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GUNSHOT WOUNDS MANAGEMENT IN THE EMERGENCY DEPARTMENT; A REVIEW OF CURRENT LITERATURE

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Abstract:

Introduction: *The National Vital Statistics Reports estimated that more than 31,000 deaths occurred due to a gunshot injury in the United States in the year 2009 alone. A gunshot wound can result in varying levels of tissue damage. This depends on several factors including the type of the gun as a high-velocity gun will lead to more damage of the soft tissue than a low-velocity gun.*

Methodology: *We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: gun-shot wounds, emergency department management, acute hemodynamic management of gun-shot wound, penetrating foreign body*

Aim: *In this review, we aim to study emergent management of gun-shot wound with respect different parts of the body*

Conclusion: *Gunshot wounds can be in any part of the body, and the site of it will determine management plan. Abdominal gunshot wounds are managed surgically with laparotomy when there are peritoneal signs and/or hemodynamic instability. Head gunshot wounds are more severe and associated with significant mortality and mortality where only 9% of patients survive despite strict management. In all cases hemodynamic stabilization is the priority, followed by surgical intervention.*

Keywords: *gun-shot wounds, emergent management of gun-shot wounds, penetrating foreign objects*

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INTRODUCTION:

Injuries resulting from gunshots have been decreasing lately in the United States. However, the number of these injuries remains significantly high; the National Vital Statistics Reports estimated that more than 31,000 deaths occurred due to a gunshot injury in the United States in the year 2009 alone. The number of non-fatal gunshots injuries is also high and is about double the number of fatal injuries **[1]**.

Trauma to the hands and upper extremity from gunshots has recently become more prevalent due to the increase in gang violence and the wider prevalence of guns in civilian life **[2]**. A gunshot wound can result in varying levels of tissue damage. This depends on several factors including the type of the gun; for example, a high-velocity gun will lead to more damage of the soft tissue than a low-velocity gun. A more recent classification of guns that is can predict damage more accurately, is low- and high-energy guns **[3]**. The type of the bullet has also been used to predict the level of tissue damage.

Despite becoming common in civilian life, gunshot wounds are still not managed properly leading to significant complications and mortality. In this study, we will review most recent literature regarding emergency management of gunshot wounds.

METHODOLOGY:

- **Data Sources and Search terms**

We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: gun-shot wounds, emergency department management, acute hemodynamic management of gun-shot wound, penetrating foreign body

- **Data Extraction**

Two reviewers have independently reviewed the studies, abstracted data, and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

The study was approved by the ethical board of King Abdulaziz University Hospital.

Management of gunshot wounds to the abdomen:

Previously, it has been thought that any gunshot wound to the abdomen should be explored as soon as possible, and when the condition of the patients permits. This belief started later to become less solid, and laparotomy following abdominal gunshot wound started to be performed less.

A study conducted by Moore et al has found that of 245 patients who had abdominal gunshot wounds (162 of them had peritoneal penetration), about 156 patients had injuries to internal abdominal viscera. Authors of this study concluded that patients who have abdominal gunshot wounds with peritoneal penetration must undergo laparotomy. However, in the absence of peritoneal penetration, observation and conservative management are preferred to avoid unnecessary surgical intervention **[4]**.

Another study was conducted on 41 patients who had an abdominal gunshot wound with minimal clinical signs. Although all these patients were managed conservatively, seven of them required laparotomy eventually due to discovered colon, small bowel, and liver injuries. However, no significant long-term complications or mortality were recorded in any of these patients. Therefore, thus study concluded that laparotomy should only be performed in selected patients with abdominal gunshot wounds. Other patients can be managed conservatively **[5]**.

All later studies showed that patients who develop peritoneal signs or hemodynamic instability following an abdominal gunshot wound, should urgently undergo laparotomy. Therefore, the decision of undergoing laparotomy could be based on physical examination and clinical findings, with sensitivity and specificity reaching 100% and 95% respectively. In fact, the ability of clinical examination to predict the need for surgery is not limited to abdominal gunshot wounds but could also be applied in pelvic gunshot wounds patients **[6]**. Avoiding unnecessary surgical intervention is important as it leads to significant decrease in costs, hospital stays, and infections.

In addition to thorough physical examination, abdominal imaging is essential to better determine proper management. CT scan is recommended to be used in these cases as it will help establish a better management and follow up plan. In a previous study, Velmahos et al.**[7]** studied 100 patients with abdominal gunshot wounds who were clinically selected to undergo conservative management. They performed CT scans on them and followed them for later outcomes. Authors of this study concluded that the use of CT scan was associated with a sensitivity of 90.5% and specificity of 96% in the prediction of the need of delayed laparotomy. Therefore, they recommended it is use as a safe option along with clinical examination to be able to establish a more accurate management plan.

The use of ultrasound in these patients remains controversial, with no solid evidence supporting its benefits, due to its relatively low sensitivity. However, it is still usually done in emergency departments due to its wide availability and low cost **[8]**. On the other hand, the use of angiography could be beneficial in some cases to detect possible vascular injuries. Further studies on the use of angiography are required to establish guidelines and recommendations to physicians **[9]**.

In conclusion, it is almost agreed currently among emergency physicians that not all patients with abdominal gunshot wound will require emergent laparotomy. Conservative management should be used when patients do not show hemodynamic instability or peritoneal signs, and this will lead to faster improvement and shorter hospital stays. However, there is still a fraction of these patients who will eventually require delayed laparotomy. On the other hand, patients who show severe clinical signs should immediately undergo laparotomy to prevent long term complications and mortality. These results should be further examined in larger studies to establish more solid guidelines.

Management of gunshot wounds to the head:
Generally, head gunshot wounds leading to traumatic brain injury are immediately fatal; up to 73% of victims die immediately, about 12% die within three hours, and about 7% die later **[10]**. However, in cases where Glasgow Coma Scale is higher than 6, patients may undergo medical and/or surgical management to improve outcomes and survival of these patients **[11]**. Another important factor in determining prognosis in patients with head gunshot wounds is hemodynamic status. In fact, up to 50% surviving victims present to the emergency department with hypotension, which is associated with poorer prognosis **[12]**.

It is essential to keep measuring the Glasgow Coma Scale of the patient repeatedly. It is estimated that up to two thirds of patients who are admitted to the emergency department with head gunshot wounds have a Glasgow Coma Score that is less than 6 **[13]**. The remaining one-third have a Glasgow Coma Score that is equal or higher than 6. Only these patients are eligible to medical and/or surgical intervention following a head gunshot wound, and have a chance for recovery. Another key factor in determining the prognosis of a patient with a head gunshot wound is the time between the injury and admission to the emergency department **[13]**.

Pupillary size and light reaction are considered other useful outcomes that can predict prognosis in patients with head gunshot wounds **[14]**. Abnormal response of the pupil, which is considered a poor prognostic sign, is in fact present in more than half patients with head gunshot wound. Moreover, some patients with head gunshot wound can even present with coagulopathies. This has also been associated with poor prognosis **[15]**.

In cases of head gunshot wounds, imaging findings are of high benefit in determining the exact lesion and planning surgical treatment. The wound is visualized mainly using CT scanning. Wound visualization includes checking air sinuses involvement, the presence of fragments and debris, and the projectile trajectory. When the patient is eligible to medical treatment or decompressive craniectomy, it is also important to determine brain swelling degree, the presence of a midline shift, and the presence of basal cisterns obliteration **[16]**.

Management of gunshot wounds to the hand:
When studying hand gunshot wounds, studies report varying infection rates. However, infection is not considered a significant concern when dealing with a hand gunshot wound. The risk of infection increases significantly when treatment and wound management is delayed for more than six hours following injury **[17]**.

It is universally established that hand gunshot wounds require early management and treatment, especially when there is as associated fracture or soft tissues damage. In these cases, immediate interventions are essential. The first step in relatively mild wounds is to debride the wound immediately. This is followed by application of dressing and later routine follow up. When hand gunshot wounds are more severe, surgical debridement of the wound is indicated along with reconstruction of the damaged structures. Early closure is the wound is not generally recommended in mild cases. The main determinant of the severity of the wound, and thus management plan is the involvement of bones, nerves, and/or tendons. Performing early debridement and anatomical reconstruction, along with wound cleaning have been associated with significantly improved clinical outcomes and better hand functions **[18]**.

In more severe cases where there is significant tissue injury, injury of the vessels, presence of neurologic symptoms, frank contamination of the wound, involvement of hand joints, the presence of signs suggesting compartment syndrome, the presence of severe fractures, and/or injuries to the tendons, surgical interventions is indicated. Another indication of surgery is late presentation of the patient after

more than eight hours from the injury **[19]**. Type of surgical intervention is usually determined based on the injury present.

When surgery is indicated, it is recommended to be performed as early as possible. Early intervention is significant determinant of recovery and restoration of joint movements, elimination of edema, and return of fully-functioning hand **[20]**. When sufficient surgical intervention is nor performed on time, risk of infection increases significantly with late-term complications **[17]**.

In severe hand gunshot wounds where neurologic and/or vascular injuries are present, no established guidelines are present for management. A reason for this lack of evidence may be due to the relative rarity of these injuries in hand gunshot wounds; it is estimated that only 8% of patients with hand gunshot injuries will develop neurologic and/or vascular injuries **[21]**. Generally, physicians recommend immediate surgical repair of the wound along with the vessel or nerve damaged, in attempts to restore functions. When surgically intervening, it is important to start with repairing more important structures like arteries and nerves. Post-operative rehabilitation is important and is thought to have significant impact on long term outcomes **[21]**.

CONCLUSIONS:

Gunshot wounds are important emergency cases that require early management and treatment. Gunshot wounds can be in any part of the body, and the site of it will determine management plan. Abdominal gunshot wounds are managed surgically with laparotomy when there are peritoneal signs and/or hemodynamic instability. Otherwise, observations with conservative management are enough. Head gunshot wounds, on the other hand, are more severe and associated with significant mortality and mortality. Only 9% of patients survive a head gunshot wound, and these 9% require strict management and high quality care to be able to restore functions. Hand gunshot wounds are usually less severe and are easily managed. Early debridement of the wound is essential to prevent infections along with other long term complications and loss of functions. In severe hand gunshot wounds injuries, surgical intervention is indicated to restore function.

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