



The influence of prehospital time on trauma patients outcome: A systematic review



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ABSTRACT

Objective: Time is considered an essential determinant in the initial care of trauma patients. Salient tenet of trauma care is the 'golden hour', the immediate time after injury when resuscitation and stabilization are perceived to be most beneficial. Several prehospital strategies exist regarding time and transport of trauma patients. Literature shows little empirical knowledge on the exact influence of prehospital times on trauma patient outcome. The objective of this study was to systematically review the correlation between prehospital time intervals and the outcome of trauma patients.

Methods: A systematic review was performed in MEDLINE, Embase and the Cochrane Library from inception to May 19th, 2014. Studies reporting on prehospital time intervals for emergency medical services (EMS), outcome parameters and potential confounders for trauma patients were included. Two reviewers collected data and assessed the outcomes and risk of bias using the STROBE-tool. The primary outcome was the influence on mortality.

Results: Twenty level III-evidence articles were considered eligible for this systematic review. Results demonstrate a decrease in odds of mortality for the undifferentiated trauma patient when response-time or transfer-time are shorter. On the contrary increased on-scene time and total prehospital time are associated with increased odds of survival for this population. Nevertheless rapid transport does seem beneficial for patients suffering penetrating trauma, in particular hypotensive penetratingly injured patients and patients with a traumatic brain injury.

Conclusion: Swift transport is beneficial for patients suffering neurotrauma and the haemodynamically unstable penetratingly injured patient. For haemodynamically stable undifferentiated trauma patients, increased on-scene-time and total prehospital time does not increase odds of mortality. For undifferentiated trauma patients, focus should be on the type of care delivered prehospital and not on rapid transport.

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Introduction

Trauma is one of the major causes of death worldwide; approximately five million people die each year as a result of traumatic injuries. In the USA alone, trauma is the leading cause of death for Americans under the age of 40 [1]. In 2011 road traffic injuries claimed nearly 3,500 lives each day worldwide [2]. Emergency medical systems (EMS) around the world are

constantly evolving in order to reduce these numbers and provide better quality medical care. To do so, focus has often been on shortening prehospital times [3]. Historically, time is considered to be an essential determinant on the outcome of trauma patients. A fundamental tenet of trauma care is the 'golden hour', the immediate time after injury when resuscitation, stabilization and rapid transport are perceived to be most beneficial to the patient [4]. It is thought that when advanced emergency medical care is provided in this brief window of time and this time interval is kept to a minimum, mortality and morbidity of the trauma patients will be reduced [5–8]. However, not all trauma literature is in concordance on this matter [9,10]. In many emergency medical systems patients spend this extremely important time-interval in a prehospital setting, without receiving definitive care [11]. Though

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it seems intuitive to transport a trauma patient as fast as possible to a trauma centre, especially those with a severe haemorrhage or increasing intracranial pressure, this may have adverse effects on the outcome, as some patients may be in need of specialized care before transfer [9,12]. There is discussion on the exact influence of the duration of time elapsed before reaching a trauma centre on patients outcome. Many of the scientific findings concerning prehospital times derive from studies done in war settings with military systems of care [13]. Whether or not this can be extrapolated to civilian trauma care, has not fully been investigated. Different ideas exist with regard to geographical factors, the mechanism of injury (MOI) and swiftness of transfer [14]. Timely transfer is thought to be a critical predictor of outcomes for patients with acute traumatic injuries in rural and developing regions. And also for the penetrating injuries where the concept of 'scoop and run' is often implemented. Several studies have tried to investigate the effect of prehospital time intervals on patient outcome [15–17]. So far, no study has systematically reviewed the effect of the prehospital time intervals on outcome parameters for trauma patients. The objective of this study was to systematically examine and review the influence of different time intervals in the prehospital phase on outcome measurements for trauma patients. Our aim is to provide a thorough summary of the current relevant literature.

Methods

This systematic review was performed according to the recommendations of the preferred reporting items for systematic reviews and meta-analysis (PRISMA statement [18]).

Searches and data sources

To identify all relevant publications systematic searches were performed in collaboration with a medical research librarian, in the bibliographic databases PubMed, Embase.com and The Cochrane Library (via Wiley) from inception to May 19th 2014. Search terms included controlled terms from MeSH as well as free text terms in PubMed, Emtree in EMBASE.com. We used free text terms only in The Cochrane library. Search terms expressing 'trauma patients' were used in combination with search terms comprising 'on-scene time' and 'outcome parameters'. The references of the identified articles were searched for relevant publications. The search strategy in PubMed can be found in Supplementary Data file 2. We applied a language restriction; English, German and Dutch articles were included. The search was further limited to articles with an abstract available and we only included observational studies, as our goal was to observe the normal standard of care delivered without intentionally altering care in order to test an intervention. The separate results from all searches were reconciled for duplicate articles. All searches were conducted by two investigators with prior experience in conducting a systematic review (A.H., E.J.).

Selection of studies

We included studies that reported criteria concerning pre-hospital EMS time intervals for trauma patients (1); this could mean either one of the following intervals: on-scene time or total prehospital time and when also available activation interval, response time and transfer time. Definitions of the time intervals used are portrayed in Table 1. The studies had to investigate the influence of the length of prehospital times on outcome parameters (2). Adequate information had to be provided on outcome parameters such as; length of hospital admission, length of ICU admission or mortality. Definitions of prehospital time intervals and outcome measurements had to be clarified (3).

Table 1
Definitions of prehospital time intervals.

Prehospital time interval	Abbreviation	Definition
Activation time	AT	Time required for EMS to deploy after emergency call
Response time	RT	Includes the AT and the time to get to the scene of accident
On-scene time	OST	Time spent on scene by EMS
Transport time	TT	Time from departing scene to arrival at the hospital
Total prehospital time	TPT	Total time between emergency call and arrival at the hospital

Exclusion criteria were articles with insufficient information (1), for example, very limited or only gross information on prehospital transport time intervals. Article with duplicates of previously published data (2), articles with no full-text available (3), comments (4), editorial (5), studies that did not adjust and/or report on confounders (6) or inadequate statistical analysis (7), were also excluded. The abstracts obtained by the search were independently reviewed for suitable articles by two reviewers (A.H., P.M.). If suitable the full-text versions were retrieved. Furthermore we hand searched the reference-list of included publications and the subject indices of prominent journals to identify further suitable articles. Two investigators (A.H., P.M.) independently assessed all full-text articles to ensure that the inclusion criteria were met. Any discrepancies between the reviewers about the articles meriting inclusion were resolved by consensus after deliberation with a third investigator (G.G.).

Data extraction and management

The following data were extracted from the studies when available: title, year of publication, location of study, study design, number of patients, MOI, age and gender of participants, prehospital time interval: activation time (AT), response time (RT), on-scene time (OST), transfer time (TT) or total prehospital time (TPT). The outcome parameters extracted when available were mortality, hospital length of stay (LOS), days of admission to the ICU and complications (as reported by the American College of Surgeons (ACS)). When an included study did not supply the necessary information the authors were contacted by e-mail to provide the additional information. Unfortunately many of the authors addressed were unable to supply us with the requested information. We attempted to perform a meta-analysis with the available and acquired data to combine results and to estimate more the true effect size. However, due to heterogeneity of the analyses used, inability to extract data from the papers and inadequate information provision, this could not be achieved.

Assessment of methodological quality and risk of bias

The methodological quality of each included paper was assessed by two independent reviewers (A.H., G.G.) using the elaborate STROBE-statement for non-randomised observational studies [19]. The level of evidence of each article was scored using the grading system for level of evidence from the Centre for Evidence-Based Medicine [20]. The levels of evidence range from one, which entails high-quality evidence up to five, which entails poor quality evidence or expert opinion. Discrepancies were thoroughly discussed and resolved by consensus.

Results

The search yielded a total of 2,938 potentially relevant articles. After removing duplicates of references that were selected from

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