



Management of Abdominal Gunshot Wounds: Clinical Roles and Responsibilities of Emergency Medical Technicians

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Abstract

Background: Abdominal gunshot wounds (GSWs) represent a severe and high-mortality subset of penetrating trauma. The damage is complex, driven by ballistic principles like kinetic energy transfer and cavitation, and frequently involves multiple intra-abdominal organs. Rapid clinical deterioration from hemorrhage and contamination necessitates an urgent, systematic response.

Aim: This review outlines the comprehensive management of abdominal GSWs, emphasizing the critical roles of prehospital care, emergency department evaluation, and the integrated, multidisciplinary approach required for optimal patient outcomes.

Methods: A narrative synthesis of clinical protocols and evidence-based practices is presented, covering pathophysiology, epidemiology, diagnostic evaluation (including the Extended FAST exam and CT imaging), and definitive treatment strategies guided by the patient's hemodynamic status.

Results: Management begins with prehospital ABCs (Airway, Breathing, Circulation) and hemorrhage control. In the emergency department, hemodynamic status dictates the pathway: unstable patients proceed directly to exploratory laparotomy, while stable patients undergo CT scanning for injury characterization. The EFAST exam is a vital bedside tool for detecting hemoperitoneum in unstable cases. Definitive treatment is overwhelmingly surgical for patients with peritonitis or instability. Non-operative management is reserved for a highly select, stable subset. Core management includes aggressive resuscitation, often with massive transfusion protocols, broad-spectrum antibiotics, and tetanus prophylaxis.

Conclusion: Successful management of abdominal GSWs hinges on rapid recognition, immediate resuscitation, and timely surgical intervention coordinated by a multidisciplinary trauma team. Despite advances, mortality remains high, underscoring the need for efficient trauma systems and ongoing advocacy for primary prevention of firearm violence.

Keywords: Abdominal Gunshot Wound, Penetrating Trauma, Exploratory Laparotomy, EFAST, Hemoperitoneum, Damage Control Surgery, Trauma Resuscitation, Multidisciplinary Care.

Introduction

Traumatic injury to the abdomen encompasses a broad spectrum of mechanisms and clinical presentations, ranging from relatively minor insult to catastrophic disruption of multiple organ systems with subsequent high risk of mortality. Abdominal gunshot wounds, in particular, represent a subset of penetrating trauma in which the extent of damage is largely determined by the trajectory of the projectile and the nature of the intra-abdominal structures traversed.[1] Even when external wounds appear limited, the internal consequences may be profound, given the confined anatomical space and the dense concentration of vital organs and major vascular structures within the abdominal cavity. As a result, abdominal firearm injuries are closely associated with hemodynamic instability, complex

surgical challenges, and significant potential for rapid clinical deterioration if not promptly recognized and managed. While blunt abdominal trauma is more commonly associated with mechanisms such as road traffic collisions—especially in young adults between 15 and 24 years of age—in this population the predominant cause of abdominal trauma-related death remains motor vehicle accidents, abdominal gunshot wounds continue to account for a disproportionately high share of fatalities among penetrating injuries, contributing to as much as 90 percent of the mortality burden linked to penetrating abdominal trauma.[2] This statistic underscores the critical importance of understanding the pathophysiology, diagnostic approach, and management strategies specific to abdominal gunshot wounds within modern trauma care systems [1][2].

Penetrating abdominal injuries are most frequently attributed to stab wounds and gunshot wounds, with the latter being uniquely characterized by their high-velocity and high-kinetic-energy nature. In gunshot trauma, the ballistic properties of the projectile—including its caliber, shape, velocity, yaw, and potential for fragmentation—create a complex and often unpredictable wound profile. The bullet's course through the body can deviate from a straight line due to interactions with various tissue planes and anatomical structures, rendering the ultimate trajectory and pattern of organ involvement difficult to anticipate clinically.[1] Consequently, significant internal damage may occur remote from the apparent entry and exit sites. Epidemiological and clinical observations have consistently demonstrated that the small intestine is the most frequently affected organ in abdominal gunshot trauma, with injury rates approaching 50%, followed by the large intestine with involvement in approximately 40% of cases. The liver, given its size and anterior position in the right upper quadrant, is similarly vulnerable and is reported to be injured in nearly 40% of such incidents, while major intra-abdominal blood vessels are affected in roughly 30% of patients sustaining these injuries. These organ-specific patterns are clinically relevant because they influence both the initial resuscitation priorities and the operative strategy, particularly regarding hemorrhage control, contamination management, and the prevention of sepsis and multi-organ failure [1][2].

Beyond the direct tissue disruption caused by the bullet itself, secondary mechanisms of injury further compound the complexity of abdominal gunshot trauma. Projectiles may fragment on impact, generating shrapnel that disperses throughout the peritoneal cavity and embeds in or lacerates additional organs. These fragments can follow erratic paths and may not be readily detected on initial examination, contributing to delayed or occult injuries. Moreover, the transfer of kinetic energy from a high-velocity bullet can create a temporary cavitation effect, where tissues are rapidly displaced outward from the projectile path and subsequently recoil, causing additional microvascular damage and necrosis that extend beyond the visible wound tract. This phenomenon can result in injury to tissues that appear intact on initial visual inspection during surgery. Taken together, these primary and secondary injury mechanisms highlight why abdominal gunshot wounds demand a high index of suspicion, meticulous diagnostic assessment, and timely surgical or interventional management. They also explain why, despite advances in imaging, resuscitation, and critical care, abdominal firearm injuries remain a major contributor to trauma-related morbidity and mortality worldwide, particularly within regions and populations where firearm-related violence and armed conflict are prevalent.[2]

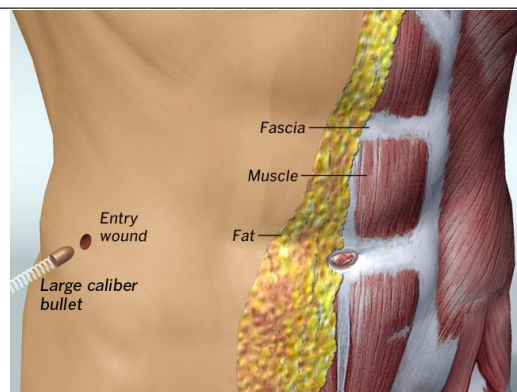


Fig. 1: Abdominal Gunshot.

Etiology

Penetrating abdominal trauma resulting from gunshot injuries is a complex pathological process that often involves multiple organ systems and carries a substantial risk of hemodynamic compromise, septic complications, and death. When a firearm is discharged, the projectile generated possesses considerable kinetic energy, enabling it to breach the integumentary barrier and traverse successive layers of subcutaneous tissue, muscle, and fascia. As it progresses along its trajectory, the bullet or other projectile is capable of destroying or severely damaging any anatomical structure encountered in its path. This may be limited in some cases to soft tissue disruption; however, more frequently, the injury pattern includes structural compromise of osseous components, major blood vessels, and a variety of intra-abdominal organs, such as segments of the gastrointestinal tract, solid organs, or retroperitoneal structures. The ultimate extent of injury depends on several variables, including the velocity and design of the projectile, the angle of entry, and the density of the tissues traversed. In abdominal gunshot injuries, the foreign object may remain lodged within a soft tissue or organ compartment, or it may pass completely through the body, producing both an entry and an exit wound. Injuries in which the projectile enters and remains within the body are generally classified as penetrating trauma, whereas those that involve both an entry and an exit site are often referred to as perforating abdominal wounds. In clinical practice, a significant proportion of abdominal gunshot wounds manifest as penetrating trauma, with the possibility of extensive internal damage even when external wounds appear relatively limited or deceptively benign.[3]

Given the potential for severe intra-abdominal pathology, the cornerstone of initial management for any suspected or confirmed penetrating gunshot wound to the abdomen is rapid, systematic emergency assessment. The primary objectives of this early evaluation are to identify or exclude an acute abdomen, promptly recognize life-threatening hemorrhage, and initiate interventions aimed at preventing exsanguination. Failure to rapidly address active bleeding and contamination of

the peritoneal cavity by gastrointestinal contents or infected material can predispose the patient to the development of peritonitis, sepsis, and subsequent multi-organ dysfunction. Therefore, early surgical consultation is frequently indicated, and in many trauma systems it is considered mandatory in the presence of hemodynamic instability, signs of peritoneal irritation, or clear evidence of intra-abdominal penetration. This interdisciplinary approach, typically involving emergency physicians, trauma surgeons, anesthesiologists, and critical care teams, is designed to facilitate timely decision-making regarding operative versus non-operative management, fluid resuscitation strategies, and the initiation of broad-spectrum antimicrobial therapy when contamination is suspected. The clinical decision-making process is further refined by continuous reassessment of vital signs, serial abdominal examinations, and review of adjunctive diagnostic data, all of which contribute to a dynamic understanding of the evolving injury pattern.[3]

In addition to the thorough physical examination and standard trauma resuscitation protocols, contemporary emergency assessment of abdominal gunshot injuries often incorporates focused imaging modalities to enhance diagnostic accuracy and expedite appropriate intervention. One of the most widely utilized bedside tools in this context is the Focused Assessment with Sonography in Trauma (FAST), a rapid, non-invasive ultrasound examination used to detect the presence of free intraperitoneal fluid, most commonly blood, suggestive of hemoperitoneum.[4] The FAST examination can be performed within minutes and repeated serially, making it particularly valuable in unstable patients or in environments where access to advanced imaging is limited. Beyond ultrasound, clinicians may elect to obtain plain radiographs to determine the approximate location of the projectile, identify associated fractures, or detect radiopaque foreign bodies. When the patient is hemodynamically stable, cross-sectional imaging—most notably contrast-enhanced computed tomography of the abdomen and pelvis—can be employed to delineate the exact trajectory of the bullet, characterize organ-specific injuries, and guide operative planning or, in selected cases, non-operative management. These imaging findings support early goal-directed treatment strategies, including prioritization of hemorrhage control, repair or resection of injured organs, and management of contamination. In many emergency settings, particularly when patients present with hypotension, peritoneal signs, or evidence of ongoing blood loss, individuals with abdominal gunshot wounds are transported directly to the operating theater for emergent exploratory laparotomy. This approach allows both diagnostic exploration and definitive therapeutic intervention within a single procedure, thereby reducing delays in

treatment and improving the likelihood of survival in this high-risk patient population.[4]

Epidemiology

Firearm-related injuries and fatalities constitute a major public health concern in the United States and globally, reflecting a complex interplay of societal, demographic, and environmental factors. In the United States, firearm-related deaths rank as the third leading cause of trauma-associated mortality, underscoring the profound burden these injuries impose on healthcare systems, communities, and families. Statistical analyses reveal that in a typical week, approximately 645 individuals die from firearm violence, while an additional 1,565 people require emergency department treatment for firearm-associated injuries.[5] These numbers illuminate the magnitude of the issue and illustrate that firearm trauma is not only a pressing clinical problem but also a pervasive social and epidemiological challenge. Among youth aged 10 to 24 years, firearm homicide stands as the second leading cause of injury-related death, illustrating the disproportionate vulnerability of adolescents and young adults to interpersonal violence and gun-related assaults. The patterns of firearm mortality shift with age; among adults aged 35 years and older, firearm suicide is the third leading cause of injury death, surpassed only by drug overdoses and motor vehicle collisions. These trends demonstrate that firearm trauma manifests differently across the lifespan, influenced by factors such as mental health, socioeconomic conditions, substance use, and community violence. Cumulatively, firearm injuries remain one of the five leading causes of death for individuals aged 1 to 64 years, revealing a widespread and persistent burden that spans nearly the entire human developmental continuum.[6]

Regional variability also shapes the epidemiology of firearm deaths. A national study conducted between 2010 and 2012 found that nearly half of all firearm-related fatalities occurred in the Southern United States, while the lowest rates were recorded in the Northeast. This regional pattern may reflect differences in firearm access, cultural norms, socioeconomic stressors, and state or local firearm legislation. Beyond the United States, global firearm injury rates are heavily influenced by geopolitical conditions. Nations experiencing war, internal conflict, or political instability often witness dramatically increased rates of abdominal and other penetrating gunshot injuries due to greater availability and circulation of firearms. In such settings, healthcare infrastructures may be ill-equipped to manage the influx of severe trauma cases, elevating mortality and long-term disability. These international trends mirror global concerns about armed conflict, humanitarian crises, and the medical consequences of widespread weapon proliferation. A deeper examination of firearm injury epidemiology also highlights significant racial and

demographic disparities that persist despite public health efforts. Black males experience a firearm homicide rate seven times higher than any other demographic group, reflecting systemic inequities, disparities in exposure to community violence, and structural determinants of health. Conversely, firearm suicide disproportionately affects other groups: non-Hispanic whites and non-Hispanic American Indian/Alaska Native populations account for the majority of firearm-related suicides, often connected to rural isolation, limited access to mental health services, and high rates of firearm ownership within these communities [5][6].

Age remains one of the strongest predictors of firearm injury risk. Young adults aged 25 to 34 years exhibit the highest rate of fatal firearm injuries, a trend that aligns with broader patterns of risk-taking behavior, interpersonal violence, and social vulnerability in early adulthood. The demographic most affected by firearm injury overall is males aged 20 to 24 years, a group consistently shown to be at increased risk for violent encounters, occupational hazards, and behavioral factors that elevate the likelihood of firearm exposure. Overall, males account for 86% of all firearm-related deaths, demonstrating the disproportionate impact of firearm mortality on men across racial, ethnic, and geographic boundaries. Collectively, these epidemiological patterns reveal that firearm injuries—including abdominal gunshot wounds—are not isolated clinical events but rather manifestations of broader social, economic, and structural dynamics. Understanding these trends is essential for developing effective prevention strategies, informing public policy, and strengthening trauma care systems capable of responding to the high burden of firearm-related harm [4][5][6].

Pathophysiology

Abdominal gunshot wounds represent one of the most devastating forms of penetrating trauma due to the complex interplay of high-velocity energy transfer, unpredictable projectile behavior, and the dense concentration of vital structures within the abdominal cavity. The pathophysiological consequences of such injuries often extend far beyond the visible entry wound, as the force generated by a penetrating bullet can cause extensive internal damage involving multiple organ systems simultaneously. When a projectile pierces the abdominal wall, it may disrupt hollow viscera, solid organs, major blood vessels, and supportive connective tissues, frequently resulting in hemoperitoneum and hemorrhagic shock. Even a single gunshot wound has the potential to produce life-threatening internal bleeding, particularly when major arterial structures or large venous networks—such as the aorta, vena cava, or mesenteric vessels—are affected. The rapid accumulation of blood within the peritoneal cavity can impair cardiac output,

decrease organ perfusion, and precipitate irreversible shock if not promptly controlled. The unpredictable trajectory of bullets compounds the severity of abdominal injuries. Once inside the body, projectiles may deflect off bones, change course due to variations in tissue density, or fragment into multiple pieces, thereby enlarging the zone of injury. This variability makes it difficult for clinicians to accurately predict the anatomical structures involved based solely on external examination. Furthermore, temporary cavitation—the rapid expansion and collapse of a cavity around the bullet's pathway—creates additional tissue destruction that surpasses the bullet's direct track. This phenomenon results in microvascular disruption, tissue necrosis, and delayed ischemic injury even in areas not directly struck by the projectile [4][5][6].

Understanding ballistics—the study of projectile motion and energy transfer—is essential for anticipating the nature and extent of internal injuries. Ballistic principles help determine how factors such as bullet velocity, shape, mass, and stability influence tissue damage. High-velocity rounds, for example, impart significantly more kinetic energy, producing a larger cavitation effect and more extensive organ disruption compared to low-velocity projectiles. By integrating knowledge of ballistics with clinical assessment, healthcare providers can better anticipate the probable injury patterns associated with specific gunshot mechanisms. In summary, the pathophysiology of abdominal gunshot wounds is characterized by extensive tissue destruction, unpredictable injury pathways, and a high risk of life-threatening hemorrhage. Rapid recognition and intervention are therefore critical to preventing shock, multi-organ failure, and death in affected patients [5][6].

History and Physical

A comprehensive history and physical examination are foundational components in the evaluation of patients presenting with penetrating abdominal trauma, particularly gunshot wounds, as they provide critical contextual information and influence early decision-making. During initial presentation to the emergency department, obtaining a meticulous and structured history is vital for assessing the potential severity and trajectory of injury. The mechanism of injury is often complex, and patients may be confused, hemodynamically unstable, or unable to communicate due to pain, shock, or altered mental status. In such cases, collateral information becomes indispensable. Paramedics, police officers, and fire rescue personnel who were present at the scene of injury frequently serve as valuable sources, offering insights into the circumstances surrounding the event. Details such as the setting in which the injury occurred, the number of shots heard, the suspected caliber or type of weapon utilized, and whether additional violence or

trauma occurred may help clinicians better anticipate the pattern and extent of internal injury. Moreover, understanding the environment—whether the injury occurred indoors, outdoors, in a confined space, or at close range—may shed light on potential risks for contamination, burn injury, or multi-projectile involvement. In addition to situational context, it is essential to obtain relevant medical history whenever possible. Information about the patient's allergies, current medications, past medical or surgical history, and baseline functional status allows clinicians to anticipate potential complications or contraindications to treatment. For instance, patients taking anticoagulant medication may be at heightened risk for severe hemorrhage, while those with previous abdominal surgeries may harbor adhesions that alter bullet trajectory or complicate surgical intervention. Gathering this information rapidly and efficiently is crucial, especially as these insights may guide the urgency and type of imaging, resuscitative measures, and operative strategies required [6][7].

Ensuring the safety of healthcare providers is an equally important component of early evaluation. Hospital security and law enforcement personnel should be involved when the circumstances of the assault remain unclear or pose potential danger, particularly in cases involving interpersonal violence, ongoing criminal activity, or weapon-related disputes. Maintaining a controlled and secure environment allows the trauma team to focus their efforts on stabilizing the patient without risk of secondary harm. Following the acquisition of an appropriate history, the physical examination—conducted in accordance with the principles of Advanced Trauma Life Support (ATLS)—is the next critical step. The assessment begins with the ABCs: airway, breathing, and circulation, ensuring that life-threatening conditions are immediately identified and addressed. Penetrating abdominal injuries frequently present atypically, making diagnosis challenging and necessitating a high index of suspicion. Beyond obvious pain, patients may exhibit a variety of clinical signs that signal internal injury. These may include hemodynamic instability, tachycardia, hypotension, or signs of shock, which often reflect ongoing internal hemorrhage. Bleeding per rectum, hematuria, or hematemesis may also provide clues regarding the specific organs affected. A focused abdominal examination may reveal external findings such as entry and exit wounds, abrasions, burns, or surrounding ecchymosis. Abdominal distension may indicate internal bleeding or bowel perforation, while diminished or absent bowel sounds can be a sign of peritonitis or ileus. Tenderness to palpation—particularly when accompanied by guarding, rigidity, or rebound tenderness—suggests peritoneal irritation and potential perforation of hollow viscera. In cases of penetrating trauma, it is crucial for clinicians to identify all possible wounds, as multiple entrance or exit points may indicate multiple projectiles or bullet

fragmentation. A systematic inspection of the entire torso, including the flanks, back, perineum, and buttocks, is therefore essential. Serial monitoring of vital signs and repeated physical examinations are indispensable, as the patient's condition may evolve rapidly. Early signs of shock can be subtle, and deterioration may occur abruptly as internal bleeding progresses. Continuous reassessment ensures timely recognition of worsening physiology and allows for rapid escalation of care, including emergent surgical consultation or operative intervention. In sum, a thorough history and physical examination not only serve as the cornerstone of clinical evaluation in abdominal gunshot trauma but also guide the trajectory of subsequent diagnostic imaging, resuscitative efforts, and definitive management [6][7].

Evaluation

The evaluation of a patient with abdominal gunshot trauma follows the fundamental principles of trauma care and begins with a rapid, structured assessment of airway, breathing, and circulation. Securing the airway, ensuring adequate ventilation, and stabilizing circulatory status are the highest priorities, as unaddressed compromise in any of these domains can quickly prove fatal. Once immediate life threats have been identified and managed according to established trauma protocols, attention turns to the diagnosis and characterization of intra-abdominal injury. In the context of penetrating trauma, this diagnostic process is heavily influenced by the patient's hemodynamic status and the presence or absence of peritoneal signs. In hemodynamically stable patients without clinical evidence of peritonitis, contrast-enhanced computed tomography (CT) of the abdomen and pelvis represents a central diagnostic modality. Modern CT imaging offers high sensitivity and specificity for detecting intraperitoneal free fluid, solid organ lacerations or contusions, active contrast extravasation suggestive of ongoing hemorrhage, and associated injuries such as retroperitoneal hematomas or diaphragmatic disruption. The capacity of CT to delineate bullet trajectory and define the extent of soft tissue and organ involvement allows clinicians to distinguish injuries that can be managed non-operatively from those necessitating surgical intervention. Importantly, CT evaluation is most appropriate when the patient's vital signs are relatively stable, permitting the time and transport required to complete the scan safely. By contrast, in patients who are hemodynamically unstable or showing signs of rapid deterioration, immediate bedside imaging is preferred over more time-consuming diagnostic procedures. In this setting, the Extended Focused Assessment with Sonography for Trauma (EFAST) is recognized as the ideal initial radiologic assessment. The EFAST examination is a point-of-care ultrasound protocol designed for use in critically ill or injured patients. It extends the traditional FAST exam by incorporating

evaluation of the pleural spaces for pneumothorax or hemothorax in addition to detecting intraperitoneal and pericardial fluid. As a rapid, repeatable, and non-invasive tool, EFAST enables clinicians to identify life-threatening hemorrhage or cardiac tamponade within minutes at the bedside, allowing immediate decisions regarding resuscitation and operative management.[7]

The EFAST study focuses on a series of defined anatomical windows. The right upper quadrant view is one of the most clinically significant components because intraperitoneal hemorrhage often accumulates in this area due to gravitational and anatomical factors. In this view, the examiner evaluates the inferior pole of the right kidney, the subphrenic space between the diaphragm and liver, and the hepatorenal recess, commonly known as Morrison's pouch, as well as the right pleural space. Free fluid appearing in these potential spaces is highly suggestive of intra-abdominal bleeding. The left upper quadrant view targets the peri-splenic region and allows visualization of the inferior pole of the left kidney, the subphrenic space on the left side, the splenorenal recess, and the left pleural space. Detection of fluid in these areas similarly raises concern for splenic or renal injury with associated hemoperitoneum. The suprapubic window offers information about fluid accumulation in the dependent pelvic spaces. In female patients, this view permits assessment of the pouch of Douglas, the rectouterine recess located between the uterus and rectum, where blood or free fluid may collect. In male patients, attention is directed to the rectovesical space between the bladder and rectum. The presence of anechoic or hypoechoic fluid in these regions can indicate lower abdominal or pelvic injury with intraperitoneal hemorrhage. Another critical component of the EFAST exam is the subcostal or subxiphoid view, which allows visualization of the pericardium and assessment for hemopericardium. The identification of fluid within the pericardial sac suggests the possibility of cardiac injury and tamponade, conditions that demand immediate intervention. Additionally, the pulmonary or pleural views in EFAST focus on the thoracic cavity, enabling identification of pneumothorax or hemothorax through evaluation of lung sliding and the presence of pleural fluid or air. This thoracic extension is particularly valuable in penetrating trauma to the torso, where both thoracic and abdominal structures may be involved [7].

The indications for performing an EFAST examination include both blunt and penetrating trauma to the torso when there is suspicion of intraperitoneal hemorrhage, pericardial tamponade, or hemothorax. In abdominal gunshot wounds, where multiple organ systems can be injured along a single bullet path, EFAST serves as a rapid screening tool that helps distinguish patients who may benefit from

emergent laparotomy from those who might undergo further imaging or observation. With training and experience, healthcare professionals become proficient in quickly recognizing abnormal anatomic patterns and differentiating between physiological and pathological fluid collections in the pleural, peritoneal, and pericardial spaces. Despite the utility of CT and EFAST, it is essential to emphasize that imaging must never delay life-saving operative intervention in unstable patients. In individuals with penetrating abdominal gunshot wounds who exhibit peritonitis, hemodynamic instability, or clear signs of ongoing intra-abdominal bleeding, the standard of care is immediate operative exploration. Clinical findings such as diffuse abdominal tenderness, rigidity, rebound tenderness, or severe hypotension in the context of known penetrating trauma are sufficient to proceed directly to surgery without waiting for confirmatory imaging. Exploratory laparotomy in these scenarios functions both as a diagnostic and therapeutic procedure, allowing direct visualization of the intra-abdominal cavity, identification of injuries to solid and hollow organs, and rapid control of hemorrhage and contamination. In summary, the evaluation of abdominal gunshot wounds is a dynamic process that integrates fundamental trauma assessment principles with judicious use of diagnostic imaging. Hemodynamic status and physical examination findings guide the choice between CT in stable patients and EFAST in unstable or rapidly deteriorating patients. While these modalities significantly enhance diagnostic accuracy and inform management strategies, the overarching principle remains that in patients with penetrating abdominal trauma complicated by peritonitis or shock, operative intervention is the mainstay of care and should not be postponed in favor of additional diagnostic testing [7].

Treatment / Management

Treatment and management of abdominal gunshot injuries begins at the moment of first contact with the victim, typically by prehospital providers such as paramedics, emergency medical technicians, or trained first responders. Early interventions carried out at the scene play a decisive role in determining prognosis and overall survival. The initial priorities follow standard trauma principles, with emphasis on rapid assessment and stabilization of the airway, breathing, and circulation. Establishing and maintaining a patent airway is paramount, particularly in patients with altered mental status, decreased level of consciousness, or compromised protective reflexes. Once the airway is secured, attention shifts to ventilation and oxygenation; assessment of respiratory effort and breath sounds is essential, as the presence of an abdominal wound does not exclude simultaneous thoracic, diaphragmatic, or other extra-abdominal injuries. Penetrating projectiles may traverse the

thoracoabdominal region, and life-threatening injuries to the lungs, heart, or great vessels must always be considered. Cervical spine protection should be implemented when the mechanism of injury suggests associated blunt trauma, falls, or high-energy transfer sufficient to raise concern for spinal injury. Hemorrhage control is the next critical pillar of early management. Prehospital providers should attempt to limit ongoing blood loss using direct pressure over visible bleeding sites. In the field, available materials such as gauze, bandages, clothing, or towels may be repurposed as pressure dressings to encourage hemostasis. While tourniquets are highly effective in extremity hemorrhage, their applicability is limited in abdominal gunshot wounds due to anatomical constraints; however, in junctional areas or when associated limb injuries are present, appropriately applied tourniquets may be lifesaving. Continuous reassessment of vital signs is essential, and if at any point the patient is found to be apneic or pulseless, cardiopulmonary resuscitation (CPR) should be initiated immediately in accordance with established resuscitation protocols. For patients demonstrating hemodynamic instability, prehospital providers should begin aggressive fluid resuscitation as permitted by local protocols and transport times, with the goal of maintaining perfusion to vital organs without exacerbating bleeding [8].

Upon arrival at the emergency department, resuscitation efforts are intensified and refined. Intravenous access is secured with large-bore cannulas to allow rapid administration of crystalloids and blood products. Early blood sampling for type and screen is crucial so that crossmatched blood can be made available as soon as possible. In many institutions, type O negative packed red blood cells are prepared for immediate transfusion in exsanguinating patients, as this blood type carries the lowest risk of severe acute hemolytic reactions when transfused emergently before full crossmatching can be completed.[8] In centers equipped with a massive transfusion protocol, this may be activated for severely unstable patients with ongoing blood loss, allowing coordinated delivery of red blood cells, plasma, and platelets in balanced ratios to address both oxygen-carrying capacity and coagulopathy. Definitive management decisions for abdominal gunshot wounds are guided by the patient's clinical status and objective findings from the physical examination and adjunctive investigations. All patients who exhibit signs of peritoneal hemorrhage, generalized peritonitis, uncontrolled active bleeding, or worsening hemodynamic parameters despite resuscitation are candidates for immediate exploratory laparotomy.[9] In such cases, delay for extensive diagnostic imaging may be dangerous, and operative intervention serves as both a diagnostic and therapeutic strategy, enabling direct visualization of the injury pattern, control of hemorrhage, repair or resection of damaged organs, and reduction of

contamination from gastrointestinal perforations. Damage control surgery may be indicated in profoundly unstable patients, prioritizing rapid hemorrhage and contamination control followed by temporary abdominal closure and staged definitive repair once physiological derangements have been corrected in the intensive care unit [8][9].

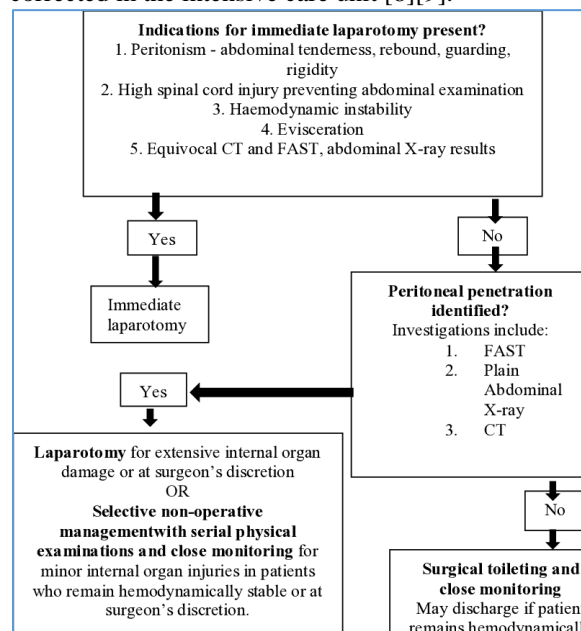


Fig. 2: Management of abdominal gunshot wound.

Non-operative management, while less invasive, must be selected with great caution and is typically reserved for hemodynamically stable patients without signs of peritonitis or ongoing blood loss and with injury patterns amenable to conservative treatment. These decisions rely heavily on the clinical judgment of the treating team and are usually supported by detailed imaging, especially contrast-enhanced CT scans demonstrating contained injuries, absence of major vascular disruption, and minimal hemoperitoneum. Even in such cases, non-operative management requires the ability to provide continuous monitoring, rapid access to surgical intervention if the patient deteriorates, and clearly established thresholds for conversion to operative treatment. Because not all facilities have surgical or intensive care capabilities, early recognition of the need for specialized care and timely transfer to a trauma center can be lifesaving. Pharmacologic management complements surgical and resuscitative strategies. Tetanus prophylaxis should be administered according to immunization status and institutional protocols, given the penetrating and often contaminated nature of gunshot wounds. Broad-spectrum intravenous antibiotics are frequently indicated to reduce the risk of intra-abdominal infection, abscess formation, and sepsis, especially when hollow viscus perforation or gross contamination is suspected.¹⁰ Adequate analgesia is essential for humane care and to reduce physiologic stress responses that may worsen hemodynamic

instability. Opioid and non-opioid analgesics may be employed judiciously, with close monitoring of respiratory function. Anxiolytics may be useful to alleviate severe anxiety, agitation, or psychological distress, provided they do not compromise airway protection or mask important clinical signs [8][9].

Once initial resuscitation has achieved relative hemodynamic stability, ongoing management focuses on vigilant surveillance for clinical deterioration. Patients with abdominal gunshot wounds should undergo frequent reassessment of vital signs, including heart rate, blood pressure, respiratory rate, oxygen saturation, and urine output, as these parameters offer valuable insight into circulatory adequacy and end-organ perfusion. Serial physical examinations of the abdomen are crucial for detecting evolving peritonitis, increasing tenderness, distension, or rigidity that may signify delayed perforation, ongoing hemorrhage, or ischemic complications. Laboratory analyses, including serial hemoglobin and hematocrit levels, coagulation studies, lactate, and base deficit, are used to track trends in blood loss, tissue perfusion, and the development of coagulopathy or metabolic acidosis. In patients managed operatively, postoperative care encompasses close monitoring in an intensive care or high-dependency setting, with attention to ventilatory support, fluid and electrolyte balance, infection prevention, and early recognition of complications such as anastomotic leakage, abscess, or organ failure. Nutritional support, early mobilization when feasible, and multidisciplinary rehabilitation are important components of longer-term recovery. Throughout the continuum of care—from prehospital response to definitive treatment and postoperative management—effective communication, coordinated teamwork, and adherence to evidence-based trauma protocols are essential to optimize outcomes in individuals suffering from abdominal gunshot injuries [8][9].

Differential Diagnosis

The differential diagnosis of abdominal trauma in the setting of suspected firearm injury begins with a careful distinction between penetrating and non-penetrating mechanisms, as this classification has immediate implications for evaluation and management. Clinicians must first determine whether the integrity of the abdominal wall has been breached, recognizing that even small, seemingly innocuous wounds may conceal deep penetration into the peritoneal cavity. For penetrating injuries, the differential diagnosis encompasses gunshot wounds, stab wounds, and other mechanisms such as impalement by sharp objects, blast-related shrapnel, or high-velocity industrial fragments. A detailed and structured history of the incident is central to refining this differential. Information regarding whether a firearm was involved, the type of weapon, the distance at which it was discharged, and

the number of reported shots can help distinguish between single- and multiple-projectile injuries and between low- and high-velocity mechanisms. Similarly, in the absence of a clear firearm history, the possibility of a stab wound—whether self-inflicted, accidental, or assault-related—must be carefully considered, particularly when there are linear lacerations or wounds in typical locations such as the epigastrium or flanks. Non-penetrating abdominal trauma, including blunt mechanisms such as motor vehicle collisions, falls, or physical assault, should also remain in the differential diagnosis, especially when the history is incomplete or the patient is unable to communicate. In such scenarios, ecchymosis, seatbelt marks, or diffuse tenderness may suggest occult blunt injury with underlying solid organ or hollow viscus damage rather than, or in addition to, penetrating trauma. In some cases, mixed mechanisms occur—for example, a combination of blunt impact from a fall and penetration from an object encountered during the incident. Concomitant thoracic or pelvic injuries may further obscure the clinical picture. Ultimately, the history of the event, corroborated by prehospital reports and any available witnesses, is indispensable for narrowing the differential and guiding the use of imaging and operative exploration in patients with suspected penetrating abdominal injury [9].

Prognosis

The prognosis of patients with abdominal gunshot wounds is closely linked to the rapidity and quality of early, goal-directed management, yet it is fundamentally determined by the severity, location, and extent of the injuries sustained, as well as the time elapsed before definitive care is initiated. Early resuscitative efforts aimed at securing the airway, maintaining adequate ventilation, and restoring circulatory stability are essential but must be coupled with prompt surgical evaluation when indicated. Standard management typically includes hemostatic interventions, transfusion of blood and blood products, cardiopulmonary support, and operative repair or resection of damaged intra-abdominal structures, with concurrent attempts to remove or control foreign objects such as bullets or fragments.[11] Timely surgical intervention, particularly in the setting of major vascular injury or hollow viscus perforation, has the potential to reduce both mortality and long-term morbidity by limiting hemorrhage, contamination, and progression to sepsis or multi-organ failure. Despite advances in trauma systems, operative techniques, and critical care, mortality associated with abdominal gunshot wounds remains high. This is largely attributable to the highly variable and often devastating nature of ballistic trauma. The caliber of the bullet, its velocity, yaw, fragmentation, and ultimate trajectory within the abdominal cavity all influence the magnitude of tissue destruction. High-energy transfer can result in

extensive cavitation, shattering of solid organs, disruption of major vessels, and complex multi-organ involvement. Even with rapid transport and sophisticated trauma care, patients with massive intra-abdominal hemorrhage or multiple critical organ injuries may succumb within hours of injury [10][11]. Epidemiologic data highlight the gravity of these injuries. A study of trauma patients in Philadelphia between 2003 and 2007 evaluated outcomes for individuals with penetrating trauma from stab and gunshot wounds who presented to eight Level I and Level II adult trauma centers. Of the 4,122 patients included, 2,961 were transported by emergency medical services and 1,161 by police, with an overall mortality rate of 27.4 percent.[12] Notably, approximately 77.9% of these patients had sustained gunshot wounds, while 22.1% had stab wounds. Roughly one-third of individuals with gunshot wounds died from their injuries, compared with about 7.7% of those with stab wounds, underscoring the significantly higher lethality associated with firearm-related abdominal trauma. These figures emphasize the need for rapid recognition, early definitive intervention, and ongoing refinement of trauma protocols to improve outcomes [12].

Complications

Abdominal gunshot wounds are associated with a broad spectrum of acute and chronic complications that can significantly influence both short-term survival and long-term quality of life. One of the most immediate and life-threatening complications is exsanguination, in which uncontrolled hemorrhage from major intra-abdominal vessels or solid organs rapidly leads to hypovolemic shock, cardiovascular collapse, and death if not promptly addressed. Even when initial bleeding is partially controlled, inadequate resuscitation can perpetuate tissue hypoperfusion, acidosis, and coagulopathy, creating a vicious cycle that complicates operative and postoperative management. Airway collapse or respiratory compromise may occur secondary to massive blood loss, associated thoracic injury, or decreased level of consciousness, highlighting the importance of early airway control and ventilatory support. Peritonitis is another major complication, often resulting from perforation of hollow viscera such as the stomach, small bowel, or colon, leading to spillage of gastrointestinal contents into the peritoneal cavity. If not rapidly recognized and managed, localized contamination can progress to diffuse intra-abdominal sepsis, which may manifest as abscess formation, systemic inflammatory response, septic shock, and multi-organ failure. Surgical interventions themselves carry inherent risks; anastomotic leakage, inadequate source control, or persistent contamination may precipitate intra-abdominal sepsis or the formation of enterocutaneous or enteroenteric fistulas. Wound complications are also common,

including wound dehiscence—where the surgical incision partially or completely separates—hematoma formation, and superficial or deep surgical site infections. These complications may prolong hospitalization, necessitate reoperation, and increase the risk of incisional hernia and disfiguring scarring over time. In the longer term, patients may experience chronic pain, adhesions, bowel obstruction, and functional impairment related to organ loss or stoma creation. Psychological sequelae such as post-traumatic stress disorder, anxiety, and depression are also frequent but often underrecognized consequences of violent trauma. Ultimately, death remains the most serious complication, particularly in patients with severe initial injury, delayed presentation, or inadequate access to trauma and critical care services. Recognizing these potential complications and instituting vigilant surveillance, early interventions, and rehabilitative support are critical components of comprehensive care for survivors of abdominal gunshot wounds [12].

Postoperative and Rehabilitation Care

Postoperative care following surgery for abdominal gunshot wounds is individualized according to the specific injuries identified and operative procedures performed, yet several overarching principles apply. Pain control is a cornerstone of postoperative management; adequate analgesia not only improves patient comfort but also facilitates deep breathing, coughing, and early mobilization, thereby reducing the risk of pulmonary complications such as atelectasis and pneumonia. Multimodal analgesic strategies may be employed to minimize opioid requirements while maintaining effective pain relief. Early consideration of enteral nutrition is equally important. Once gastrointestinal continuity and integrity are deemed sufficient, initiating enteral feeding supports mucosal integrity, modulates the immune response, and promotes wound healing, while parenteral nutrition may be reserved for patients with prolonged ileus, high-output fistulas, or complex bowel resections. Prevention of venous thromboembolism is another critical element of postoperative care. Patients with major trauma, recent surgery, and prolonged immobilization are at elevated risk of deep vein thrombosis and pulmonary embolism. Pharmacologic prophylaxis, when not contraindicated by ongoing bleeding risk, combined with mechanical measures such as intermittent pneumatic compression devices, is recommended to mitigate this risk. Close monitoring in a high-dependency or intensive care unit is often required in the immediate postoperative period, especially for patients with significant hemodynamic instability, extensive injuries, or major transfusion requirements. Continuous assessment of vital signs, urine output, laboratory parameters—including hemoglobin, coagulation profile, and inflammatory markers—and repeated physical

examinations are crucial to detect early signs of complications such as rebleeding, anastomotic leak, intra-abdominal abscess, or evolving organ dysfunction. Rehabilitation care begins as soon as the patient is clinically able to participate. Early mobilization, respiratory physiotherapy, and progressive activity help restore functional capacity and reduce the risk of deconditioning and thromboembolic events. Long-term recovery may involve nutritional counseling, stoma education when applicable, and structured physical therapy. Psychological support is also an integral component of rehabilitation, as survivors of violent trauma frequently experience emotional distress, anxiety, and post-traumatic stress symptoms. Comprehensive postoperative and rehabilitative care, delivered by a coordinated multidisciplinary team, is essential for optimizing functional outcomes, promoting reintegration into daily life, and addressing both the physical and psychosocial consequences of abdominal gunshot injuries [10][11][12].

Consultations

The management of abdominal gunshot wounds requires a coordinated, multidisciplinary approach, and timely consultation with key specialties is essential to provide comprehensive and effective care. Emergency medicine specialists are typically the first physicians to evaluate the patient on arrival, leading initial resuscitation, organizing diagnostic testing, and coordinating with other team members in accordance with established trauma protocols. General surgery and trauma surgery are central to the management pathway; these surgeons assess the need for operative intervention, perform exploratory laparotomy or other procedures, and oversee postoperative surgical care. In many institutions, dedicated trauma surgeons possess specialized expertise in damage control surgery, vascular repair, and complex abdominal reconstruction, which are often required in high-velocity firearm injuries. Radiology plays a pivotal role in diagnostic evaluation. Radiologists and sonographers contribute through interpretation of EFAST examinations, CT scans, and other imaging studies that help delineate bullet trajectory, characterize organ-specific damage, and identify associated injuries in the chest, pelvis, or retroperitoneum. Anesthesia teams are integral during operative management, providing hemodynamic monitoring, advanced airway control, anesthetic care, and perioperative resuscitation, especially in unstable or massively transfused patients. Their expertise in managing shock, coagulopathy, and complex ventilatory requirements is indispensable in achieving intraoperative and immediate postoperative stability. Forensic pathology consultation may be necessary in cases where the injury is associated with criminal activity, medico-legal investigation, or fatal outcome. Forensic specialists can assist in documenting wound

characteristics, reconstructing ballistic trajectories, and preserving evidence in a manner consistent with legal standards. In some settings, additional consultations may include critical care, infectious diseases, psychiatry, social work, and rehabilitation services, depending on the patient's clinical course and psychosocial needs. Ultimately, effective communication and collaboration among all consulting disciplines enhance the quality of care, streamline decision-making, and improve outcomes in patients with abdominal gunshot trauma [11][12].

Other Issues

Several key insights have emerged over recent decades regarding the management of abdominal gunshot wounds, reflecting both advances in trauma systems and enduring challenges. Mortality rates have substantially decreased as specialized trauma centers have refined protocols for rapid assessment, resuscitation, and operative management. The integration of standardized approaches such as Advanced Trauma Life Support, early activation of trauma teams, use of EFAST and CT imaging, and implementation of massive transfusion protocols has contributed to more efficient care and improved survival. Nonetheless, abdominal gunshot wounds remain distressingly common in many parts of the United States, particularly in urban environments with high rates of interpersonal violence. Beyond clinical care, healthcare professionals occupy a unique position within society to advocate for primary prevention of firearm-related injuries. Each encounter with a patient or family affected by gun violence provides an opportunity to discuss firearm safety, including secure storage practices, safe handling, and risk mitigation strategies for households with children or individuals at risk of self-harm. Educational messages emphasizing the inherent dangers of firearms, the importance of keeping weapons unloaded and locked, and the separation of firearms from ammunition can be promoted in a nonjudgmental, culturally sensitive manner. At a broader level, healthcare systems and professional organizations can engage in public health initiatives and community partnerships aimed at violence prevention, conflict resolution, and injury reduction. Other important issues include the psychosocial and economic impact of abdominal gunshot wounds. Survivors may face prolonged hospitalization, loss of income, long-term disability, and psychological trauma, all of which have ripple effects on families and communities. Awareness of these broader consequences underscores the importance of comprehensive follow-up care, including mental health support and social services. In this context, trauma care extends beyond the operating room and intensive care unit, encompassing a continuum of prevention, acute management, rehabilitation, and societal engagement aimed at reducing the burden of firearm-related harm [12].

Enhancing Healthcare Team Outcomes

Improving outcomes for patients with abdominal gunshot wounds depends heavily on the performance and coordination of the entire healthcare team. The persistently high mortality associated with these injuries is largely attributable to the high-velocity, penetrating nature of firearm trauma, the propensity for rapid onset of hemorrhagic shock, and the potential for catastrophic injury to vital organs and major intraperitoneal vessels. Most deaths occur within the first 24 hours following injury, often within minutes to hours, underscoring the need for streamlined, well-rehearsed response systems. Enhancing team performance begins with robust training in trauma protocols, including regular simulation exercises that rehearse airway management, damage control resuscitation, activation of massive transfusion protocols, and rapid operative decision-making. Interdisciplinary communication is critical. Trauma care involves a complex interface among prehospital providers, emergency physicians, surgeons, anesthesiologists, radiologists, critical care specialists, nurses, and ancillary staff. Clearly defined roles, structured handoffs, and standardized communication tools (such as checklists and briefings) help minimize errors, reduce delays, and ensure that vital clinical information is shared efficiently. Early involvement of senior trauma and surgical staff can expedite operative decisions and avoid unnecessary diagnostic delays in unstable patients. Continuous quality improvement programs, including morbidity and mortality conferences, trauma registries, and protocol reviews, enable teams to analyze outcomes, identify system gaps, and implement targeted improvements. Education and support for nursing staff, technicians, and allied health professionals are equally important, as these team members are often responsible for executing critical tasks such as monitoring, medication administration, and wound care. Fostering a culture of safety, where all team members feel empowered to speak up about concerns, contributes to error reduction and patient protection. Finally, addressing provider well-being and psychological resilience is essential, given the emotional toll of caring for victims of severe violence. Through coordinated efforts in training, communication, systems design, and support, healthcare teams can improve the timeliness, effectiveness, and compassion of care delivered to patients suffering from abdominal gunshot wounds, ultimately translating into better survival and recovery [10][11][12].

Conclusion:

In conclusion, the management of abdominal gunshot wounds is a time-critical, high-stakes endeavor that demands a seamless, protocol-driven response from the moment of injury. The pathophysiological complexity, driven by ballistic energy and unpredictable trajectories, results in high morbidity and mortality, with most deaths occurring

within the first 24 hours. The cornerstone of survival is a rapid transition from prehospital stabilization—focusing on the ABCs and hemorrhage control—to definitive care in a trauma center. Clinical decision-making is primarily guided by the patient's hemodynamic stability: instability or peritonitis mandates immediate exploratory laparotomy, while stability allows for CT-based evaluation. The EFAST exam serves as a crucial rapid diagnostic tool. Ultimately, successful outcomes depend on the coordinated efforts of a multidisciplinary team, including EMS, emergency physicians, trauma surgeons, anesthesiologists, and radiologists, all working within an established trauma system. While advances in trauma care have improved survival, the persistently high mortality associated with these injuries highlights the ongoing need for optimized clinical protocols and, fundamentally, a public health commitment to primary prevention of firearm violence.

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