Focus on Polytrauma

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Current Concepts of Polytrauma Management

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Abstract

In recent years, the implementation of standardized protocols of polytrauma management led to a significant improvement of trauma care in European countries and to a decrease in posttraumatic morbidity and mortality. As such, the "Advanced Trauma Life Support" (ATLS®) protocol for the acute management of severely injured patients has been established as a gold standard in most European countries since the 1990s. Continuative concepts to the ATLS® program include the "Definitive Surgical Trauma Care" (DSTC™) algorithm and the concept of "damage control" surgery for polytraumatized patients with immediate life-threatening injuries. These phase-oriented therapeutic strategies appraise the injured patient in the whole extent of the sustained injuries and are in sharp contrast to previous modalities of "early total care" which advocate immediate definitive surgical interventions. The approach of "damage control" surgery takes the influence of systemic posttraumatic inflammatory and metabolic reactions of the organism into account and is aimed at reducing both the primary and the secondary – delayed – mortality in severely injured patients. The present paper shall provide an overview on the current state of management algorithms for polytrauma patients.

Key Words

Polytrauma · Management · ATLS® · Damage control · Multiorgan failure · Mortality

Introduction

Trauma still represents the "major killing factor" in young patients < 45 years of age in industrialized countries [1, 2]. In Germany alone, 4–5 million people suffer traumatic injuries each year and > 20,000 severely injured patients die every year [1, 3–5]. Trauma-related mortality has three major causes [6]: (1) the immediate mortality at the accident site ("sudden death") due to lethal injuries such as aortic rupture with free bleeding, lacerations of the brain stem, or decapitating injuries; (2) early mortality within the first few minutes to hours ("golden hour") due to compromised airways, tension pneumothorax, hemorrhagic shock as a consequence of intraabdominal or intrathoracic bleeding and pelvic ring disruptions with massive retroperitoneal hemorrhage, or due to severe traumatic brain injury with acute cerebral edema or intracranial hematoma; (3) late mortality within days to weeks after trauma due to septic complications, multiple organ failure and due to untreatable increased intracranial pressure associated with cerebral edema.

Major improvements in the management strategies of severely injured patients in the past decades have led to a significant reduction of polytrauma-associated mortality from about 40% in the 1970s to around 10% in the year 2000 [7]. This achievement is mainly owed to improved standards of trauma care due to defined algorithms of pre- and in-hospital trauma care which have been broadly propagated and established in most industrialized and developing countries [6, 8–15]. Since the patients' outcome is directly related to the time interval from injury to properly delivered definitive care, the optimization of preclinical transportation times and the implementation of the concept of patient transport to the closest appropriate – not just to the closest – hospital (rule of “three R’s” by Donald

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Trunkey: “get the Right patient to the Right hospital in the Right time”) [16, 17], have led to minimized transportation times and to shorter therapy-free intervals with overall improved outcome of polytrauma patients [1, 4, 7, 13]. Furthermore, the vast propagation of the “damage control” concept for severely injured patients with immediate life-threatening injuries, as well as the improvement of intensive care strategies for polytraumatized patients have further contributed to an increased level of trauma care with reduced trauma-associated mortality [18–24].

Successful primary care of polytraumatized patients (Box 1) is characterized by the demands of both therapeutic and diagnostic measures. Since the time factor is of crucial essence, validated concepts and algorithms have been established in the past few years for the initial diagnosis and treatment of severely injured patients. The updated “Guidelines of the German Society of Trauma Surgery” (DGU) for the diagnostics and treatment of polytraumatized patients have recently been outlined in a comprehensive review article [25]. The “Advanced Trauma Life Support“ (ATLS®) protocol of the American College of Surgeons’ Committee on Trauma has been established as a standard procedure algorithm for the initial assessment and management of polytraumatized patients in the past 3 decades in > 30 countries worldwide and in twelve European countries [6, 14]. Based on the principle of the “golden hour of shock”, injuries which would take a lethal course if left untreated within the first minutes to few hours after trauma are being cared for using standardized diagnostic algorithms and validated therapeutic concepts according to the ATLS® guidelines [6, 14, 26]. In blunt polytrauma patients, this early phase of the “golden hour” is not restricted to management within just the first 60 min after injury only, but can be safely extended to the first few hours after trauma [27]. Beyond the ATLS® concept, the “Definitive Surgical Trauma Care“ (DSTC™) course by the International Association for the Surgery of Trauma and Surgical Intensive Care provides the standards of emergency surgical procedures of patients with blunt and penetrating injuries.

The concept of “damage control” orthopedic surgery has evolved based on the observation that a prolonged early definitive treatment of long bone fractures can be detrimental for severely injured patients who are in a persisting unstable physiological state despite adequate resuscitative measures during the initial management phase [18, 19, 28–30]. In these patients, the early restoration of the “lethal triad” of persistent metabolic acidosis, hypothermia, and coagulopathy represents the prime goal for survival [28–30] (Figure 1). Thus, polytrauma patients in extremis must be transferred to intensive care at the earliest time point after stabilization of vital functions for restoration of physiological parameters, and prolonged surgical interventions must be avoided in order to prevent a lethal “second hit” in these patients [24, 31–33]. The current understanding of “damage control” surgery involves four distinct phases of assessment and management [18, 34]: (1) life-saving surgery with early recognition of those trauma patients that warrant damage control (“ground zero” recognition phase); (2) salvage operation for control of hemorrhage and contamination (“OR phase”); (3) intensive care management for restoration of physiological and immunologic baseline functions (“ICU phase”); (4) scheduled definitive surgery (“reconstructive phase”).

The present review shall provide an up-to-date overview on established diagnostic and therapeutic algorithms of preclinical and clinical management of polytraumatized patients.

**Preclinical Management**

During the prehospital period, emphasis in the management of polytrauma patients should be placed on airway maintenance, control of external bleeding, fluid resuscitation, immobilization of the spine, and immediate transport to the closest appropriate clinic. Different algorithms have been established to narrow the time window from injury to definitive care and to optimize the preclinical therapeutic strategies and determine the adequate target facility for the individual trauma patients [6, 13, 35–37]. These defined algorithms should help prevent the undertriage of trauma victims – a phenomenon which has been shown to occur mainly in elderly patients [16, 17]. Thus,

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**Box 1.** “Polytrauma” – definition according to Otmar Trentz (2000). A syndrome of multiple injuries exceeding a defined severity (Injury Severity Score (ISS) > 17) with consecutive systemic trauma reactions which may lead to dysfunction or failure of remote – primarily not injured – organs and vital systems [24].

**Figure 1.** The “lethal triad” in the pathophysiology of severely injured patients leading to a vicious circle and adverse outcome. This implication constitutes the underlying rationale for the concept of “damage control” surgery [30].