤105 mmHg in PSWs' victims. These factors' thresholds should probably be integrated into a new scoring system or assessment tools. A multicenter study is necessary to validate the usefulness of the composite indicator of the STE.

REFERENCES

1. Nishimura T, Sakata H, Yamada T, Terashima M, Shirai K, Yamada I, et al. Different Patterns in Abdominal Stab Wound in the Self-Inflicted and Assaulted Patients: An Observational Analysis of Single Center Experience. Kobe J Med Sci 2017;63(1):E17-21.

2. Mnguni MN, Muckart DJJ, Madiba TE. Abdominal Trauma in Durban, South Africa: Factors Influencing Outcome. IntSurg 2012;97(2):161-8.
3. Dijkink S, Krijnen P, Hage A, Van der Wilden GM, Kasotakis G, Hartog D den, et al. Differences in Characteristics and Outcome of Patients with Penetrating Injuries in the USA and the Netherlands: A Multi-institutional Comparison. World J Surg2018;42(11):3608-15.
4. Sakran JV, Mehta A, Fransman R, Nathens AB, Joseph B, Kent A, et al. Nationwide trends in mortality following penetrating trauma: Are we up for the challenge? J Trauma Acute Care Surg 2018;85(1):160-6.
5. Sumner SA, Mercy JA, Dahlberg LL, Hillis SD, Klevens J, Houry D. Violence in the United States: Status, Challenges, and Opportunities. JAMA 2015;314(5):478-88.
6. Begum A, Huq MR, Begum M, Alam A, Akhter G, Tasmin T. A Case Report on Stab Injury. Delta Medical College Journal 2014;2(1):36-8.
7. Alenazi A, Almutairi N, Alhuzaimi Y, Altamimi S, Alayed Y, Alanazi Z. The nature and severity of stab wounds at tertiary care hospitals in Kingdom of Saudi Arabia. Pan African Medical Journal2019;34.
8. Johannesdottir U, Jonsdottir GM, Johannesdottir BK, Heimisdottir AA, Eythorsson E, Gudbjartsson T, et al. Penetrating stab injuries in Iceland: a whole-nation study on incidence and outcome in patients hospitalized for penetrating stab injuries. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine2019;27(1):7.
9. Swann IJ, MacMillan R, Watson AA. A study of stab wounds. Arch Emerg Med 1985;2(1):31-6.
10. Lyn-Sue J, Siram S, Williams D, Mezghebe H. Epidemiology of trauma deaths in an urban level-1 trauma center predominantly among African Americans--implications for prevention. J Natl Med Assoc 2006;98(12):1940-4.
11. Alcohol, Violence, and Aggression - Alcohol Alert No. 38-1997 [Internet]. [cité 9 juin 2021]. Disponible sur: https://pubs.niaaa.nih.gov/publications/aa38.htm
12. Heus C, Mellema JJ, Giannakopoulos GF, Zuidema WP. Outcome of penetrating chest injuries in an urban level I trauma center in the Netherlands. Eur J Trauma EmergSurg2019;45(3):461-5.
13. Warwick H, Cherches M, Shaw C, Toogood P. Comparison of computed tomography angiography and physical exam in the evaluation of arterial injury in extremity trauma. Injury 2021;52(7):1727-31.
14. Nguyen BM, Plurad D, Abrishami S, Neville A, Putnam B, Kim DY. Utility of Chest Computed Tomography after a « Normal » Chest Radiograph in Patients with Thoracic Stab Wounds. Am Surg 2015;81(10):965-8.
15. De Vries CS, Africa M, Gebremariam FA, van Rensburg JJ, Otto SF, Potgieter HF. The imaging of stab injuries. ActaRadiol 2010;51(1):92-106.
16. Abdominal and Thoracic Stab Wounds: ED Evaluation and Management [Internet]. emDOCs.net - Emergency Medicine Education. 2020 [cité 9 juin 2021]. Disponible sur: http://www.emdocs.net/abdominal-and-thoracic-stab-wounds-ed-evaluation-and-management/
17. Spahn DR, Bouillon B, Cerny V, Duranteau J, Filipescu D, Hunt BJ, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. Crit Care 2019;23(1):98.
18. Traumatisme thoracique : prise en charge des 48 premieres heures - La SFAR [Internet]. Société Française d'Anesthésie et de Réanimation. 2015 [cité 18 juill 2021]. Disponible sur: https://sfar.org/traumatisme-thoracique-prise-en-charge-des-48-premieres-heures/
19. Hasler RM, Nüesch E, Jüni P, Bouamra O, Exadaktylos AK, Lecky F. Systolic blood pressure below 110 mmHg is associated with increased mortality in penetrating major trauma patients: Multicentre cohort study. Resuscitation 2012;83(4):476-81.