ORIGINAL ARTICLE

Assessment of firearm injuries undergoing advanced airway management: Role II hospital experience

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ABSTRACT

BACKGROUND: Airway problems are one of the most important factors affecting mortality in firearm injuries. The present study aims to examine the data of patients who underwent advanced airway support due to explosion and bullet injuries in a Role II hospital.

METHODS: Ninety three patients who underwent advanced airway support due to gunshot wounds in a Role II hospital between January 2015 and September 2016 were included in this study. The patients were divided into two groups as blast (Group A) (hand-made explosives, rocket, and mine) and bullet (Group B) (rifle and pistol bullet) trauma injuries. The groups were compared regarding pre-hospital intubation, NISS (New Injury Severity Score), cardio-pulmonary resuscitation (CPR), emergency surgical intervention and mortality rates.

RESULTS: There was no difference between the patient groups concerning demographic and clinical features. Thirty-six patients were included in group A, and 57 patients were included in group B. There was no statistically significant difference between the groups about emergency surgical intervention rates (p=0.42). However, a statistically significant difference was observed between the groups in terms of pre-hospital intubation (p=0.001), CPR application (p=0.001), mortality (p=0.001) rates and NISS (p=0.002) scores.

CONCLUSION: Bullet injuries that require advanced airway are more destructive and more deadly than explosion injuries. This may be due to direct airway or organ damage in bullet gunshot wounds.

Keywords: Airway management; combat; firearm; hospital; gunshot; mortality; Role II; weapon.

INTRODUCTION

Injuries via firearms and explosives may result in many life-threatening situations.[1] These include hypovolemia due to blood loss, hypotension, hypoventilation, shock, respiratory, and cardiac arrest.[2–5] Among these, failure to maintain airway management in firearm injuries is the second leading cause of death after bleeding.[6] Thus, it is vital that the casualty's airway management and bleeding control must be carefully carried out, in the conflict area and the hospital.

In the US there are four main "role" levels in the military trauma center designation. These levels begin in the field of a combat zone with Role I. Accordingly, Role I care encompasses first aid at the point of injury by the wounded people themselves, colleagues or emergency teams in the fire zone. The Role I also includes triage, treatment, and transfer by doctors/healthcare personnel at accident collection areas or battalion first-aid stations. Here, the aim is to separate the person who can return to the task and transfer the wounded who need advanced life support to the next level, healthcare center. Role II includes hospitals within the area of battleground where limited interventional and surgical procedures can be performed. Role III defines hospitals within or close to the combat region wherein advanced surgical support can be obtained. Role IV represents advanced regional medical centers.[7]

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Since the tissue destruction mechanism is different in bullet and blast injuries, the treatment principles of these two types of injury are also individual.[8] Blast injuries occur due to handmade explosives (HME), mines and shrapnel, and rockets that cause very dramatic injuries because of the high impact power due to sudden explosion at close range. Trauma that arises from handmade explosives generally affects a lot of military staff in the region and involves metal fragments in the wound.[9] Bullet injuries occur in personnel directly targeted by a gun or rifle. Military rifles and guns have lower kinetic energy than explosives. Thus, although blast trauma may cause severe injuries at close distances, bullet injuries may result in more advanced airway requirements and mortality as a result of direct trauma to the neck and thorax region.

In this study, the data of patients who received advanced airway support due to explosion and bullet injuries in a Role II hospital between 2015 and 2016 were analyzed to compare the differences between mortality and severity of the injury.

MATERIALS AND METHODS

Patients who were admitted to the Department of Emergency of our Role II hospital between January 2015 and September 2016 and who received advanced airway support were included in this study. This study received the necessary ethics committee permission from the Institutional Review Board (2018/15, 18/204). Patients who underwent advanced airway support were those who underwent endotracheal intubation and tracheotomy. Patients who died in the combat area were excluded from this study. Immediately after the first intervention in the field, the patients were transferred to the Role II hospital, which was 5–10 minutes away by ambulance. Patients were divided into two groups. Handmade explosives, rocket, and mine injuries were considered as blast injury (Group A). Rifle and pistol injuries were defined as bullet injuries (Group B). Patients' age, type of trauma, prehospital intubation status, Glasgow Coma Scale (GCS) score, cardiopulmonary resuscitation (CPR) status, emergency surgical intervention requirements, need for postoperative intensive care, and tracheotomy requirements were assessed. Groups were compared concerning prehospital intubation rates, NISS (New Injury Severity Score), mortality, follow-up periods, and injury sites.

Statistical Analysis

Patients' data were analyzed using SPSS 21.0 (SPSS Inc., Chicago, IL., USA). Descriptive statistics were given as a number, percentage, mean and standard deviation. Discrete data were compared with Fisher's Exact Test and continuous data in the Mann-Whitney U test in pairs that did not conform to normal distribution. The level of significance was set at $p<0.05$.

RESULTS

This study included 93 patients and all of the casualties were male. There were 36 patients (38.7%) in group A, and 57 patients (61.3%) in Group B. The mean age was 28.3±8.1 (Mean±SD) in group A, and 29.3±8.2 in group B (total 28.9±8.1). Clinical features of patients are given in detail in Table 1.

Table 1. Clinical features of the patients

	Group A (n=36)	Group B (n=57)	Total (n=93)	p
Glasgow Coma Scale (Mean±SD)	7.8±3.7	5.4±3.3	6.33±3.64	0.016*
Prehospital intubation, n (%)	9 (25.0)	34 (59.6)	43 (46.2)	0.001*
Follow-up with intubation, n (%)	8 (22.2)	14 (24.6)	22 (23.7)	0.796**
Tracheotomy intervention, n (%)	5 (13.9)	6 (10.5)	11 (11.8)	0.127**
Intensive care monitoring , n (%)	23 (63.9)	28 (49.1)	51 (54.8)	0.163*
New Injury Severity Score (Mean±SD)	21.27±22.26	36.12±26.87	28.69±24.43	0.002***

Group A (blast trauma injuries), Group B (bullet trauma injuries). *Chi-square Test; **Fisher's Exact Test; ***Mann-Whitney U Test. SD: Standard deviation.

Table 2. Comparison of the cases with Group A (blast trauma injuries) and Group B (bullet trauma injuries)

	Group A (n=36)		Group B (n=57)		p
	n	%	n	%	
Cardiopulmonary resuscitation	6	16.7	28	49.1	0.001*
Emergency surgical ıntervention	31	86.1	44	77.2	0.420**
Mortality	10	25.6	29	74.4	0.028*

*Chi-square Test; **Fisher's Exact Test.

Table 3. Injury sites of the casualties

	Group A (n=36)	Group B (n=57)	Total (n=93)
Head	13	16	29
Thorax	4	21	25
Pelvis	2	3	5
Abdomen	7	6	13
Neck	1	4	5
Extremity	2	1	3
Thorax and limb	2	3	5
Thorax and abdomen	3	2	5
Head and thorax	1	0	1
Abdomen and neck	1	0	1
Head and neck	0	1	1

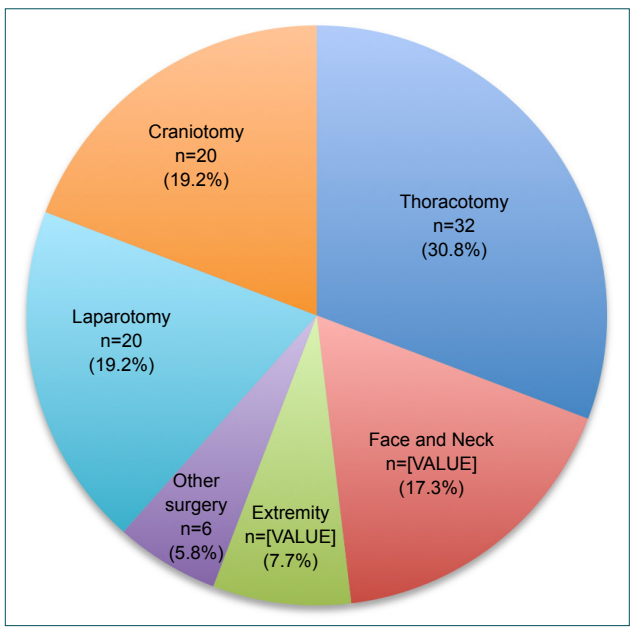

Figure 1. Distribution of the emergency surgical interventions of the patients.

When compared with group A, patients in Group B had significantly high prehospital intubation, CPR, and mortality rates ($p<0.05$). Also, the NISS value was significantly higher in group B patients ($p<0.05$). However, the difference in the emergency surgical intervention rates between the groups was statistically insignificant ($p=0.420$) (Table 2). The injury sites of the causalities are demonstrated in Table 3. In Group A, the most common injury site was the head region, while in Group B, the thorax area. Emergency surgical interventions (craniotomy, laparotomy, thoracotomy, extremity, face-neck and other surgery) are presented in the Figure 1.

DISCUSSION

In this study, the difference in mortality rate and injury severity score was investigated in patients with advanced airway support (endotracheal intubation and tracheostomy) with a bullet or blast injuries. Contrary to the prediction, we found that mortality rates in Group B were much higher than the mortality rates in Group A.

In the battlefield, gunshot injuries have become the leading cause of death in recent years due to advances in weapon industry technology. Contemporarily, war and conflicts are taking place on the urban terrain, not on the battlefields. Differences have been observed in injury sites with the change of weapon technology and combat style. In the study conducted by Güven et al.,[9] extremities were the most frequently affected site in bullet injuries, while head and neck injuries were observed in blast injuries along with extremities. In our study, the thorax region was most commonly affected in bullet injuries, while the head and neck region was affected in blast injuries.

Eastridge et al.'s[6] study examined the data about 4596 patients who were fatally wounded between 2001 and 2011on the battlefield. Of these injuries, 73.7% were due to explosives, and 22.1% were due to pistol and rifle injuries. Accordingly, in another study, the injury rate that occurred due to blast trauma was 58.3%.[9] However, in the present study, the pistol-rifle/explosive ratio was found to be 38.7%, as opposed to the previous ones. This may be due to the inclusion of only those cases who could reach the Role II hospital alive. Deaths from injuries that arise from blast trauma are usually on the battlefield or at the Role I level before reaching the Role II hospital.

The injuries affecting the respiratory system result in ventilation failure and hypoventilation. Airway management is vitally important in monitoring these critical trauma patients.[10,11] Studies have defined that ensuring sufficient ventilation and oxygenation of trauma patients before hospital admission is associated with an increase in survival and discharge rates.[12,13] Failure to provide a safe airway is the second leading potentially preventable cause of death after bleeding in combat settings.[6] Only a few studies to date have investigated the airway management during and after combat operations by evaluating the rate of accurate insertion of the airway, frequency of cricothyroidotomy, and incidence of maxillofacial traumas.[13–18] However, none of these studies about airway management in combat zones and afterward have evaluated the effects of the mechanism of the trauma on mortality in these patients.

In the current study, when the patients who needed endotracheal intubation and tracheotomy were evaluated, it was observed that mortality rates were higher in pre-hospital intubated patients. Also, the mortality rates are found to be higher among the patients brought to the emergency service with bullet trauma injuries. In this regard, similar results were obtained in studies conducted in a civilian environment.[6,10]

The high mortality rate in pre-hospital intubated patients may possibly be due to excessive severity of injury or the presence of airway injury in these patients.

When the presence of a correlation between weapon type and NISS values is examined, relatively old literature presents comparatively more pistol and rifle injuries in previous studies. However, in recent studies, injuries due to explosives were reported more.[19] Also, injuries due to explosives were determined to have higher severity scores. In our study, injuries occurring due to bullet trauma injuries were found to have higher injury severity scores. This difference may be because the majority of blast trauma injuries cannot reach Role II. In patients with bullet injuries, insufficient attention to the existing wound, ongoing bleeding and body compensation may prevent an understanding of the severity of the injury.

In the literature, mortality rates in this study were much higher when compared to relevant studies. One study using 10-year data in the Role IV area found mortality rates in the Afghanistan and Iraq wars were 2/167 and 2/224, respectively.[20] In our study, when the mortality rates were evaluated, the general rate was 39/93. In this study, the higher mortality rates may be because patients presenting to Role II were newly injured and not yet stabilized. Additionally, the low number of people reaching the Role II area among those with injury occurring due to blast trauma injuries leads to the consideration that mortality occurs more in the field of conflict for these injuries.

The most important limitation of our study was that the design was retrospective, and the number of patients was relatively low. The reason for the low number of patients is that the data obtained from a hospital located in a certain conflict area, not in a wide battlefield, were used. Another limitation was that the causes of death of the deceased patients could not be revealed from the patient records.

Conclusion

Patients in need of prehospital advanced airway support were found to have high mortality rates for both bullet and blast trauma injuries. Although blast injuries involve risk of multi-organ traumas, the reason for high mortality from bullet injuries is considered to be because of direct destruction of the projectile to the airway or the vital organs. To conclude, the high mortality rates associated with bullet trauma injuries require special attention. To generalize the results of our study, large series are needed.

Ethics Committee Approval: This study received the necessary ethics committee permission from the Institutional Review Board (2018/15, 18/204).

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ORİJİNAL ÇALIŞMA - *ÖZET*

İleri hava yolu yönetimi uygulanan ateşli silah yaralanmalarının değerlendirilmesi: Role II hastane deneyimi

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AMAÇ: Havayolu sorunları, ateşli silah yaralanmalarında mortaliteyi etkileyen en önemli faktörlerden biridir. Bu çalışmanın amacı, bir Rol II hastanesinde patlama ve mermi yaralanmaları nedeniyle ileri hava yolu desteği uygulanan hastaların verilerini incelemektir.
GEREÇ VE YÖNTEM: Çalışmaya, Ocak 2015 ile Eylül 2016 tarihleri arasında bir Role II hastanesinde ileri hava yolu desteği uygulanan 93 hasta dahil edildi. Hastalar patlayıcı (Grup A) (el yapımı patlayıcılar, roket ve mayın) ve mermi (Grup B) yaralanmaları olarak iki gruba ayrıldı (tüfek ve tabanca mermi) travma yaralanmaları. Gruplar hastane öncesi entübasyon, NISS (Yeni Yaralanma Şiddeti Skoru), kardiyopulmoner resüsitasyon (CPR), acil cerrahi müdahale ve mortalite oranları açısından karşılaştırıldı.
BULGULAR: Hasta grupları arasında demografik ve klinik özellikler açısından fark yoktu. Otuz altı hasta A grubuna, 57 hasta B grubuna alındı. Acil cerrahi müdahale oranları açısından gruplar arasında istatistiksel olarak anlamlı fark yoktu (p=0.42). Ancak gruplar arasında hastane öncesi entübasyon (p=0.001), CPR uygulaması (p=0.001), mortalite (p=0.001) oranları ve NISS (p=0.002) skorları arasında istatistiksel olarak anlamlı bir fark gözlendi.
TARTIŞMA: İleri hava yolu gerektiren mermi yaralanmaları, patlama yaralanmalarından daha yıkıcı ve daha ölümcüldür. Bunun nedeni, mermi ile ateşli silah yaralarında doğrudan hava yolu veya organ hasarı oluşması olabilir.
Anahtar sözcükler: Ateşli silah; hastane; havayolu yönetimi; mortalite; Rol II; savaş; silah; tabanca atışı.

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