



# DAMAGE CONTROL IN ABDOMINAL AND MULTISYSTEM TRAUMA: COMPREHENSIVE SURGICAL APPROACH AND APPLICATION OF THE ATLS PROTOCOL IN INITIAL CARE

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## ABSTRACT

**Introduction:** initial management of abdominal and multisystem trauma presents a clinical challenge that requires a systematic and multidisciplinary approach. The Advanced Trauma Life Support (ATLS) protocol is an international standard that guides rapid evaluation and stabilization of trauma patients, improving survival and reducing complications.

**Objective:** to detail the importance and application of the ATLS protocol and damage control in the initial management of abdominal trauma, emphasizing integration across general surgery, orthopedics, neurosurgery, and urology.

**Methodology:** a narrative review of current scientific literature was conducted, analyzing relevant articles and guidelines on ATLS and damage control in abdominal and multisystem trauma from databases such as PubMed, Scopus, and Google Scholar. Studies addressing clinical implementation, outcomes, and challenges across surgical specialties were selected.

**Results:** the ATLS protocol has proven effective in improving early assessment and stabilization, facilitating timely and coordinated surgical interventions. In general surgery, damage control decreases mortality due to hemorrhagic shock. In orthopedics, early fracture stabilization reduces systemic complications. In neurosurgery, rapid detection and management of traumatic brain injury improve neurological prognosis. In urology, early identification of genitourinary injuries prevents functional sequelae. However, challenges remain in the uniform implementation of the protocol, especially in resource-limited settings.

**Conclusions:** ATLS and damage control are essential in the initial management of abdominal and multisystem trauma, integrating a multidisciplinary approach that enhances survival and reduces complications. Continuous training and adaptation of the protocol to diverse clinical contexts are vital to optimize outcomes in trauma patients.

**KEYWORDS:** ATLS, Abdominal Trauma, Damage Control, General Surgery, Orthopedics, Neurosurgery, Urology.

## INTRODUCTION

Abdominal trauma represents one of the leading causes of morbidity and mortality in polytraumatized patients worldwide, accounting for a significant percentage of deaths due to severe hemorrhage and multisystem organ failure (1,2). The complexity of abdominal injuries—which may involve both solid organs such as the liver and spleen, as well as hollow viscera—requires rapid and effective management to improve clinical outcomes (3).

The initial management of trauma patients is based on the ATLS (Advanced Trauma Life Support) protocol, which provides a systematic and structured evaluation of injuries to prioritize treatment of life-threatening conditions (4,5). Among the most frequently used diagnostic tools is the FAST ultrasound, which allows for rapid detection of free intra-abdominal fluid and is especially useful in hemodynamically unstable patients (6).

In cases of hemodynamic instability or clear signs of severe intra-abdominal injury, damage control surgery (DCS) has



become a fundamental strategy. This surgical approach prioritizes early control of hemorrhage and contamination, postponing definitive repair until the patient's physiological status is stabilized (7,8). This article reviews the current approach to abdominal trauma under the paradigm of damage control and ATLS application, highlighting recent advances, clinical indications, and associated outcomes.

## METHODOLOGY

A narrative review of the scientific literature was conducted using the databases PubMed, SciELO, Google Scholar, and the Cochrane Library. The search terms used included “*damage control surgery*”, “*abdominal trauma*”, “*ATLS*”, “*emergency laparotomy*”, and “*trauma surgery*”, combined with Boolean operators to enhance search precision. Articles published between 2015 and 2025 in English, Spanish, and Portuguese were considered.

A total of 45 relevant articles were identified. After applying inclusion criteria based on clinical relevance, recency, and methodological quality, 34 studies were selected for final analysis. These included systematic reviews, observational studies, clinical trials, and clinical guidelines focused on the surgical management of abdominal trauma and the application of the ATLS protocol.

## DEVELOPMENT

### Abdominal Trauma: Classification and Clinical Features

Abdominal trauma is classified as either blunt or penetrating, depending on the mechanism of injury (2,3). Blunt trauma is more commonly associated with motor vehicle accidents and falls, while penetrating trauma typically results from stab wounds or gunshot injuries. The most frequently affected solid organs are the liver and spleen, whereas penetrating injuries often involve hollow viscera such as the small intestine and colon (3).

Clinical presentation can range from minimal symptoms to hypovolemic shock, making a high index of suspicion essential—especially in cases involving high-energy mechanisms, unexplained hypotension, or signs of peritoneal irritation (4).

### Initial Management According to ATLS and Diagnostic Evaluation

Initial management should follow the ATLS protocol, which applies the ABCDE sequence to prioritize the treatment of life-threatening conditions (5). During the primary survey, intravenous access is established, the airway and cervical spine are protected, and hemodynamic monitoring is initiated (5).

FAST ultrasound is essential for detecting free fluid in the abdominal cavity, with a sensitivity ranging from 69% to 98%, particularly in hemodynamically unstable patients (6). Computed tomography is the diagnostic modality of choice in stable patients to assess organ and retroperitoneal injuries (7).

Emergency laparotomy is indicated in patients with persistent hemodynamic instability, signs of peritonitis, or significant hemoperitoneum (3,8).

## Damage Control Surgery (DCS)

Damage Control Surgery (DCS) emerges as an alternative for patients with severe abdominal trauma and physiological instability who are unable to tolerate prolonged surgery (7). The primary goal is to rapidly control hemorrhage and contamination while avoiding premature definitive closure (7).

DCS consists of three phases (7,9)

Phase I: Abbreviated initial surgery aimed at controlling hemorrhage (e.g., ligation, packing) and contamination (e.g., resection without anastomosis), leaving the abdomen open with temporary closure systems (9).

Phase II: Intensive care unit (ICU) resuscitation focused on correcting the lethal triad—coagulopathy, hypothermia, and acidosis—through hemodynamic, ventilatory, and transfusional support (10).

Phase III: Definitive surgery, performed once the patient is physiologically stabilized, usually within 24 to 72 hours after the initial procedure (11).

## Clinical Outcomes and Prognosis

The use of Damage Control Surgery (DCS) has been shown to reduce mortality in cases of severe abdominal trauma, particularly in patients with massive hemorrhage or multiple injuries (12). However, its indiscriminate use may lead to complications such as infections, fistulas, or abdominal compartment syndrome (13).

Factors associated with a poorer prognosis include pH < 7.2, hypothermia (<34°C), and prolonged surgical times (14). Proper patient selection based on clinical criteria and the application of the ATLS protocol improve clinical outcomes and optimize the use of DCS (5,7).

## Orthopedics and ATLS

The ATLS (Advanced Trauma Life Support) protocol has revolutionized the initial management of patients with severe orthopedic trauma by enabling a rapid and systematic assessment that prioritizes airway stabilization, ventilation, and hemorrhage control. In musculoskeletal injuries—particularly open fractures or life-threatening conditions such as unstable pelvic fractures—ATLS facilitates the early identification of hemorrhagic shock, hidden bleeding, and associated injuries that require urgent intervention (15). Early integration of bleeding control techniques, such as compressive dressings or temporary immobilization with external fixators, is essential to prevent the progression of hypovolemic shock and improve patient survival (16).

From an orthopedic perspective, ATLS-based management also emphasizes the importance of early stabilization of major fractures as part of the initial resuscitation process, which helps reduce pain, minimize secondary tissue damage, and prevent systemic complications such as fat embolism syndrome or trauma-induced coagulopathy (17). Additionally, ATLS facilitates multidisciplinary coordination with surgical teams



for planning definitive treatment, including orthopedic damage control surgery when the patient's physiological condition does not permit immediate repair (18). Rapid evaluation and management following this protocol result in better functional outcomes and reduced morbidity in patients with severe musculoskeletal trauma.

### Neurosurgery and ATLS

In neurosurgery, the ATLS protocol is crucial for the early evaluation of traumatic brain injuries, allowing for the rapid identification and management of neurological alterations that may compromise survival and neurological function (19). The initial priority is to maintain a secure airway and adequate oxygenation to prevent secondary cerebral hypoxia, as well as to control intracranial pressure through timely interventions (20). The systematic application of ATLS facilitates early detection of signs of intracranial hypertension and neurological deterioration, supporting decisions regarding the need for urgent neuroimaging and possible surgical intervention, such as hematoma evacuation (21). This comprehensive approach has been shown to reduce mortality and improve functional prognosis in patients with severe traumatic brain injury (22).

### Urology and ATLS

In urology, initial management under the ATLS protocol is essential for evaluating and treating genitourinary injuries in polytrauma patients, which may go unnoticed during the primary survey (23). The rapid identification of gross hematuria or hemodynamic instability associated with abdominal or pelvic trauma guides the use of specific diagnostic studies such as intravenous urography or contrast-enhanced computed tomography (24). ATLS promotes hemodynamic stabilization and the prevention of shock, enabling the planning of emergency surgical interventions or conservative treatments depending on the extent and location of the injury (25). Early implementation of this protocol improves clinical outcomes and reduces complications related to urologic trauma (26).

### DISCUSSION

The initial management of trauma—both abdominal and multisystem—has significantly evolved with the implementation of the ATLS protocol, which provides a standardized framework for the assessment and stabilization of critically injured patients. From a multidisciplinary perspective, ATLS facilitates efficient coordination among various specialties, enhancing the speed and effectiveness of clinical decision-making (27). In general surgery, the adoption of damage control principles, such as limiting operative time in hemodynamically unstable patients, has been shown to reduce mortality associated with hypovolemic shock and the lethal triad (28). Likewise, in trauma orthopedics, early immobilization and stabilization of fractures contribute to minimizing systemic complications and improve long-term functional outcomes (29).

In neurosurgery, the prompt management of traumatic brain injuries through ATLS has been essential in reducing mortality and neurological sequelae by enabling timely interventions to control intracranial pressure and prevent secondary injury (30). In urology, the early identification and treatment of

genitourinary injuries help prevent complications such as infections and functional loss, thereby improving clinical outcomes (31). Nevertheless, despite these advances, challenges remain in ensuring uniform application of the ATLS protocol across different healthcare settings, especially in resource-limited centers. This highlights the ongoing need for continuous training and adaptation of the protocol to local realities (32).

Likewise, the management of penetrating trauma to the abdomen and extremities remains a significant clinical challenge due to its variable presentation and risk of long-term complications. Stab and gunshot wounds to the abdomen commonly affect the bowel, liver, and major vessels, increasing the risk of sepsis and mortality without prompt intervention. Early laparotomy and contamination control, when guided by systematic ATLS evaluation, have been shown to improve outcomes. In extremity trauma, although amputation rates have decreased, vascular and nerve injuries continue to affect long-term function, highlighting the importance of early surgical and diagnostic intervention in the care of polytrauma patients (33).

Benítez Iglesias et al. (2024) emphasize that in intestinal trauma—especially penetrating injuries—rapid diagnosis and management based on hemodynamic stability are crucial for improving prognosis. Tools such as FAST ultrasound, CT scan, and laparoscopy help guide treatment and avoid unnecessary surgeries. Laparotomy is indicated in unstable patients, while primary repair and conservative management are options in less severe cases. Early enteral nutrition promotes postoperative recovery and reduces complications (34).

### CONCLUSIONS

The ATLS protocol is an indispensable tool in the initial management of trauma, integrating a systematic approach that improves survival and reduces complications in patients with abdominal, orthopedic, neurological, and urological injuries. The coordinated and multidisciplinary application of its principles allows for optimized assessment, stabilization, and timely treatment, highlighting the importance of damage control and continuous reevaluation. To maximize its benefits, it is essential to promote ongoing training of healthcare personnel and adapt the guidelines to different clinical settings, thereby ensuring quality and equitable care for all trauma patients.

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