



PENETRATING WOUNDS: PENETRATING ABDOMINAL TRAUMA AND PENETRATING EXTREMITY WOUNDS

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ABSTRACT

Introduction: This article provides a review of penetrating injuries to the extremities and abdomen. Extremity injuries require early attention to avoid limb loss, with factors such as soft tissue, nerve and bone damage determining the feasibility of saving the limb. In abdominal trauma, the most common causes are stab wounds and gunshot wounds, mainly affecting the bowel, liver and abdominal vessels. Close range injuries are more severe and difficult to assess, which can lead to complications. Prompt attention is key.

Objective: to detail current information related to penetrating abdominal trauma and penetrating extremity wounds in terms of etiology, epidemiology, evaluation, diagnosis and treatment.

Methodology: a total of 25 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 17 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: extremity trauma, penetrating trauma, abdominal trauma, projectile injuries, stab injuries.

Results: the extremities are the most affected by penetrating trauma, with a high percentage of vascular injuries, especially from gunshot wounds. Although amputation rates have decreased, long-term complications such as nerve damage and fractures persist. In the case of penetrating abdominal trauma, mortality is high in the presence of contamination or multi-organ injuries. Early and adequate surgical treatment, such as laparotomy and contamination control, is crucial to reduce mortality and improve patient prognosis.

Conclusions: penetrating trauma is a significant cause of serious injuries, with variability in clinical presentation depending on the type of object causing the injury, its kinetic energy and the location of the injury. Advances in diagnostic imaging and surgical techniques have led to an improvement in patient prognosis, reducing amputation and mortality rates, especially in extremity injuries. However, the complexity of managing penetrating injuries, both abdominal and extremity, remains a challenge due to the potential for long-term complications such as infection, nerve damage and fractures. Early intervention, thorough evaluation and constant monitoring are essential to avoid shock, peritonitis and other serious complications. Surgical treatment, ranging from laparotomy to repair of vascular damage, is crucial to restore function and reduce morbidity.

KEY WORDS: trauma, wound, penetrating, abdominal, extremities.



INTRODUCTION

Timely management of penetrating extremity injuries and advances in surgical techniques allow arterial repair with a low rate of postoperative thrombosis, so it is crucial to recognize and treat arterial injuries promptly. Concomitant soft tissue, nerve and bone injuries are the most important factor determining whether the limb can be saved, for which scales such as the MESS scale can be used. The role of the first emergency care is decisive in the treatment of penetrating injuries of the extremity by identifying injuries at an early stage to start early with primary care to preserve the affected limb. Unnecessary delays greater than 6 to 12 hours in proper management can have repercussions such as irreversible limb ischemia and subsequent loss of the limb(1).

The most frequent causes of penetrating abdominal trauma are stab wounds and gunshot wounds, which usually injure the small intestine in 50%, the large intestine in 40%, the liver in 30% and the intra-abdominal vessels in 25%. When an injury occurs at close range, there is greater kinetic energy compared to injuries sustained at a distance. Stab wounds that penetrate the abdominal wall are difficult to assess, sometimes some injuries may go unnoticed, resulting in late complications that may increase morbidity. This article describes the subject of penetrating wounds, both those caused in the abdomen and those caused by penetrating wounds in the joints and extremities(2-4).

METHODOLOGY

A total of 25 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 17 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: extremity trauma, penetrating trauma, abdominal trauma, projectile injuries, stab injuries.

The choice of literature exposes elements related to penetrating abdominal trauma and penetrating extremity injuries in terms of etiology, epidemiology, evaluation, diagnosis and treatment.

DEVELOPMENT

ETIOLOGY

Penetrating trauma occurs when a foreign object pierces the skin and enters the body, causing injury. In the case of blunt or non-penetrating trauma, the skin is not necessarily broken. In a penetrating trauma, the object becomes lodged in the tissue or passes through the tissues and exits the body. An injury in which an object enters and passes through the body is known as a perforating injury. Perforating trauma is associated with an entry wound and an exit wound.

Penetrating trauma indicates that the object does not pass completely through the wound. This type of trauma can be caused by violence and can originate from:

- Fragments of a fractured bone
- Gunshots
- Knife cuts

Penetrating trauma often causes damage to internal organs, resulting in shock and infection. The severity depends on the organs affected, the characteristics of the object and the amount of energy transferred. Evaluation includes X-rays, CT scans and MRI scans. Treatment consists of surgery to repair damaged structures and remove foreign objects.

Puncture and penetration are similar concepts.

A puncture has no exit wound. It is usually due to something sharp or pointed.

This type of trauma is seen when receiving a stabbing or stepping on a nail(3,4).

EPIDEMIOLOGY

More than 50% of penetrating trauma injuries involve the extremities, with penetrating trauma accounting for up to 82% of all extremity vascular injuries. Gunshot or shotgun wounds account for about 65% of penetrating injuries to extremity vessels while penetrating wounds account for about 15%. In the past, before the 1950s, individuals with a penetrating extremity injury with vascular involvement had a 50% chance of amputation; today, with advances, penetrating extremity injuries result in amputation in less than 5% of cases. However, there is still considerable long-term morbidity due to other complications such as nerve damage, fractures, wound infections, open joint injuries and compartment syndromes. The frequency of penetrating abdominal injuries increases with the availability of weapons, as well as in the presence of military conflicts, so their frequency varies from place to place. Studies indicate that in the USA, penetrating abdominal trauma affects 35% of individuals hospitalized in urban trauma centers and up to 12% of those hospitalized in suburban or rural centers, with up to 90% of penetrating trauma patients being male. Traumatic injuries are the third leading cause of death and the number one cause of death in people aged 1-44 years. They also show that age-adjusted firearm death rates are two to seven times higher for non-Hispanic black males(1,2,5).

PATHOPHYSIOLOGY

When a projectile penetrates a tissue, it slows down and transfers its kinetic energy to the tissue. The increase in velocity generates more damage than the mass. The kinetic energy increases by the square. The space left in the tissue destroyed by the penetrating object forms a cavity, known as permanent cavitation. In addition to direct damage to the tissues it contacts, medium and high velocity projectiles cause secondary cavitation injury as the object enters the body and generates a pressure wave that forces the tissue to displace, forming a cavity. The tissues return to their original position, eliminating the cavity, but the cavitation has already caused considerable damage.

The characteristics of the affected tissue determine the severity of the injury: the denser the tissue, the greater the amount of energy transmitted to it. Gunshot and knife injuries account for the majority of penetrating extremity injuries. Diagnosis, medical care and prognosis vary depending on the type and severity of the injury. Although the damage caused by a penetrating wound may be relatively predictable with a good



knowledge of clinical anatomy, tissue damage caused by a bullet or blast depends on multiple factors(4).

CLINICAL EVALUATION AND DIAGNOSIS

Initial care of the multiple trauma patient should be characterized by a rapid but thorough clinical examination, including airway management, ventilatory characteristics, circulatory status, basic neurological assessment and complete exposure of the patient, which forms the ABCDE in the initial management of trauma. If life-threatening alterations are present, they should be treated immediately. In addition, it is necessary to perform continuous monitoring, obtaining information on blood pressure, heart rate, respiratory rate, oxygen saturation, among other parameters.

Penetrating abdominal trauma is caused by stabbing, gunshot wounds and industrial accidents. These injuries can be life-threatening because the abdominal organs bleed profusely. If the pancreas is affected, they can generate further injury due to autodigestion. Liver injuries often present in shock, as liver tissue has a large blood supply. The intestines are at risk of perforation, which can lead to the presence of fecal matter that aggravates penetration. Penetrating abdominal trauma can lead to hypovolemic shock and peritonitis.

Penetration may reduce bowel sounds due to bleeding, infection and irritation, and arterial lesions may cause murmurs. Percussion shows hyperresonance or dullness, suggesting the presence of blood. The abdomen may be distended or tender, indicating that surgical intervention is necessary. Macroscopic evaluation can be complicated, since the damage is usually internal. A physical examination of the patient should be performed and then proceed with an ultrasound, radiography or computed tomography. Sometimes a clip is placed over the entry and exit wounds before an X-ray is taken.

In the extremities, after the initial post-trauma resuscitation and completion of the primary and secondary examinations, the possibility of joint injuries, fractures, ligament, muscle, nerve, arterial and venous injuries should be assessed, as well as the events surrounding the injury, for example, the type of weapon and the number of shots fired. This is important at the time of treatment because the behavior may depend on this, in important injuries immediate surgical intervention may be necessary.

A complete physical examination should be performed on extremities affected with a perforating injury, assessing muscle strength, neurovascular status as well as soft tissue involvement, the penetrating object must be analyzed as a possible cause of future infection. Immediate recognition of arterial injury is one of the fundamental goals of extremity treatment; therefore, it is essential to observe the presence and intensity of distal pulses in the injured extremity. The Severity of Injured Extremity Scale (MESS) was developed to determine whether amputation is necessary in cases of extremity trauma. It assigns points based on 4 aspects of the injury: the extent of soft tissue and skeletal damage, lack of circulation to the extremity and duration of ischemia, shock, and age. A score of 7 or more indicates that primary amputation is required. Foreign

objects, such as bullets, can be removed, but if there is a possibility that they will cause further damage, they should be left in place. Wounds are cleaned to remove tissue that cannot survive and could induce infection(1,4,6-9).

TREATMENT

Management in penetrating abdominal trauma.

The manifestation of a patient with a penetrating abdominal wound may evidence shock, hypotension, narrow pulse pressure, tachypnea, oliguria and a visible trajectory or open wound. In a penetrating abdominal wound, examination in conscious patients may show signs of peritonitis, such as muscle guarding or pain on palpation. The management of patients with penetrating abdominal trauma depends on the type of instrument that caused the injury and the hemodynamic status. The standard treatment for this type of trauma is laparotomy. Increased understanding of the mechanisms of injury and improved imaging techniques have led to less invasive surgical strategies in some cases.

Indications for surgical intervention include (1) patient with hemodynamic instability, (2) appearance of peritoneal signs such as involuntary guarding, localized pain or pain on palpation, and (3) diffuse abdominal pain that does not improve. Patients with stab wounds and obvious signs of peritonitis also require laparotomy. Stable patients with stab wounds may undergo local exploration or triple-contrast computed tomography. Surgical principles include (1) control of bleeding, (2) prompt identification of any serious injury, (3) immediate control of contamination, and (4) reconstruction when possible. If there is an associated vascular injury, consultation with a vascular surgeon is strongly recommended.

The prognosis of patients with penetrating abdominal trauma is variable and depends on the extent of the injury and the time elapsed until presentation to the emergency department. In cases of significant abdominal contamination due to perforation of viscera, hemorrhage, multi-organ injury, associated head injury or coagulopathy, mortality rates are high. In patients who are stabilized and explored promptly, mortality rates remain low. Stab wounds to the abdomen generally have a much more favorable prognosis than gunshot wounds.

Depending on the injury, these patients often require some form of rehabilitation to regain their original functional level(10-13).

Management of Penetrating Extremity Trauma

Proper management of a penetrating injury caused by a knife or bullet to an extremity should follow a structured approach based on current medical guidelines. The first thing is to quickly assess the situation and ensure airway, breathing and circulation (ABC). Any active bleeding should be controlled by applying direct pressure or using a tourniquet in case of profuse bleeding, especially in large arteries. Assessment of neurovascular and soft tissue status is recommended. In the case of a knife wound, it is recommended not to remove the penetrating object, as it may be acting as a plug for bleeding, so it should be stabilized with a bandage. In gunshot injuries, in addition to hemorrhagic control, it is crucial to perform an assessment of internal damage, as bullets can cause significant damage to bones, blood



vessels and nerves. After stabilizing the patient, the need for surgery to clean the wound, remove any foreign material and repair damaged tissues should be assessed. In both types of lesions, antibiotic treatment and tetanus prophylaxis are essential. Surgical treatment should include damage control, hemostasis control, washing of the focus in the affected extremity with physiological saline solution, as well as debridement. Surgical debridement is discussed according to different authors, some recommend deep debridement, excision of all necrotic tissue and projectile fragments, others opt for superficial cleaning, resecting only the wound edges, but accompanied by washing with physiological saline solution. On occasions, the damage caused to the extremity may lead to fractures and instability in the affected extremities, and the use of external fixators may be necessary as part of the damage control surgery. After damage control surgery, the affected individual should be re-evaluated. If there are osteomuscular, vascular or nervous lesions or loss of tissue that were not treated in the first instance, an evaluation should be requested to the corresponding specialist for a future resolutive or definitive intervention for the patient's problem (14-17).

CONCLUSIONS

Penetrating trauma is a significant cause of serious injuries, with variability in the clinical presentation depending on the type of causative object, its kinetic energy and the location of the injury. Advances in diagnostic imaging and surgical techniques have led to an improvement in patient prognosis, reducing amputation and mortality rates, especially in extremity injuries. However, the complexity of managing penetrating injuries, both abdominal and extremity, remains a challenge due to the potential for long-term complications such as infection, nerve damage and fractures. Early intervention, thorough evaluation and constant monitoring are essential to avoid shock, peritonitis and other serious complications. Surgical treatment, ranging from laparotomy to repair of vascular damage, is crucial to restore function and reduce morbidity.

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