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REVIEW / DERLEME

Updates in Emergency Department Trauma Management: A Narrative Review

Acil Serviste Travma Yönetimindeki Güncellemeler: Bir Derleme

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ABSTRACT

Traumatic injury remains a major global cause of death and disability, with uncontrolled hemorrhage continuing to represent one of the leading causes of early preventable death after trauma. This narrative review summarizes current evidence-based updates in emergency department (ED) trauma management. The primary survey algorithm has been revised to "x-ABCDE," placing immediate hemorrhage control before airway assessment. Aggressive crystalloid resuscitation has been replaced by damage control resuscitation (DCR) using low-titer O-negative whole blood (LTOWB) or balanced 1:1:1 component therapy. The Assessment of Blood Consumption (ABC) score is recommended to guide activation of the massive transfusion protocol (MTP). Pediatric fluid limits are now strictly defined by weight. Video laryngoscopy (VL) should be considered the default first-attempt device in most critically ill ED trauma patients when visualization is not severely compromised. Pre-intubation hemodynamic optimization is essential to prevent cardiovascular collapse during intubation. Permissive hypotension is contraindicated in traumatic brain injury (TBI) and spinal cord injury (SCI), with a target systolic blood pressure (SBP) ≥ 100–110 mmHg. Tranexamic acid (TXA) given within three hours reduces TBI-related mortality. Universal cervical immobilization has shifted to selective spinal motion restriction (SMR). Structured communication tools, Trauma-Informed Care (TIC), and the Zero and Quaternary Surveys have been incorporated into routine trauma practice. Together, these changes move trauma care from volume-driven resuscitation toward physiology-guided and patient-centered approaches.

Keywords: Damage control resuscitation, Emergency department trauma management, Hemorrhage control, Trauma-informed care

ÖZ

Travmatik yaralanmalar küresel çapta majör bir mortalite ve morbidite nedeni olmaya devam ederken, kontrolsüz hemoraji travma sonrası erken dönemde önlenebilir ölümlerin önde gelen nedenlerinden birini oluşturmayı sürdürmektedir. Bu naratif derleme, acil serviste (AS) travma yönetimi konusundaki kanıta dayalı güncel gelişmeleri özetlemektedir. Primer bakı algoritması "x-ABCDE" şeklinde revize edilmiş ve acil hemoraji kontrolü, havayolu değerlendirmesinin önüne alınmıştır. Agresif kristalloid resüsitasyonunun yerini; düşük titreli 0 (sıfır) Rh negatif tam kan (LTOWB) veya 1:1:1 oranlı dengeli kan komponent tedavisinin uygulandığı hasar kontrol resüsitasyonu (DCR) almıştır. Masif transfüzyon protokolünün (MTP) aktivasyonuna rehberlik etmesi amacıyla Kan Tüketimi Değerlendirmesi (ABC) skorunun kullanılması önerilmektedir. Pediyatrik popülasyonda sıvı limitleri artık vücut ağırlığına göre katı bir şekilde tanımlanmıştır. Glottik görüşün ciddi şekilde engellenmediği durumlarda, kritik durumdaki AS travma hastalarının çoğunda videolaringoskopi (VL) ilk denenecek varsayılan cihaz olarak kabul edilmelidir. Entübasyon sırasında gelişebilecek kardiyovasküler kollapsı önlemek için pre-entübasyon hemodinamik optimizasyon elzemdir. Travmatik beyin hasarı (TBH) ve spinal kord yaralanmalarında (SKY) permisif hipotansiyon kontrendike olup, hedef sistolik kan basıncı (SKB) ≥ 100–110 mmHg olarak belirlenmelidir. İlk üç saat içerisinde uygulanan traneksamik asit (TXA), TBH ile ilişkili mortaliteyi azaltmaktadır. Üniversal servikal immobilizasyon yaklaşımı, yerini seçici spinal hareket kısıtlamasına (SMR) bırakmıştır. Yapılandırılmış iletişim araçları, Travma Odaklı Bakım (TIC) ile Sıfırıncı ve Dördüncül Bakılar (Zero and Quaternary Surveys) rutin travma pratiğine entegre edilmiştir. Tüm bu değişiklikler, travma bakımını volüm odaklı resüsitasyondan fizyoloji kılavuzluğunda yürütülen hasta merkezli yaklaşımlara dönüştürmektedir.

Anahtar Kelimeler: Hasar kontrol resüsitasyonu, acil servis travma yönetimi, kanama kontrolü, travma odaklı bakım

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Introduction

Traumatic injury continues to impose a substantial global burden of mortality and disability. Global Burden of Disease 2021 analyses indicate that injuries were associated with approximately 4.34 million deaths worldwide in 2021. Within this burden, exsanguinating hemorrhage remains a leading cause of early preventable death and supports the growing emphasis on immediate bleeding control and hemostatic resuscitation in contemporary trauma care. Traditional trauma care relied on fixed algorithms and high-volume crystalloid resuscitation. Current practice has moved away from this toward approaches guided by patient physiology, available resources, and clinical context (1,2). A summary of the key practice shifts from previous algorithms to the current evidence-based recommendations is provided in Table 1.

From ABCDE to x-ABCDE

The principle "treat the greatest threat first" has prompted a revision to the primary survey. In the updated framework, the "x" step — control of eXsanguinating external hemorrhage precedes airway assessment (2). The reasoning is straightforward: uncontrolled massive external bleeding causes irreversible circulatory collapse within seconds, while airway obstruction develops over minutes. Hemorrhage control is therefore the immediate priority, and it does not replace the rest of the ABCDE sequence.

On arrival, the first action is to control compressible bleeding from extremity and junctional wounds using direct pressure, wound packing, or a tourniquet. These steps are fast, require minimal equipment, and can be done simultaneously with airway management by other team members. A 2024 multicenter study confirmed that prioritizing circulatory support over intubation in patients with exsanguinating injuries was independently associated with improved survival, and that post-intubation hypotension was associated with significantly worse outcomes (3). A separate prehospital cohort study showed that an x-ABC approach reduced in-hospital mortality by 34 percentage points compared to standard ABC care in hypotensive patients with penetrating injury (4).

Tourniquets must be applied with enough pressure to exceed systolic blood pressure and eliminate the distal pulse. The application time must be recorded. Once hemorrhagic shock is controlled, tourniquets should be reassessed within six hours and converted to definitive hemostatic methods. A North Atlantic Treaty Organization (NATO)-developed algorithm now provides structured guidance for tourniquet reassessment, particularly in settings where evacuation is delayed, using clear time thresholds: <2 hours, 2–6 hours, and >6 hours (5).

Clinical Domain	Previous Practice	Current Recommendation	Key References
Primary Survey	ABCDE — airway first	x-ABCDE: control exsanguinating hemorrhage before airway	(2,3,4)
Resuscitation Strategy	Aggressive crystalloid bolus (2 L)	Damage control resuscitation; LTOWB or 1:1:1 component therapy	(2,6,7)
Lethal Coagulopathy Pattern	Lethal triad: hypothermia, acidosis, coagulopathy	Lethal tetrad: adds hypocalcemia as the fourth component	(6)
MTP Activation	Empirical or clinical judgment	ABC Score ≥ 2 triggers MTP	(2,9)
Pediatric Fluid Limit	Up to 3×20 mL/kg crystalloid boluses; 10 mL/kg pRBC if bleeding persists (ATLS 10th ed.)	10–20 mL/kg (<20 kg); max 1 L (>20 kg)	(2)
Intubation Tool	Direct laryngoscopy (primary)	Video laryngoscopy — first-line for all trauma airways	(10,11,12)
Pre-intubation Hemodynamics	Optimize after intubation	Mandatory hemostatic resuscitation before RSI; vasopressors as a bridge if needed	(2,8)
Hypotension in TBI/SCI	Permissive hypotension applied broadly	Contraindicated; target SBP ≥ 100–110 mmHg	(2)
TXA in TBI	Inconsistent use	2 g bolus (or 1+1 g) within 3 h — reduces mortality	(13,14,15)
Cervical Immobilization	Routine rigid collar + backboard	Selective SMR; MILS during intubation; backboard for extrication only	(2,16,17)
Team Communication	Variable, informal	IMIST-AMBO handoff; S-xABCDE-BAR transfer; TIC as standard practice	(2,18,21)
Pre-arrival Preparation	No formal protocol	Zero Survey: assess resources and environment before the patient arrives	(2,20)
Post-resuscitation Transfer	Primary/secondary survey only	Quaternary Survey: logistical check before transfer in resource-limited settings	(2)

Table 1. Key Updates in Emergency Trauma Management
DCR: Damage Control Resuscitation, LTOWB: Low-Titer O-negative Whole Blood, MTP: Massive Transfusion Protocol, ABC: Assessment of Blood Consumption, TBI: Traumatic Brain Injury, SCI: Spinal Cord Injury, SMR: Spinal Motion Restriction, MILS: Manual In-Line Stabilization, RSI: Rapid Sequence Intubation, TIC: Trauma-Informed Care, TXA: Tranexamic Acid, SBP: Systolic Blood Pressure.

Damage Control Resuscitation, ABC Score, and Pediatric Fluids

High-volume crystalloid resuscitation worsens trauma-induced coagulopathy and contributes to the "lethal tetrad": hypothermia, acidosis, coagulopathy, and hypocalcemia (6). Hypocalcemia is now recognized as an independent fourth component that impairs both myocardial function and coagulation. Current European guidelines recommend calcium supplementation in combination with blood products for patients with massive bleeding (6).

Damage control resuscitation (DCR) replaces crystalloid-first approaches with early hemostatic resuscitation. The preferred strategy is low-titer O-negative whole blood (LTOWB) or a balanced 1:1:1 ratio of packed red blood cells (pRBCs), fresh frozen plasma (FFP), and platelets. A large cohort study found that earlier LTOWB administration — within the first hour of ED arrival — was independently associated with better survival (hazard ratio, 0.32; 95% CI, 0.22–0.45) compared with later transfusion (7). Furthermore, recent findings by Torres et al. highlight a critical '14-minute rule' for timing. Initiating low-titer O-negative whole blood (LTOWB) transfusion within the first 14 minutes of emergency department arrival maximizes the probability of survival. For every 1-minute delay beyond this 14-minute threshold, the risk of mortality increases exponentially, equating to an approximate 15% increase in the risk of 4-hour mortality. (7) Ongoing trials are further evaluating LTOWB, but current evidence supports its use as the preferred strategy in centers with established capability in hemorrhagic shock (8).

Permissive Hypotension

In actively bleeding patients without TBI or spinal cord injury (SCI), a target systolic blood pressure (SBP) of 80–90 mmHg is recommended until definitive hemorrhage control is achieved. Vasopressors are not a primary resuscitation tool in hemorrhagic shock. They may be used as a short-term measure when blood products are unavailable or when hemodynamics remain unstable despite adequate volume resuscitation (2,6). The management of massive hemorrhage encompasses not only external bleeding but also potentially fatal sources of internal bleeding. In hemodynamically unstable patients, hemorrhage originating from major pelvic ring fractures and associated retroperitoneal venous or arterial systems can lead to exsanguination within minutes. In trauma patients with suspected pelvic fractures and unexplained hypotension (especially if the FAST exam is negative), a pelvic binder or sheet must be applied as soon as possible to reduce pelvic volume, limit the movement of fracture ends, and promote a tamponade effect to halt bleeding. For the device to be effective, it is anatomically imperative that it be centered over the greater trochanters rather than the iliac crests. Furthermore, internally rotating the patient's legs and securing the ankles together reduces pelvic volume and helps control bleeding (2).

ABC Score and Massive Transfusion Protocol

The ABC (Assessment of Blood Consumption) score is recommended over clinical judgment alone to activate the massive transfusion protocol (MTP). One point is assigned for each of the following: SBP ≤ 90 mmHg, heart rate ≥ 120 bpm, positive FAST, and penetrating torso mechanism. A score ≥ 2 indicates a likely need for MTP and should prompt immediate activation (2). A large multicenter study (n = 49,301) found that high cryoprecipitate-to-pRBC ratios (≥ 1:1) within the MTP were independently associated with a 48% reduction in 6-hour mortality (adjusted OR 0.52, 95% CI 0.45–0.58), supporting the inclusion of cryoprecipitate in balanced resuscitation (9).

Pediatric Fluid Limits

To reduce the risk of fluid overload and dilutional coagulopathy in children, crystalloid limits were defined in the ATLS 10th edition as up to three sequential 20 mL/kg isotonic crystalloid boluses, followed by 10 mL/kg packed red blood cells if bleeding continued after the third bolus. The ATLS 11th edition has revised this approach toward earlier blood product use: after an initial 20 mL/kg crystalloid bolus, if the patient does not demonstrate a sustained response, transition to 10 mL/kg of packed red blood cells or whole blood is now preferred over additional crystalloid. For pediatric damage control resuscitation, the ATLS 11th edition further defines: 10–20 mL/kg for children under 20 kg, and a maximum of 1 L for those over 20 kg. Pediatric DCR protocols using these limits have shown lower rates of coagulopathy and mortality compared to conventional crystalloid resuscitation (2).

Airway Management

Every trauma airway should be treated as potentially difficult. Video laryngoscopy (VL) is now the recommended first-line intubation tool in the ED (2). The DEVICE trial (NEJM, 2023) showed a 14% absolute improvement in first-pass success with VL over direct laryngoscopy (DL) in critically ill adults, with a number needed to treat of 6–7 (10). A 2024 systematic review and meta-analysis of 20 RCTs (n = 4,569) found that VL increased first-pass success (RR 1.13, 95% CI 1.06–1.21) and cut the rate of esophageal intubations in half (RR 0.47, 95% CI 0.27–0.82) (11). A separate 2024 meta-analysis in ED and ICU patients confirmed VL superiority for first-pass success (RR 1.12, 95% CI 1.04–1.20) and fewer aspiration events (12).

Rapid sequence intubation (RSI) in hemodynamically unstable patients can trigger cardiovascular collapse. Induction agents reduce sympathetic tone, and positive pressure ventilation decreases venous return. For this reason, hemostatic resuscitation should be optimized before intubation. When this is not possible, short-term vasopressor support during the peri-intubation period should be considered as a bridge to hemodynamic stabilization (8).

Neuroprotection and Critical Neuroworsening

Permissive hypotension is contraindicated in TBI and SCI. Cerebral perfusion pressure (CPP) equals mean arterial pressure (MAP) minus intracranial pressure (ICP). Any drop in MAP reduces CPP and worsens secondary brain injury. A minimum SBP of 100–110 mmHg is recommended in adult TBI patients — revised upward from the previous 90 mmHg threshold — based on evidence linking lower blood pressure to worse neurological outcomes (2).

The role of tranexamic acid (TXA) in isolated TBI has been defined by the CRASH-3 trial (Lancet, 2019), which showed that early TXA reduced head injury mortality and was cost-

effective in mild and moderate TBI (13). A 2024 systematic review confirmed that TXA reduces total mortality in patients with TBI without increasing the risk of thromboembolic events (14). The recommended regimen is a 2-gram bolus (or 1 g followed by another 1 g) given within three hours of injury. A 2024 network meta-analysis established the dose–response relationship and supports this dosing strategy (15).

"Critical Neuroworsening" refers to a sudden drop in Glasgow Coma Scale (GCS) motor score, new pupillary asymmetry, or loss of pupillary reactivity. These signs indicate impending cerebral herniation and require immediate action: repeat ABCDE assessment, urgent neurosurgical consultation, and consideration of osmotherapy, controlled hyperventilation, or emergent surgical decompression (2).

Spinal Motion Restriction

Universal rigid cervical immobilization has been replaced by selective spinal motion restriction (SMR). Rigid backboards should be used only for short-term extrication and transport, not as a prolonged stabilization method. Cervical collars should be applied selectively. Rigid collars have been shown to increase intracranial pressure, reduce venous drainage, and interfere with airway management (2).

A 2024 systematic review found no high-quality evidence that routine cervical immobilization improves neurological outcomes in blunt trauma compared to selective restriction (16). A 2025 scoping review confirmed that SMR protocols reduced long spine board use significantly without increasing rates of secondary spinal cord injury (17).

Airway and hemostatic resuscitation must not be delayed by spinal restriction measures. In an agitated patient, a forcibly applied collar may produce more cervical movement than no collar at all. During difficult airway management, the anterior portion of the collar should be removed, and manual in-line stabilization (MILS) applied throughout the procedure (2).

Special Populations, Human Factors, and Trauma-Informed Care

Geriatric Trauma:

With the rapid growth of the aging population, geriatric trauma management has become a critical priority, with the ATLS 11th edition introducing "ageism" as a significant factor that can lead to implicit bias, undertriage, and suboptimal management. Geriatric patients are frequently undertriaged because subtle physiological changes and atypical presentations—such as severe injury resulting from low-energy ground-level falls—often mask the underlying severity. A landmark update in current practice is the upward revision of the hemodynamic threshold for shock; for patients aged ≥65 years, a systolic blood pressure (SBP) < 110 mmHg is now the recognized threshold for hypotension, as conventional "normal" readings often mask occult hypoperfusion in this population.

Furthermore, age-related decline in physiological reserve and the prevalent use of beta-blockers mean that tachycardia—the classic sign of hypovolemia—is frequently absent. Given the high prevalence of anticoagulant use, rapid assessment of the coagulation profile and prompt reversal with targeted agents, such as prothrombin complex concentrate (PCC), are essential to prevent the fluid overload associated with fresh frozen plasma. Finally, selective spinal motion restriction (SMR) is paramount, as rigid cervical collars in older adults significantly increase the risks of swallowing difficulties, aspiration, and airway management challenges (2).

Human Factors and Trauma-Informed Care

Communication failures — not gaps in clinical knowledge — are the most common cause of preventable adverse events in the trauma bay. A 10-year analysis of trauma morbidity and mortality conferences found communication errors to be the single leading category of identified problems (18). This evidence has driven the integration of structured non-technical skills into core trauma training.

Effective team coordination in the trauma bay relies on three key practices: 1) pre-arrival huddles to assign roles, 2) tactical pauses at critical decision points, and 3) closed-loop communication using the "Three Cs" — Cite names, Be Clear and concise, and Close the loop. Two standardized handoff tools have been adopted: the IMIST-AMBO protocol (Identification, Mechanism/chief complaint, Injuries, Signs, Treatment, Allergies, Medications/history, Background, and Other) (21) for prehospital-to-ED transitions, and the S-xABCDE-BAR tool (Situation, xABCDE assessment summary, Background, Assessment, and Recommendation) for interfacility transfers. Both reduce information loss during care transitions (2).

When delivering serious news to patients and families, the "Headline = Fact + Meaning" model provides a clear structure. Family meetings follow the ABCDE framework: Acquaint/Ask, Begin with a warning, Concise summary, Use silence, Encourage emotions/End with a plan. The NURSE mnemonic (Name, Understand, Respect, Support, Explore) supports empathetic communication and addresses the emotional needs of patients and their relatives (2)

Trauma-Informed Care (TIC) and Social Determinants of Health

Trauma-Informed Care (TIC) is a clinical framework built on the '4R' principles: Recognizing the widespread impact of trauma, recognizing its signs and symptoms, responding to them appropriately, and preventing re-traumatization. It acknowledges that patients may arrive with pre-existing psychological, emotional, or social vulnerabilities that affect their behavior and engagement with care (2). A 2023 scoping review of 31 studies found that TIC integration in acute care reduces patient distress and improves therapeutic communication, especially for victims of interpersonal violence (19).

In practice, TIC involves maintaining patient privacy, using certified interpreters for patients with language barriers, and communicating non-judgmentally. Addressing social determinants of health alongside physiologic resuscitation supports both physical and psychological recovery (2).

Zero and Quaternary Surveys in Austere and Disaster Settings

Trauma care in resource-limited settings — including disaster zones, mass-casualty incidents, and areas with extended evacuation times — requires adaptations beyond the standard primary and secondary surveys. Two additional assessment phases address this need.

Zero Survey

The Zero Survey takes place before the patient arrives. It involves a systematic check of available personnel, blood products, equipment, logistical resources, and institutional capacity (2). Originally described as the "Zero Point Survey" within the STEP UP resuscitation framework (20), it has been incorporated into standard trauma training to support decision-making in multiple-casualty and mass-casualty incidents.

Quaternary Survey

The Quaternary Survey is performed after initial resuscitation, before the patient is transferred to a higher level of care. In austere settings, patients often need sequential transfers over long distances with limited resources, sometimes while resuscitation is still ongoing. The Quaternary Survey checks transport platform capabilities, expected delays, continued resuscitation needs, and the risk of deterioration during transfer (2).

Conclusion

Emergency trauma resuscitation has shifted from high-volume, crystalloid-first care to targeted, physiology-guided management. Controlling hemorrhage early — before airway management — reduces preventable death. DCR with LTOWB or balanced component therapy is more effective than crystalloid resuscitation in hemorrhagic shock. Video laryngoscopy improves first-pass intubation success and should be the default tool in all trauma airways. Pre-intubation hemodynamic stabilization prevents cardiovascular collapse during RSI.

In TBI and SCI, strict blood pressure targets (SBP ≥ 100–110 mmHg) and early TXA administration within 3 hours are key neuroprotective measures. Recognition of Critical Neuroworsening allows timely intervention before herniation. Selective SMR replaces universal immobilization, with no evidence supporting routine rigid collars in all trauma patients.

Non-technical skills — structured communication, team coordination, and Trauma-Informed Care — are as important as clinical interventions for good trauma outcomes. Future research should focus on RCTs to validate LTOWB in civilian settings, standardize vasopressor use in hemorrhagic shock, define optimal TXA dosing in polytrauma with TBI, and validate the Zero and Quaternary Survey frameworks across diverse healthcare systems.

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