

## Review

# The impact of time to surgery on outcomes in patients with traumatic brain injury: A literature review



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## ABSTRACT

**Aim:** To review the relationship between the time interval to surgery and outcomes in patients with traumatic brain injury (TBI).

**Methods:** A literature review was conducted by employing several search strategies, including electronic database searches and footnote chasing. The quality of the selected studies was assessed in terms of internal and external validity. Data regarding authors, publication year, sample size, surgical procedure, time interval to surgery, and outcome was extracted.

**Results:** Among 16 finally selected studies, five studies (31.3%) found that patient outcome was significantly affected by the timing of surgery and 11 (68.7%) did not. The impact of time to surgery on outcomes was not significant in most (75%) of the studies targeting patients with severe TBI. The effect of time to surgery on outcome showed different findings depending on the type of surgical procedure. A significant effect of time to surgery on outcome was reported in one (14.2%) of the seven studies targeting patients who underwent haematoma evacuation and in four (44.4%) of the nine studies on patients who underwent decompressive craniectomy.

**Conclusion:** This review shows that current opinion is still divided regarding when to operate. Despite this discrepancy, most authors agree that the timing of decompression is crucial to outcome.

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## Introduction

Traumatic brain injury (TBI) is common and has poor outcomes, such as death or permanent disability, when severe (Moppet, 2007). The primary brain injury may be followed by secondary injury caused by a series of events, including elevated intracranial pressure (ICP), reduced cerebral blood flow, cerebral hypoperfusion, and further brain swelling (Winter et al., 2005). Early management of TBI is, therefore, directed towards minimizing progression of secondary brain injury (Moppet, 2007). Although the management for brain oedema and increased ICP is primarily medical, in cases refractory to medical treatment, the alternative is to perform surgery (Winter et al., 2005; Mathai et al., 2010).

Does timing of surgery have an independent impact on outcomes? If time to surgical management significantly impacts outcomes, how rapidly should the surgical procedure be provided to patients? Since the 1970s, increasing attention has been given to the timing of surgical intervention in patients with TBI. Since

1982, several studies have reported that the most common cause of preventable mortality and morbidity after head injury is delay in evacuation of an intracranial haematoma (Langfitt and Gennarelli, 1982; Sawachi et al., 2002). In contrast, other studies have found no significant relationship between the timing of surgery and outcomes in patients with head injury (Massaro et al., 1996; Aarabi et al., 2006; Jagannathan et al., 2007). Thus, the effect of time to surgery on outcomes in patients with TBI remains controversial. Therefore, the purpose of this paper is to systematically review the impact of time to surgery on outcomes in patients with TBI.

## Methods

### Search strategy for relevant literature

Several search strategies were employed to find published literature assessing the impact of timing of surgery on outcomes in patients with TBI. The first strategy involved computerized database searches using PubMed, MEDLINE, CINAHL, Cochrane Library, Google scholar, HealthSTAR, and EMBASE. Studies published between January 1990 and February 2013 were searched. The following

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key words were used: traumatic brain injury, head injury, trauma, outcome, mortality, survival, functional status, timing, time, operation, surgery, neurosurgery, haematoma evacuation, decompressive craniectomy. The second strategy was footnote chasing, which examines references cited in articles previously identified by the search string. Third, clinical experts or investigators were contacted to gain knowledge on any studies missed by the electronic searches.

#### Inclusion and exclusion criteria of studies

Studies were eligible for inclusion if they: included patients of any age, included patients who were diagnosed with TBI, reported the relationship between patient outcome and time to surgery, provided data from population-based study, reported any patient outcomes such as in-hospital mortality or functional status, and were published as a journal article or a book chapter in English. Studies were excluded if they: provided data from a forum, panel discussion, case study, or experience talk; did not clearly define the time to surgery; and included patients with multiple injuries, burn injuries, or injuries in other body regions besides the brain.

#### Quality assessment of selected studies

The final studies selected for the review were assessed for their quality by using the instrument used by Perel et al. (2006). This instrument allows one to evaluate each methodological aspect by using a component approach appraisal instead of quality scoring. The internal and external validity of each study were assessed for quality. Internal validity referred to the systematic error of the study and was related to study design, variable definition, management of missing data, statistical analysis method, handling of continuous variables, or number of outcome events relative to number of variables. External validity referred to the application of the study to other settings or populations and included an assessment for sample characteristics, discrimination (the ability to separate individuals with different outcomes), and calibration (the ability to produce correct estimates of the outcome probability) (Perel et al., 2006). In total, 14 questions (eight for internal validity and six questions for external validity) from that quality assessment instrument were adopted for the quality evaluation of each study. The quality assessment was restricted to studies meeting the inclusion criteria.

#### Data extraction

The author independently screened all article titles and abstracts for an initial eligibility judgment. The author and a reviewer then selected studies that met inclusion and exclusion criteria, and reviewed the quality of the selected studies. The agreement rate between the two reviewers was 97% in terms of quality assessment and data extraction. Minor disagreement was resolved through deep discussion between the reviewers and the opinion of a third expert. A standardized data extraction form was used to record information on authors, publication year, sample size, surgical procedure, time interval to surgery, outcome, etc.

#### Results

Fig. 1 illustrates the study selection process. A total of 17,600 papers were initially retrieved using the various search strategies. After screening titles, 17,503 articles were excluded. After reviewing the abstracts of 97 articles, 45 articles that did not meet all inclusion criteria were then excluded. Consequently, 16 studies were selected for final review.

#### General characteristics of the selected studies

Nine studies (56.2%) were conducted after the year 2000, and half of the studies (56.2%) were done in the USA and Canada (Table 1). Almost all the studies (93.8%) collected data in one institution. Data was retrospectively collected in most of the studies (75.0%). A median of 66.5 patients (range 12–368) were included per study, with in-hospital mortality and Glasgow Outcome Scale (GOS) measured as study outcomes in 73.1% of the studies. Multivariate regression was used for statistical analysis in only five studies.

#### Quality assessment of the selected studies

Regarding internal validity, half of the studies included a discussion about the rationale to select variables and a definition of those variables (Table 2). None of the selected studies reported on the management of missing data. Some of the quality assessment questions, such as interaction, could only be applied to studies using regression analysis. With regard to external validity, only two studies reported measures of calibration and discrimination. Three studies (18.7%) presented their respective confidence intervals.

#### Impact of time to surgery on patient outcomes

Table 3 presented a summary of the studies examining the relationship of time to surgery and patient outcomes. Among the 16 finally selected studies, 12 studies measured time from injury to surgery, and four measured time from emergency department (ED) arrival to surgery. Twelve studies (75%) collected data retrospectively from medical charts, while only three studies adopted the randomized control trial for their research design. Five studies (31.3%) found that patient outcome was significantly affected by timing of surgery, while 11 (68.7%) did not.

Fig. 2 illustrates the impact of time to surgery on outcome according to the type of measurement of time to surgery (injury to surgery vs. ED arrival to surgery). Of the 12 studies measuring time from injury to surgery, eight (66.7%) revealed that time to surgery was not a significant factor influencing outcomes. Fig. 3 presents the effect of time to surgery on outcome according to the severity of injury (severely injured patients vs. all levels of injured patients). Of the 12 studies targeting patients with severe TBI

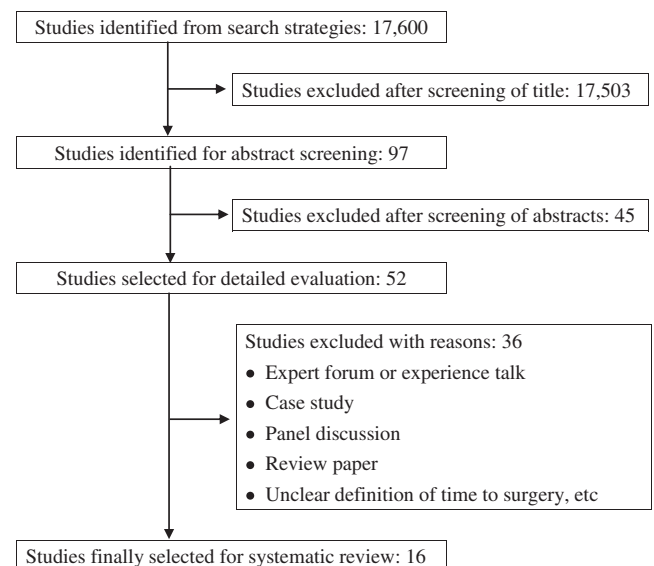


Fig. 1. Study selection process for the systematic review.

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