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Selected Topics: Prehospital Care

INFLUENCE OF ENTRAPMENT ON PREHOSPITAL MANAGEMENT AND THE HOSPITAL COURSE IN POLYTRAUMA PATIENTS: A RETROSPECTIVE ANALYSIS IN AIR RESCUE

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□ **Abstract—Background: Entrapment is a challenging and crucial factor in the prehospital setting. Few studies have addressed whether entrapment has an influence on on-scene treatment or on the following hospital course. Objectives: Here we aimed to investigate the influence of entrapment on prehospital management and on the hospital course of polytrauma patients. Methods: We performed a retrospective analysis of consecutive patients with an Injury Severity Score ≥16 and aged 16–65 years that were admitted between 2005 and 2013 to a Level I trauma center. Two groups were built: entrapped (E) and nonentrapped patients (nE). These groups were evaluated for multiple prehospital and clinical parameters, including on-scene time, prehospital interventions, and posttraumatic complications. Results: There were 310 patients (n = 194 no entrapment [Group nE], n = 116 with entrapment [Group E]) enrolled. The on-scene time was significantly longer in Group E than Group nE. Moreover, this group received a significantly higher volume of colloidal solution. Regarding the Injury Severity Score and Abbreviated Injury Scale (AIS), there were no significant differences between the groups, except for the $AIS_{extremities}$, which was significantly increased in Group E. The overall hospital stay and the initial theater time were significantly longer in Group E than Group nE. No significant differences were present for the occurrence of systemic inflammatory response syndrome, multiple organ dysfunction syndrome, and acute respiratory distress syndrome, nor for Acute Physiology and Chronic Health Evaluation II and estimated and final mortality. Conclusion: In polytraumatized patients, entrapment has a minor influence on the outcome and treatment in the prehospital and hospital setting when using physician-based air rescue. However, entrapped patients are prone to sustain more severe trauma to the extremities.**

□ **Keywords—entrapment; polytrauma; air-medical rescue; helicopter emergency medicine**

INTRODUCTION

In polytraumatized patients, an adequate time management would be necessary to achieve a hospital admission within the golden hour of shock. Despite all efforts, the rescue time frequently exceeds this recommended hour, even in Germany, which is known for its ubiquitously available rescue system (1). Time effectiveness

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and the possibility of covering long distances are some of the advantages of the helicopter emergency medical service (HEMS). In addition to this, helicopter rescue is associated with a reduction in mortality in polytrauma patients (2–4). Taking this into account, the helicopter is considered the most suitable rescue vehicle for polytraumatized patients (3,4).

The overall rescue time depends not only on the transportation time, but also on some prehospital factors. A time-consuming part of the prehospital trauma treatment can be the extrication of entrapped patients (5,6). In the literature, the mean extrication time varies from 12.5–33 min, which emphasizes the enormous influence in the small window of the golden hour of shock (1,5,6). A very limited number of studies were published investigating the influence of entrapment in trauma patients, investigating heterogeneous trauma cohorts (7,8). Also, the literature is lacking evidence about the influence of entrapment on the posttraumatic course because the combination of prehospital and hospital data is rare and hard to achieve.

The primary outcome parameter of this study was to evaluate the influence of the entrapment of polytrauma patients on the clinical outcome in a retrospective analysis in HEMS at a Level I trauma center combining prehospital and hospital data. We aimed to identify differences in the on-scene treatment and the hospital course, as well as to evaluate the differences in injury pattern and trauma mechanisms.

MATERIALS AND METHODS

Study Population and Patient Recruitment

Consecutive polytraumatized patients between January 1, 2005 and April 30, 2013 that were transported by a rescue helicopter to a Level I trauma center were evaluated retrospectively through our database. The in-house database of polytrauma patients consists of various parameters including laboratory parameters, posttraumatic complications such as the systemic inflammatory response syndrome (SIRS), multiple organ dysfunction syndrome (MODS), Acute Physiology and Chronic Health Evaluation (APACHE), mortality and others. Also, injury characteristics and severity of the polytrauma patients treated at our institution are recorded. The database is managed by trauma surgeons of the trauma department with special focus on polytrauma patients; these are also responsible for entering the datasets.

To identify prehospital parameters and group allocations, emergency physicians' protocols of transported trauma patients and the emergency medical services database were reviewed. The database was searched manually by physicians. Correctness of the data collected was ensured by searching handwritten as well as all digital documents available and merging the information. The Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), the Marshall Score, and the APACHE II were also checked twice; the first assignment took place when the patient arrived at the hospital, during inpatient stay and a second calculation was performed retrospectively by a surgical consultant on the basis of the documented data. Permission was given by the local Ethical Committee.

Inclusion criteria for this study were: injury severity score (ISS) $\geq$ 16; transport via one specific physician-staffed rescue helicopter located at and operated by staff of the trauma department, and age 16–65 years. Dataset including prehospital and hospital parameters.

Study Groups

The study population was divided into two groups: Group nE (no entrapment) and Group E (entrapment). Entrapment was defined as entrapment with the need for technical rescue for extrication. Allocation to the groups was based on emergency physicians' protocols and the emergency medical services database, which represents prospective collected data. Both the database and emergency physicians' protocols have been reviewed for this study to reduce bias. Prehospital crash characteristics were analyzed. All patients were evaluated for multiple prehospital (endotracheal intubation, chest tube application, resuscitation volume, Glasgow Coma Scale (GCS), helicopter operating time, on-scene time, and overall prehospital time) and hospital parameters (hospital length of stay, time in the intensive care unit [ICU], ISS, AIS, respirator time, SIRS, MODS, acute respiratory distress syndrome [ARDS], and the APACHE score).

Definitions

The following definitions were used: helicopter-operating time, the flight time of the helicopter, including the start and landing phase; on-scene time, the time from landing at the scene until starting at the scene; overall prehospital time, and the time from alarm notice to patient handover. Crystalloids refer to 0.9% saline; colloids to hydroxyethyl starch (HES 6%/130). In rare cases, HyperHaes (7.2% sodium chloride; 6% HES 200/0.5; Fresenius) was used and subsummarized under crystalloids.

Injury severity was assessed by the AIS and the ISS. The ISS is an anatomical score to assess the degree of injury of polytraumatized patients. Six body regions are included in the assessment. All injuries are scored according to severity (1 = mild injury to 6 = fatal injury). Injuries are assessed with the AIS 2005. Overall, the ISS consists of the squared scores of the three most severely affected AIS regions. By definition, a maximum score of 75 is possible (9,10).