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Advances in polytrauma management in the emergency setting: A comprehensive review

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***Abstract*---Background:** Polytrauma, a major global health issue, poses significant challenges to healthcare systems worldwide due to its high mortality and disability rates. Despite advances in diagnostic

and therapeutic approaches, trauma remains a leading cause of death, particularly from road traffic accidents and among the elderly. Traditional definitions and management strategies for polytrauma have evolved, now incorporating comprehensive criteria such as the Berlin definition. **Aim:** This review aims to provide an updated overview of polytrauma management in emergency settings, focusing on advancements and current practices in pre-hospital care, emergency department resuscitation, and subsequent rehabilitation phases. **Methods:** The review synthesizes recent research and guidelines related to polytrauma management, including pre-hospital care techniques, resuscitation strategies, and innovative approaches like Damage Control Orthopaedics (DCO) and Damage Control Resuscitation (DCR). Key areas of focus include airway management, hemorrhage control, and the management of trauma-associated coagulopathy. **Results:** Advances in polytrauma management include the implementation of the Advanced Trauma Life Support (ATLS) and Pre-Hospital Trauma Life Support (PHTLS) systems, which have improved outcomes by standardizing care protocols. The integration of DCO and the shift towards individualized care approaches, such as Prompt Individualized Safe Management (PRISM), have enhanced patient stabilization and recovery. Enhanced techniques for hemorrhage control and resuscitation, including the use of hemostatic agents and viscoelastic tests, have shown promise in improving survival rates. **Conclusion:** Effective polytrauma management requires a coordinated approach across all stages of care, from pre-hospital interventions to rehabilitation. Continued advancements in treatment protocols and technologies are essential for reducing mortality and improving outcomes for polytrauma patients.

***Keywords*---**Polytrauma, pre-hospital care, emergency department, Damage Control Orthopaedics, Damage Control Resuscitation, trauma management.

Introduction

Polytrauma continues to be a significant global health issue and is projected to be a critical challenge for future healthcare systems, according to the World Health Organization (WHO) [1]. Despite progress in diagnostic and therapeutic protocols, trauma remains a leading cause of death and disability worldwide [2, 3]. Trauma, particularly resulting from increased road traffic accidents (RTA), is a major cause of mortality among young adults [4]. However, with shifting demographics and an aging population, there is a rising incidence of polytrauma among elderly patients [5]. Healthcare expenditures related to acute and emergency care are notably higher for polytrauma cases [6]. The definition of polytrauma has evolved over recent decades to incorporate clinical patterns, organ system involvement, and associated physiochemical changes. In 1975, Border et al. introduced the initial formal definition of "polytrauma,"

characterizing it as the presence of two or more significant injuries [7]. For an extended period, definitions of polytrauma were based on the Injury Severity Score (ISS) and its variants [8]. The Abbreviated Injury Score (AIS), which identifies involvement of more than one ISS body region, subsequently gained prominence in refining the definition of polytrauma [9]. Polytrauma was defined as an injury with an AIS >2 in at least two ISS body regions. Following a push for a universally accepted definition, an international consensus led to the development of a database-supported definition [10, 11]. According to the updated "Berlin definition," polytrauma is defined as having an AIS ≥3 for two or more distinct body regions, along with one or more additional features from five physiological parameters: age, consciousness, hypotension, coagulopathy, and acidosis [12].

Management of polytrauma patients begins at the trauma site and should follow a continuum of care, including the prehospital phase, emergency department, and necessary damage control surgical interventions [13, 14]. Advances in understanding clinical, pathophysiological, and immunological responses to trauma have led to evolving management strategies. This has resulted in a shift from "Early Total Care" and "Damage Control Orthopaedics" to the current approaches of "Early Appropriate Care" and "Prompt Individualized Safe Management (PRISM)" [15, 16, 17, 18]. The trauma team's objectives include identifying the patient's issues, prioritizing life-saving interventions using the Advanced Trauma Life Support (ATLS) protocol and stabilizing the patient before transferring them for specialized care. A multi-modality approach to polytrauma management has been shown to significantly reduce mortality rates, though each stage of care involves various risks.

Polytrauma Management:

The journey of a patient with polytrauma can be characterized by several distinct stages, though these phases may overlap in practice. These stages of polytrauma care include:

1. **Pre-Hospital Care**
2. **Accident and Emergency Department Resuscitation and Management**
3. **Models of Polytrauma Care: Damage Control Orthopaedics (DCO) and Definitive Fracture Fixation**
4. **Rehabilitation Phase**

1. Pre-Hospital Care

The evolution of pre-hospital care has been notably influenced by military conflicts, which led to significant advancements in trauma management.

The introduction of the Advanced Trauma Life Support (ATLS) system in 1978 was a milestone, soon followed by the development of Pre-Hospital Trauma Life Support (PHTLS) in 1984. These systems were designed to standardize the approach of prehospital providers to injured patients, enhancing the quality of care [19, 20]. The implementation of PHTLS has markedly improved the outcomes for polytrauma patients by focusing on a systematic approach to prioritize medical needs and optimize patient management [21]. According to the trimodal distribution of deaths post-polytrauma proposed by Baker et al., the first peak of mortality occurs at the scene of injury. This underscores the critical importance of providing prompt and effective care at the site to reduce both morbidity and mortality [3, 22]. Recent research by Teuben et al. (2019) demonstrated the efficacy of pre-hospital care through various endpoints, including the percentage of emergency doctor involvement, total operation time (the interval between the arrival of healthcare professionals on the scene and the departure of paramedics), and transfer time (the duration from the trauma team's departure from the scene to hospital arrival). Their study found that the use of PHTLS improved efficacy across all these metrics [21]. The pre-hospital environment presents numerous challenges, ranging from hostile patients to adverse conditions. Pre-hospital care is fundamentally guided by ATLS principles, which aim to ensure comprehensive and efficient trauma management under diverse circumstances.

2. Accident and Emergency Department Resuscitation and Management

Upon arrival at the Accident and Emergency (A&E) department, the focus shifts to resuscitation and initial management. This phase is crucial for stabilizing the patient, addressing life-threatening conditions, and preparing for further interventions. The integration of advanced resuscitation techniques and monitoring tools is essential for effective management in the A&E setting.

3. Models of Polytrauma Care: Damage Control Orthopaedics (DCO) and Definitive Fracture Fixation

In the management of polytrauma, the approach has evolved from traditional methods to include Damage Control Orthopaedics (DCO) and definitive fracture fixation. Damage Control Orthopaedics focuses on immediate stabilization of fractures to prevent further injury and facilitate subsequent definitive care. This model has proven effective in managing complex polytrauma cases by prioritizing rapid intervention and gradual progression to more permanent solutions.

4. Rehabilitation Phase

The rehabilitation phase is critical for the recovery of polytrauma patients, involving a multidisciplinary approach to restore function and quality of life. This phase includes physical therapy, psychological support, and ongoing medical care to address the long-term effects of polytrauma. Effective rehabilitation is essential for improving patient outcomes and enhancing overall recovery. Each stage of polytrauma care plays a pivotal role in the comprehensive management of patients, aiming to reduce mortality, enhance recovery, and improve overall outcomes through a coordinated and systematic approach.

Strategies to Mitigate Risks in Pre-Hospital Care

1. Airway Maintenance and Cervical Spine Immobilization

The primary step in pre-hospital care involves ensuring airway maintenance while simultaneously immobilizing the cervical spine. This is critical to prevent further spinal injuries and ensure the airway remains unobstructed, particularly in trauma patients who may have compromised airway patency due to their injuries.

2. Prehospital Infusion in Polytrauma Patients

Managing hypovolemic shock in polytrauma patients involves initiating intravenous (IV) fluid administration after establishing IV lines. This practice aims to stabilize hemodynamics by replenishing intravascular volume and maintaining vital organ perfusion [23]. Historically, IV fluid administration has been a cornerstone of prehospital trauma care since the establishment of emergency medical systems (EMS). However, recent evidence suggests that indiscriminate use of IV fluids may be more detrimental than beneficial. Potential issues include delays in transporting patients to definitive care and adverse effects such as elevated systolic blood pressure, which can exacerbate hypertension and vasodilation, potentially compromising tamponade effect and leading to increased bleeding. For patients with traumatic brain injury, the administration of IV fluids should be approached with caution to prevent secondary brain injury. Consequently, IV fluid administration should be restricted to cases of penetrating injuries, severe head injuries, and patients requiring emergency surgery. Routine IV fluid administration for all trauma patients is discouraged [24].

3. Pre-Hospital Hemorrhage Control

Controlling external hemorrhage, immobilizing the patient, and ensuring rapid transport to an appropriate facility are essential aspects of pre-hospital care. Hemorrhage remains a leading cause of preventable death in both combat (90%) and civilian trauma (30-40%) [24]. Effective hemorrhage control is critical and can be achieved through direct pressure or pressure bandages. When direct pressure is insufficient, tourniquets, with or without hemostatic agents, may be employed to stop the bleeding. Current research globally explores the effectiveness of hemostatic agents, surgical adjuncts, and blood products in pre-hospital settings. Hemostatic agents are categorized into systemic and local application types. Tranexamic acid, for instance, has demonstrated improved survival rates in severely injured patients when administered within three hours of injury [26]. Although local hemostatic agents may reduce the time to treatment and adverse effects, they are less effective in severe bleeding cases. Research by Klein et al. (2020) highlights emerging therapies such as nanoscale injectable agents and syntho plates, though further human trials are necessary to validate their efficacy for both combat and civilian trauma [24].

4. Collecting Background Information

Gathering comprehensive background information is crucial for effective pre-hospital care. This includes documenting the time of injury, mechanism of injury, and a focused patient history encompassing co-morbidities, allergies, and access to centralized online Electronic Patient Records (EPR). This information aids in providing tailored and informed care, ensuring that subsequent medical interventions are based on a thorough understanding of the patient's condition and history.

2. Accident and Emergency Department Resuscitation and Management

Effective resuscitation is crucial in reducing acute mortality rates among polytrauma patients. The Airway, Breathing, Circulation, Disability, and Exposure (ABCDE) assessment algorithm, as endorsed by Advanced Trauma Life Support (ATLS), plays a vital role in enhancing the efficiency and quality of care provided in the Accident and Emergency Department (AED). This systematic approach prioritizes the identification and stabilization of life-threatening injuries, ensuring a comprehensive evaluation and management of any compromise in airway, breathing, circulation, and neurological function. The primary goal is to prevent the development of the lethal triad—coagulopathy, hypothermia, and acidosis. Contemporary trauma management emphasizes the importance of

teamwork and leadership. In the UK, trauma practice typically involves emergency medicine doctors leading the trauma team. When significant trauma mechanisms or signs of severe airway injuries are present, it is crucial to involve an anaesthetist in the trauma team at this critical juncture. This collaborative approach aligns with Professor Richard Cowley's observations from World War II, which highlighted the "Golden Hour" as a pivotal period for treating life-threatening injuries. The "Golden Hour" refers to the first 60 minutes post-major trauma, during which prompt and effective treatment is essential to reduce mortality. Research suggests that approximately 60% of avoidable deaths can occur within this timeframe, underscoring the importance of optimal care during this critical period [4]. **Figure 1** illustrates the "Trimodal Peaks Distribution of Deaths After Polytrauma" and highlights suggested interventions to mitigate these risks.

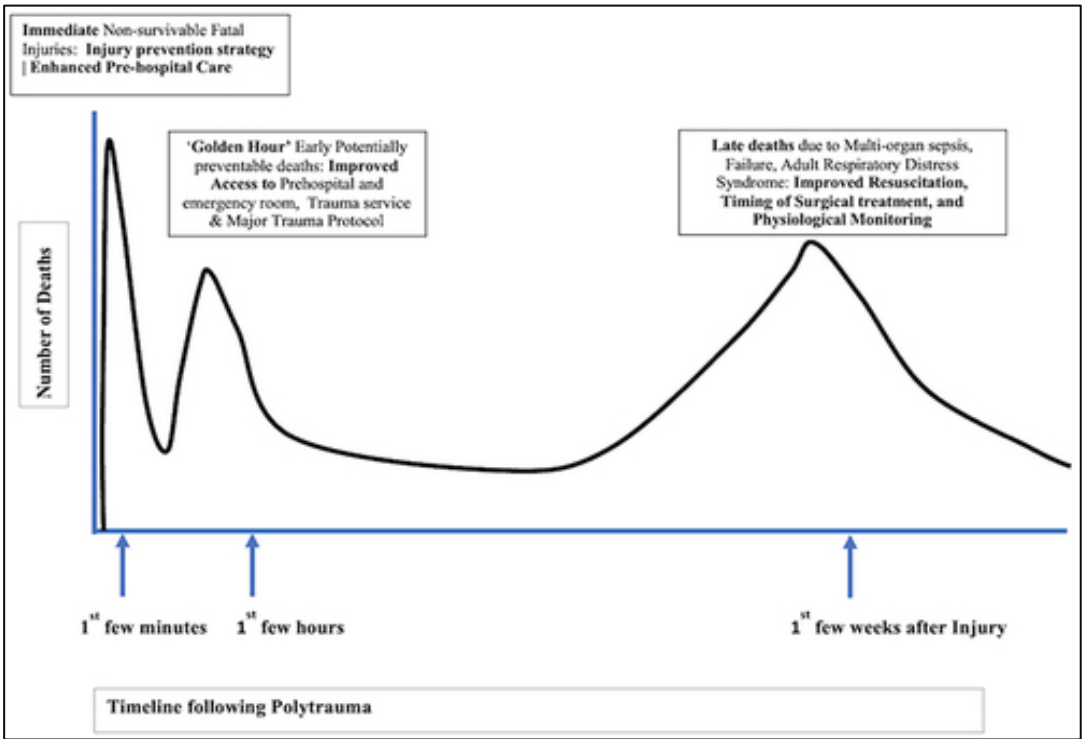

Figure 1: Timeline of following polytrauma

Airway Management (Including Cervical Spine Protection)

Airway assessment and management are paramount in the ATLS algorithm during the resuscitation of polytrauma patients [27]. In trauma cases, the airway is considered difficult to manage unless the mechanism of injury clearly excludes cervical spine trauma. Proper assessment of potential cervical spine injury is crucial and often necessitates cervical

spine stabilization using a cervical collar. When advanced airway management is required, the cervical collar must be removed and replaced with in-line immobilization provided by a trained team member. Challenges in airway management can arise from various complications such as facial injuries, mandibular and maxillary fractures, facial burns, bleeding, dislodged teeth and dentures, and upper airway injuries. Additionally, gunshot wounds, open neck injuries, or undetected pneumothorax can exacerbate the situation, particularly after endotracheal intubation. The most critical airway-related issue is airway obstruction leading to hypoxemia.

Effective management of the airway involves the use of oxygen and airway adjuncts, or a "definitive airway" intervention in cases where facial burns, unstable facial bone fractures, or laryngeal injuries pose a risk of total airway obstruction. Maintaining a definitive airway is essential for reducing mortality rates and mitigating the inflammatory cascade in polytrauma patients. While there is debate about the correlation between successful definitive airway management in the prehospital setting and improved survival, securing a definitive airway remains a crucial factor for improving survival rates in hospital settings. The success of securing a definitive airway is significantly influenced by the availability of adequate equipment and trained personnel in the emergency department, making this a challenging task in prehospital settings.

In complex trauma cases, especially those involving traumatic brain injury and severe burns, securing the airway is critical. "Definitive airway" interventions may include needle and surgical cricothyroidotomy, tracheostomy, and endotracheal intubation. Rapid Sequence Intubation (RSI) is a widely practiced technique in emergency settings. Ensuring a definitive airway in emergencies is a critical predictor of survival for polytrauma patients. Moreover, trauma patients may present with a full stomach due to inadequate fasting and prolonged gastric emptying times [28]. Standard practice involves treating these patients as having a full stomach and performing rapid sequence induction with cricoid pressure, administered by a trained operative department practitioner, anaesthetic nurse, or Emergency Medicine nurse [29].

Breathing and Ventilation

Chest injuries can significantly complicate the anesthetic management of trauma victims. The severity of chest injuries is influenced by factors such as the mechanism of injury, the speed of the vehicle involved, the impact force, and whether the victim was trapped. Life-threatening injuries associated with chest trauma include tension pneumothorax, untreated open pneumothorax, massive hemothorax, cardiac tamponade, and

tracheobronchial injury. Positive pressure ventilation via an endotracheal tube in the presence of an undetected pneumothorax can precipitate a life-threatening tension pneumothorax. Pneumothorax should be promptly addressed, and in cases of doubt, emergency needle thoracocentesis followed by chest drain insertion is essential. This approach is crucial for managing simple pneumothorax, untreated open pneumothorax, or small, undetected tension pneumothorax [30]. Persistent pneumothorax with air bubbling synchronized to positive pressure ventilation may indicate a major tracheobronchial injury, necessitating advanced airway management, one-lung ventilation, and transfer to a center equipped for cardiothoracic surgery [31]. In the absence of immediately life-threatening injuries, patients may present with high-impact chest trauma. Thoracic injury signs and symptoms can be subtle due to concurrent significant hypovolaemia from blood loss. Therefore, simultaneous radiological assessments should be conducted during resuscitation to identify and address thoracic injuries promptly.

Circulation and Hemorrhage Control

Hemorrhage is a prevalent risk factor in managing polytrauma patients, making rapid identification of bleeding sources—whether external or internal—critical for reducing mortality. Effective hemorrhage control involves rapid blood volume replacement and the initiation of Damage Control Resuscitation (DCR) [32]. Inadequate DCR can exacerbate the lethal triad of acidosis, coagulopathy, and homeostatic imbalances. Initial measures such as external direct compression and judicious use of tourniquets can be employed to control distal limb bleeding [33]. Careful assessment of bleeding sources is necessary, including evaluation of confined spaces and external hemorrhages. External bleeding might result from scalp lacerations or cutaneous injuries in the head/neck region. Massive hemothorax can cause significant blood loss, potentially exceeding 1.5 liters, which may not be readily apparent through clinical examination alone.

A Focused Assessment with Sonography for Trauma (FAST) scan is valuable for detecting blood around abdominal organs or in the pelvic area. Early application of a pelvic binder can help minimize blood loss. Long bone fractures can also contribute to substantial blood loss, and applying appropriate splints can reduce both pain and bleeding. Gathering information about blood loss from paramedics at the scene is crucial.

Assessment of circulation and restoration of intravascular volume through balanced resuscitation should be supported by early blood transfusion and the use of haemostatic agents such as tranexamic acid. Other methods to control bleeding include antifibrinolytic agents, such as

tranexamic acid, the Junctional Emergency Treatment Tool™, Combat Ready Clamp, XSTAT®, ResQFoam, and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). REBOA, an invasive technique for aortic occlusion, has proven safe and effective for patients with traumatic hemorrhage and hemodynamic instability [34]. Addressing hypovolaemia and associated complications, such as disseminated intravascular coagulation (DIC), which results in significant coagulation disorders, is also essential for effective resuscitation. Cardiac tamponade, indicated by muffled heart sounds and distended neck veins, requires urgent intervention. Patients with this condition often have significant anterior chest wall injuries, including multiple fractures, flail chest, and lung contusion, which can predispose them to Acute Respiratory Distress Syndrome (ARDS) [35].

Disability:

Patients with trauma often present with a reduced level of consciousness, which can complicate the assessment and management of their condition. This reduction in consciousness may be attributed to head injuries, a primary consideration even in cases where excessive alcohol consumption is evident [36]. In such instances, it is crucial to assess and address potential cervical spine injuries. Patients with decreased Glasgow Coma Scale (GCS) scores should be presumed to have cervical spine involvement and thus require triple immobilization using a cervical collar, blocks, and tape. Airway management might also be necessary for these patients due to the compromised level of consciousness. In cases involving multiple life-threatening injuries, a collaborative team approach is essential to prioritize and manage the most critical issues while simultaneously addressing other significant injuries.

Exposure and Environment

The severity of trauma can be exacerbated by the conditions under which the patient is extricated from a vehicle or recovered from debris, potentially exposing them to extreme cold temperatures and leading to significant hypothermia and crush injuries. Immediate warming and meticulous management of crash-related injuries are vital for these patients. One major risk associated with traumatic injury is the loss of skin and exposure to contaminated materials, which can increase the likelihood of infection and sepsis. Effective early management strategies are crucial in preventing deaths by mitigating wound contamination and bacterial infection. Failure to address these factors promptly can result in severe morbidity or mortality due to sepsis [37]. Thus, combining optimal initial care with strategic measures to prevent infection is essential for improving outcomes in trauma victims.

Managing Specific Risks During Polytrauma Management:

The pathophysiological mechanisms leading to the lethal triad of coagulopathy, hypothermia, and acidosis in polytrauma patients are illustrated in **Figure 2**. This triad is a critical factor in late mortality associated with polytrauma.

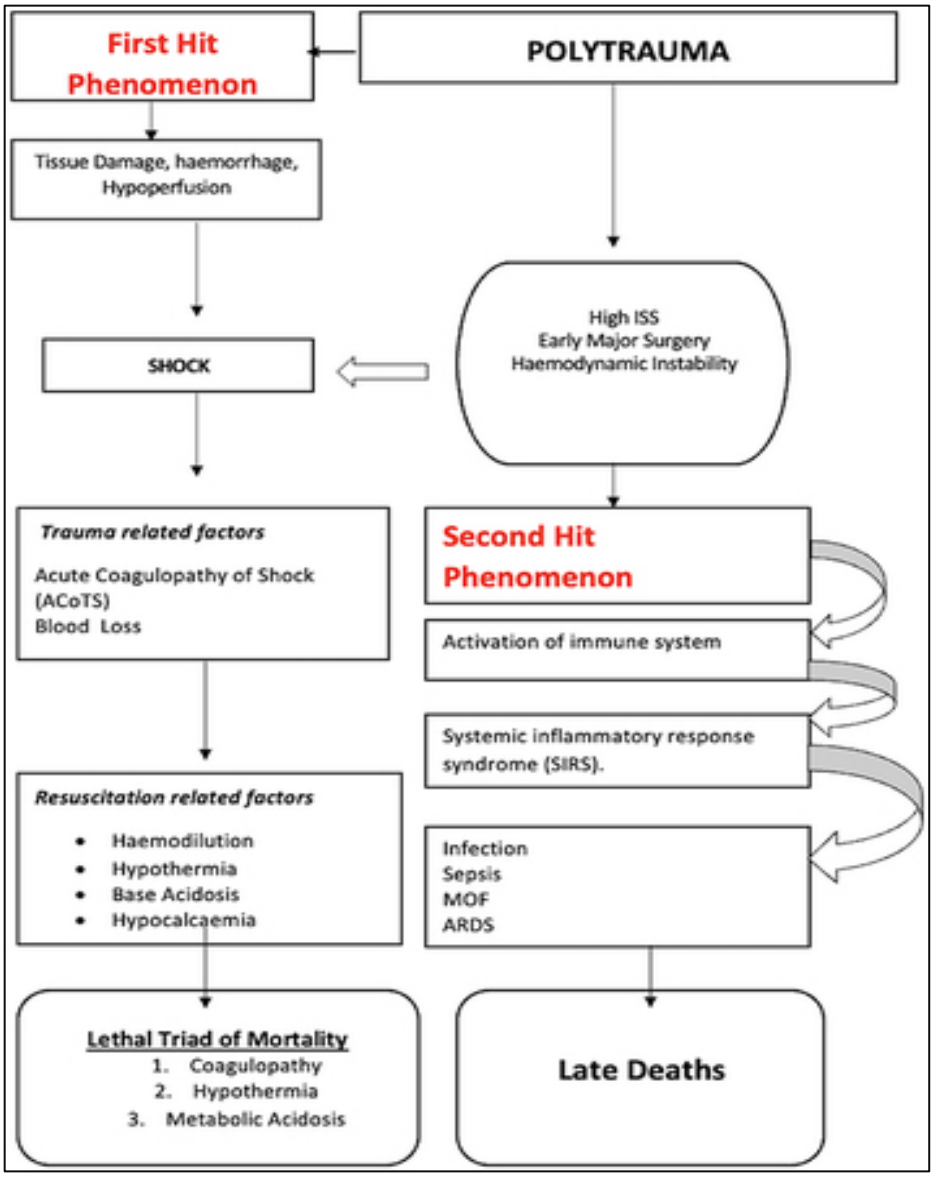

Figure 2: The pathophysiology and mechanisms leading to lethal triad of mortality and late deaths in polytrauma patients

Trauma-Associated Coagulopathy

Trauma-associated coagulopathy (TAC) in polytrauma patients can arise from two primary mechanisms: acute coagulopathy of trauma shock (ACoTS) and resuscitation-associated coagulopathy (RAC). ACoTS typically develops in the pre-resuscitation phase and is characterized by a high Injury Severity Score (ISS), a pH below 7.10, hypothermia, and hypotension with a systolic blood pressure below 70 mm Hg [38]. The activation of the protein C pathway is thought to contribute to this condition. Early identification of ACoTS can be achieved through standard bleeding profiles, coagulation tests (such as platelet count, activated partial thromboplastin time (APTT), prothrombin time (PT), and international normalized ratio (INR)), and the use of point-of-care coagulometers. These measures can guide targeted clotting factor replacement strategies. RAC occurs due to the dilution of procoagulant factors from the rapid infusion of crystalloids and colloids. It is exacerbated by hypothermia, acidosis, and hypocalcemia, further complicating the coagulation process.

Disseminated Intravascular Coagulation (DIC)

Disseminated intravascular coagulation (DIC) is a severe complication of polytrauma, characterized by widespread activation of the coagulation system. This condition leads to the intravascular deposition of fibrin and consumption bleeding, which can ultimately result in multiple organ dysfunction syndrome (MODS) [39].

Role of Viscoelastic Tests

Traditional coagulation tests such as APTT, PT, and INR primarily assess the initial stages of blood coagulation. However, they may not fully capture the dynamics of coagulation abnormalities. Viscoelastic tests (VET), such as thromboelastography (TEG) and rotational thromboelastometry (ROTEM), provide a more comprehensive assessment by dynamically evaluating coagulation abnormalities and guiding effective correction and reversal. These tests enable clinicians to tailor the administration of platelets, cryoprecipitate, fresh-frozen plasma, and other blood products to the specific needs of the patient.

Damage Control Resuscitation (DCR)

Damage Control Resuscitation (DCR) is a critical approach in polytrauma management focused on mitigating the lethal triad of coagulopathy, hypothermia, and acidosis. The core principles of DCR include:

1. **Rapid Hemorrhage Control:** Immediate control of bleeding is essential to prevent further complications.
2. **Prevention/Correction of Acidosis:** Metabolic acidosis, a component of the lethal triad, must be addressed through fluid resuscitation and correction of underlying causes.
3. **Correction of Hypothermia:** Maintaining normothermia is vital as hypothermia exacerbates coagulopathy and increases the risk of dysrhythmias [43, 44].
4. **Hemostatic Resuscitation:** A balanced transfusion strategy, using a 1:1:1 ratio of fresh frozen plasma (FFP), platelets, and red blood cells (RBCs), is recommended to manage trauma-induced coagulopathy [40].
5. **Correction of Hypocalcemia:** Hypocalcemia, often due to rhabdomyolysis or massive transfusion, can disrupt clotting processes. Administering intravenous calcium gluconate can help [46, 47, 48].

Metabolic Acidosis:

Metabolic acidosis, a key component of the lethal triad, can arise from severe hypovolemic shock and tissue hypoxia. Severe cases with a base deficit exceeding 6 mmol/L are associated with poorer outcomes [42]. The mechanisms include lactic acid accumulation from anaerobic respiration. Effective management involves:

- **Control of Hemorrhage:** Prevent further blood loss.
- **Fluid Resuscitation:** Restore blood volume.
- **Blood Products:** Administer as needed to correct acid-base imbalances [41].

Hypothermia

Hypothermia poses significant risks in polytrauma patients, including exacerbation of coagulopathy and development of cardiac dysrhythmias. Prevention and management strategies include:

- **Monitoring Core Temperature:** Regular checks to prevent hypothermia.
- **Warm Environment:** Use of external warming devices and warm intravenous fluids.
- **Rapid Hemorrhage Control:** To reduce the impact of hypothermia on coagulation [43, 44].

Managing Associated Risks

1. **Hypoxia:** Inadequate oxygen supply can result from various factors such as blood loss and reduced cardiac output. Supplemental oxygen therapy with a mask-reservoir device at a flow rate of 15

L/min can help prevent hypoxia-related complications [45]. Targeted oxygen therapy should follow initial stabilization.

2. **Hypocalcemia:** Can occur due to rhabdomyolysis or massive transfusion. It impacts platelet function and coagulation pathways. For moderate-to-severe hypocalcemia, intravenous calcium gluconate infusion is beneficial [46, 47, 48].

Models of Polytrauma Care and Fracture Fixation

The approach to managing fractures in polytrauma patients has evolved:

1. **Early Total Care (ETC):** This model advocated for definitive fracture fixation within 24 hours of injury, aiming to reduce pulmonary complications but sometimes leading to increased morbidity due to additional surgical interventions [49].
2. **Damage Control Orthopaedics (DCC):** Focused on managing hemodynamic instability with staged interventions. This model improved outcomes but often required multiple surgeries and prolonged hospital stays [50].
3. **Early Appropriate Care (EAC):** Emphasizes physiological response and appropriate management based on individual patient needs. This approach balances metabolic permissiveness with injury management [51, 52].
4. **Safe Definitive Surgery (SDS):** Proposed by Pape et al., this model integrates fracture fixation with primary trauma assessment to adapt to patient conditions dynamically [53].
5. **Prompt Individualized Safe Management (PRISM):** Developed by Giannoudis PV et al., combines EAC principles with healthcare resource management [18].

The integration of Artificial Intelligence (AI) and Machine Learning (ML) holds promise for developing personalized trauma management protocols and improving risk stratification for polytrauma patients [13, 54].

Rehabilitation Phase in Polytrauma Management
Overview:

The rehabilitation phase is crucial for survivors of polytrauma, as it addresses the complex interplay of medical, psychosocial, and socio-economic factors. The effectiveness of rehabilitation greatly depends on the coordination and specialization of care provided by a well-trained multidisciplinary team [55].

Multidisciplinary Team

A well-functioning multidisciplinary team is essential for delivering comprehensive polytrauma rehabilitation. A systematic review by Hanna et al. (2020) highlights the need for robust studies to substantiate the benefits of multidisciplinary approaches in improving clinical outcomes for polytrauma survivors [56]. Key components of an effective team include:

- **Medical Specialists:** Addressing physical injuries and medical complications.
- **Rehabilitation Therapists:** Focusing on physical therapy, occupational therapy, and speech therapy.
- **Psychologists/Counselors:** Providing mental health support.
- **Social Workers:** Assisting with socio-economic challenges and discharge planning.

Deep Venous Thrombosis (DVT) Prophylaxis

DVT prophylaxis is a critical aspect of the rehabilitation phase. A systematic review of 12 studies reported an overall DVT incidence of 20% in polytrauma patients. The incidence was higher (38%) in patients who did not receive prophylaxis and lower (13%) in those who did [57]. Key considerations for DVT prophylaxis include:

- **Risk Assessment:** Use scoring systems to guide prophylaxis decisions, as demonstrated by Peng et al. [58].
- **Early Mobilization:** Early weight-bearing and physical activity are important for preventing DVT.
- **Continual Prophylaxis:** Tailor prophylaxis is based on patient-specific risk factors such as age and comorbidities.

International Guidelines

Internationally accepted guidelines for polytrauma rehabilitation are essential for optimizing resources and improving outcomes. These guidelines should include:

- **Training Programs:** For healthcare providers to ensure they are up-to-date with best practices.
- **Performance Improvement Strategies:** To monitor and enhance the quality of rehabilitation services.
- **Effective Organization:** Ensuring a well-coordinated approach to rehabilitation that addresses all aspects of patient recovery [59].

The integration of these elements into the rehabilitation phase is vital for achieving optimal outcomes for polytrauma patients, helping them regain function and improve their quality of life.

Conclusion

The management of polytrauma has significantly advanced in recent years, with improved protocols and technologies contributing to better patient outcomes. Initially defined as the presence of two or more significant injuries, the understanding of polytrauma has evolved to include a broader spectrum of clinical and physiological criteria. The introduction of the Berlin definition and the development of sophisticated management models, such as Damage Control Orthopaedics (DCO) and Prompt Individualized Safe Management (PRISM), have refined the approach to treating polytrauma patients. Pre-hospital care, guided by systems like Advanced Trauma Life Support (ATLS) and Pre-Hospital Trauma Life Support (PHTLS), has become more standardized, emphasizing the importance of early intervention and efficient management of airway, hemorrhage, and shock. These advancements are crucial given that the initial care provided at the scene of injury significantly impacts patient outcomes. The application of new techniques and tools, such as hemostatic agents and viscoelastic tests, has enhanced the management of trauma-associated coagulopathy and hemorrhage, leading to more effective resuscitation strategies. In the emergency department, the focus on rapid stabilization and the integration of advanced resuscitation techniques have improved the management of life-threatening conditions. The principles of Damage Control Resuscitation (DCR) have been pivotal in addressing the lethal triad of coagulopathy, hypothermia, and acidosis, which are critical factors in late mortality associated with polytrauma. The balanced approach to blood product transfusion and the correction of hypocalcemia have further contributed to better patient outcomes. The rehabilitation phase is equally important, involving a multidisciplinary approach to restore function and quality of life. Effective rehabilitation strategies, coupled with ongoing medical care and psychological support, are essential for long-term recovery. Overall, the continuous evolution of polytrauma management underscores the importance of a coordinated, evidence-based approach to care. Future advancements in research and technology will likely drive further improvements in the management of polytrauma, ultimately enhancing survival rates and recovery for patients worldwide.

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تقدمات في إدارة الصدمات المتعددة في بيئة الطوارئ-دور المسعفين: مراجعة شاملة

الملخص:

الخلفية: تعد الصدمات المتعددة قضية صحية عالمية كبرى، حيث تفرض تحديات كبيرة على نظم الرعاية الصحية في جميع أنحاء العالم نظرًا لارتفاع معدلات الوفيات والإعاقة المرتبطة بها. على الرغم من التقدم في أساليب التشخيص والعلاج، تظل الصدمات أحد الأسباب الرئيسية للوفاة، خاصةً من حوادث المرور ومن بين كبار السن. تطورت التعريفات التقليدية واستراتيجيات إدارة الصدمات المتعددة، لتشمل الآن معايير شاملة مثل تعريف برلين.

الهدف: تهدف هذه المراجعة إلى تقديم نظرة محدثة حول إدارة الصدمات المتعددة في بيئات الطوارئ، مع التركيز على التقدمات والممارسات الحالية في الرعاية قبل المستشفى، والإنعاش في قسم الطوارئ، ومرحلة التأهيل اللاحقة.

الطرق: تستعرض المراجعة الأبحاث والإرشادات الحديثة المتعلقة بإدارة الصدمات المتعددة، بما في ذلك تقنيات الرعاية قبل المستشفى، استراتيجيات الإنعاش، والنهج المبتكرة مثل جراحة العظام للتحكم في الضرر (DCO) والإنعاش للتحكم في الضرر .(DCR) تشمل المجالات الرئيسية التركيز على إدارة مجرى الهواء، التحكم في النزيف، وإدارة اضطرابات التخثر المرتبطة بالصدمات.

النتائج: تشمل التقدمات في إدارة الصدمات المتعددة تنفيذ أنظمة دعم الحياة المتقدم للصدمات (ATLS) ودعم الحياة للصدمات قبل المستشفى(PHTLS) ، التي حسنت النتائج من خلال توحيد بروتوكولات الرعاية. كما أدت دمج DCO والتحول نحو النهج الفردي للرعاية، مثل إدارة الأمان الفردية السريعة(PRISM) ، إلى تحسين استقرار المرضى وتعافيهم. أظهرت التقنيات المحسّنة للتحكم في النزيف والإنعاش، بما في ذلك استخدام عوامل التجلط والاختبارات اللزجة، وعودًا في تحسين معدلات البقاء على قيد الحياة.

الخلاصة: تتطلب إدارة الصدمات المتعددة نهجًا منسقًا عبر جميع مراحل الرعاية، من التدخلات قبل المستشفى إلى التأهيل. إن التقدم المستمر في بروتوكولات العلاج والتقنيات ضروري لتقليل الوفيات وتحسين النتائج للمرضى المصابين بالصدمات المتعددة.

الكلمات المفتاحية: الصدمات المتعددة، الرعاية قبل المستشفى، قسم الطوارئ، جراحة العظام للتحكم في الضرر، الإنعاش للتحكم في الضرر، إدارة الصدمات.