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Original Research

The Effect of Prehospital Intubation on Treatment Times in Patients With Suspected Traumatic Brain Injury

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A B S T R A C T

Objective: This study examines whether, in patients requiring intubation with moderate to severe traumatic brain injury (TBI), prehospital intubation compared with emergency department intubation leads to a reduction in treatment times and time to a computed tomographic (CT) scan.
Methods: A retrospective cohort study compared adult patients with a Glasgow Coma Score of less than 14 with a suspected TBI who underwent intubation, either prehospital or on arrival to the emergency department.
Results: Prehospital intubation was associated with a decreased time from emergency department arrival to CT scan compared with emergency department intubation (43 vs. 54 minutes, $P < .001$). The prehospital intubation group had a longer median scene time (42 vs. 17 minutes, $P \leq .001$), longer median transport times (32 vs. 14 minutes, $P \leq .001$), and longer total treatment times (90 vs. 73 minutes, $P = .007$).
Conclusions: Patients intubated in the prehospital setting spend a longer time at the scene but a shorter amount of time in the emergency department before brain imaging. Prehospital intubation may lead to earlier control of airway and ventilation. The minority of intubated TBI patients required urgent neurosurgical intervention. Overall prehospital intubation shows no significant survival advantage for the patients when compared with emergency department intubation.

Injury is the worldwide leading cause of death in people under the age of 45, and traumatic brain injury (TBI) is a major contributor.[1,2] It has been estimated that the incidence of TBI is approximately 200 per 100,000 of the population worldwide and that the rate of worldwide mortality from TBI is approximately 20 per 100,000 of the population.[3] TBI is the contributing factor to 30.5% of all injury-related deaths in the United States.[4] In Australia, there are an estimated 107 hospitalizations because of TBI per 100,000 of the population per year.[5,6] The Australian Trauma Registry reported 63% of all major trauma patients treated at major trauma centers had a head injury.[6] The presence of a TBI is associated with increased treatment costs,[7] and patients with isolated head injuries have a higher mortality (34%) than other isolated injuries to the other body regions combined.

It has been shown that hypoxemia and hypotension frequently occur at the injury scene.[6,8] These secondary insults are associated with worse outcomes.[9] It is widely accepted that the avoidance of secondary brain injury because of hypoxemia, hypercapnia, and hypotension along with measures to reduce raised intracranial pressure are key principles in the management of TBI.[10-12] Endotracheal intubation of many of these patients is performed to secure a threatened airway, normalize ventilation, or manage concurrent chest injury. For the majority of patients with TBI, these interventions constitute the mainstay of treatment. Only a minority of TBI patients require a time-critical surgical procedure (eg, evacuation of an expanding intracranial hematoma). Definitive diagnosis and neurosurgical planning require brain computed tomographic (CT) imaging. With the exception of patients requiring emergent operative management of concurrent injuries, undergoing a CT scan is a critical step in TBI management. Transfer for CT imaging occurs after a period of emergency department (ED) assessment and initial resuscitative interventions have been initiated. Hence,

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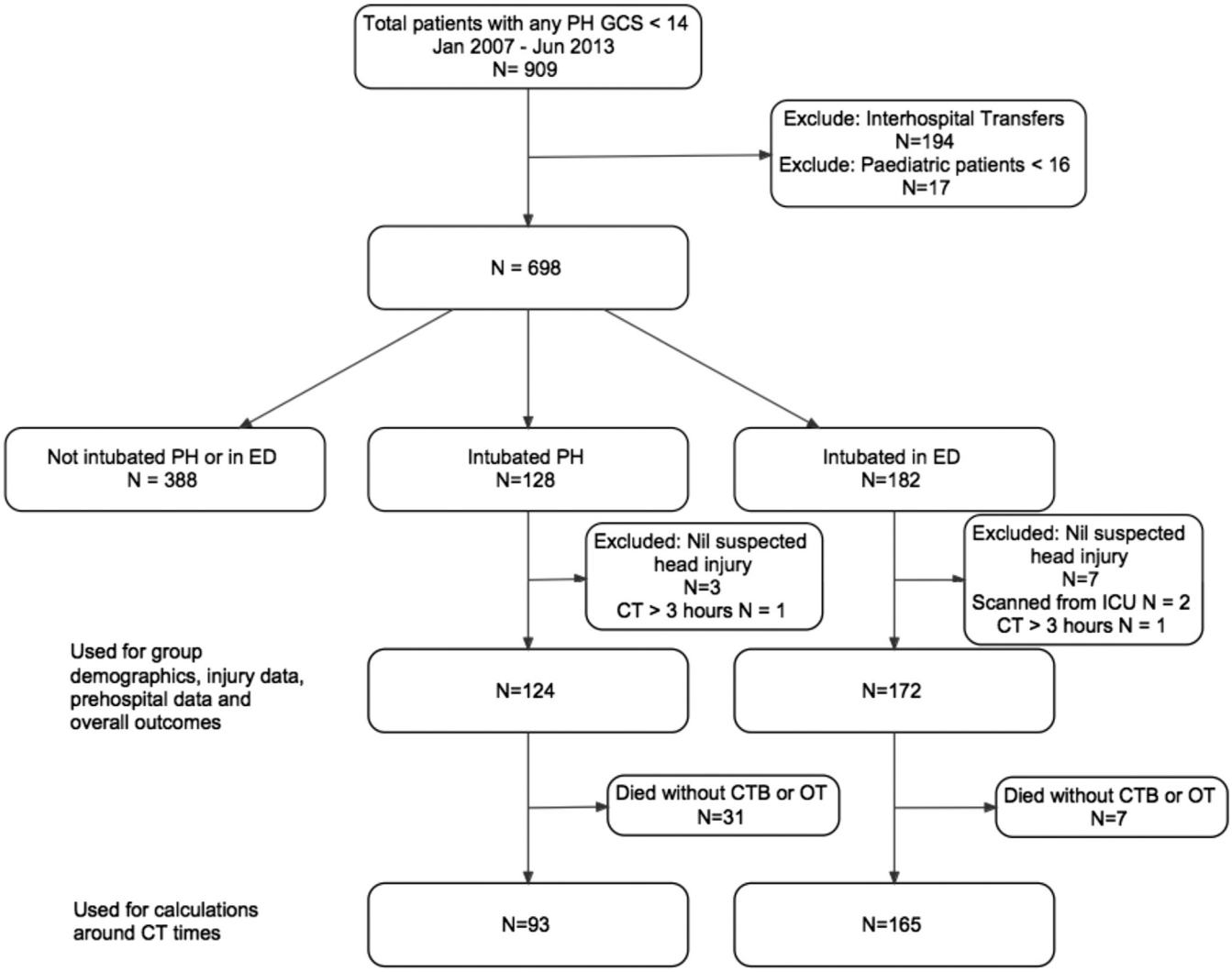

Figure 1. Participant identification and cohort allocation process.

time to a CT scan from ED arrival is a reasonable measure of trauma system performance.

Prehospital intubation for TBI occurs to a varying extent in different emergency medical services systems.[13] Prehospital intubation has been associated in retrospective studies with more severe injury.[14] There have been some concerns that performing advanced procedures such as endotracheal intubation in the prehospital setting will result in increased prehospital times.[15] Several studies have shown this to not be the case.[16-18] A secondary analysis of the Head Injury Retrieval Trial (HIRT) study[19] was published in 2015 that reported prehospital times and times from ED arrival to the commencement of a CT scan.[20] They found an increase in scene time (25 vs. 17 minutes, $P < .001$) and a decrease in ED arrival to CT time (59 vs. 70 minutes, $P < .001$). The study did not separately report on patients undergoing prehospital intubation; however, the helicopter emergency medical services (HEMS) group had a prehospital intubation rate of 46% compared with 5% in the paramedic group. Van der Velden et al[16] examined the impact of prehospital attendance by HEMS on prehospital and ED resuscitation time and found that HEMS-treated patients spent a longer time at the scene but a commensurately shorter time in the ED undergoing initial assessment.[16] Only a minority of these patients were intubated. No studies were identified looking specifically at the impact of prehospital intubation on time to CT imaging in the setting of TBI.

Objective

The current study examines whether, in patients requiring endotracheal intubation with suspected moderate to severe TBI, prehospital intubation compared with ED intubation leads to a reduction in time from ED arrival to CT imaging and whether this compensates for any increase in prehospital scene time.

Methods

A retrospective analysis was conducted of prospectively collected trauma data at a major trauma center in South-Eastern Sydney, Australia. The study site's ED sees more than 65,000 patients per year and treats approximately 2,000 trauma patients annually.[21] It has a well-established in-hospital trauma service with a trauma registry that commenced in 1992. CT imaging is available 24 hours a day, 7 days a week. During the study period, CT imaging was located approximately 100 m from the resuscitation bay.

This trauma center accepts patients from a large geographic area that includes both urban and more remote rural and bush areas. These areas are served by both a paramedic-staffed ground ambulance service and 2 physician- and paramedic-staffed medical