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Prehospital Interventions in Children with a Severe Traumatic Brain Injury

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Abstract

Trauma is the leading cause of morbidity and mortality in children and adolescents and approximately one third of the injuries are due to a traumatic brain injury (TBI). The impact of prehospital care on the outcome of patients with a TBI has been investigated and it shows a positive impact on better neurological outcome however there are limited research concerning the pediatric patient. Therefore the aim of this study was to describe prehospital care in children with a severe traumatic brain injury.

Methods: Retrospective review of prehospital medical records.

Results: Most children, 94 percent were brought to the emergency department by ground ambulance due to a severe brain injury. Prehospital interventions were found in one third of the children. Children<7 years received less intervention as compared to older children. The most common prehospital intervention was controlled airway/ endotracheal intubation.

Conclusion: Despite a severe brain injury only one third of the children received a prehospital intervention (controlled airway, pain treatment and IV fluid treatment) during the prehospital care. The initial severity of injury showed no impact on the frequencies of interventions.

Keywords: Prehospital emergency care; Traumatic brain injuries; Pediatrics

Introduction

Trauma is the leading cause of morbidity and mortality in children and adolescents and approximately one third of the injuries are due to a traumatic brain injury (TBI) [1-2].

The goal for the acute management of patients with a brain injury is to identify those in need of acute intervention as early as possible and to prevent secondary brain injuries due to hypoxia and/or hypotension [3-10].

Other prognostic factors for patients with traumatic brain injury has been presented such as Glasgow Coma Score (GCS), pupil reaction, age at injury and head computed (CT) scan findings [11,12]. However, the majority of published articles use these factors as measured at arrival in primary hospital not in the prehospital setting [13].

The impact of prehospital care on the outcome of patients with a traumatic brain injury has investigated in Sweden and the results from Rudehill et al. [14] showed a positive impact on postresuscitation neurological status and therefore better neurological outcome because of an effective prehospital care [13]. Prehospital care has increased in terms of both medical and technical competence [14]. Result that shows whether this development has had an impact on the prehospital care of the brain-injured child is scarce.

However, the result from Zebrak et al. [9] showed that children receiving no attempt to treat hypotension had an increased death of 3.4 and were 3.7 times more likely to suffer a severe disability compared with treated hypotensive children [9]. There is not only available evidence-based guidelines that could improve the outcome of the severe TBI patient, the interventions has to be documented in the Emergency Medical Services (EMS) records as reported by Laudermilch et al. [15]. The result showed an increased risk of mortality (10.3% versus 4.5%; p=0.001) in patients with incomplete documentation of physiological data by the EMS as compared to those with a complete documentation [16].

Research concerning the paediatric population in the prehospital setting is scarce and the Paediatric Emergency Care Applied Research Network (PRECARN) did stress the need for research concerning paediatric head trauma during the prehospital care in year 2010 [17].

Therefore the aim of this study was to describe prehospital care in children with a severe traumatic brain injury. Does the initial severity of injury have an impact on the frequencies of prehospital interventions to prevent hypotension and hypoxia?

Materials

The study was conducted at the Astrid Lindgren Children's Hospital, which is a level one-trauma center in the Stockholm region, Sweden. The ambulance services in Stockholm (population 2.1 million) in provided by approximately 50 ambulances, two physician-manned emergency cars and one ambulance helicopter [18].

Inclusion criteria: (i) all children (0-18 years) with a severe TBI, (GCS less than eight measured on admission to hospital) (ii) requiring Intensive care, (iii) who during the years 1996-2008 took part of a hospital based rehabilitation.

Glasgow Coma Score (GCS)

This scale was developed by Teasdale and Jennet in 1974 and is the most frequently used tool to define the level of consciousness [19]. The areas to score are eye opening, motor response and verbal response to

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stimuli. To describe the severity of brain injury, the scores divided into a severe brain injury (GCS 3-8), moderate brain injury (GCS 9-13) and a mild brain injury (GCS 14-15) [20].

Methods

Retrospective collection of data from prehospital records; age, external cause of injury, prehospital documentation of initial GCS and interventions (IV fluid, endotracheal intubation and pain management) performed in the prehospital setting. Hospital records were reviewed and data were collected such as: gender, duration of unconsciousness, GCS on admission to hospital and management of the child at the hospital.

Statistical procedure

Descriptive statistical procedures were computed using the PASW version 18.0 program. The Children were divided into two age groups: children less than 7 years and children over 7 of age. This subdivision was made due to the assumption that age has an impact on outcome made by Anderson and Moore [21].

Categorical variables were compared by means of Fisher´s exact two-tailed test or Pearson chi-square tests. For analysis of the frequencies of prehospital interventions the level of consciousness was dichotomized into yes or no and GCS into>eight or<eight. Risk estimate and 95% confidence intervals (CI), were calculated by logistic regression. Probability below 0.05 was accepted as statistically significant.

Ethical aspects

The Regional Ethical Review board in Stockholm, Sweden approved the study (Dnr: 2010/0070-32).

Result

A total of 60 children were included in this study. There were 41 boys (68%) and 19 girls (32%). Mean age at injury: 11.83 years (range 3-16) (Figure 1).

The external cause of injury showed that 66% were caused of road and traffic accidents (RTA), 11% were caused by falls and 23% were caused by other injuries (sport accidents, abuse and leisure activities).

Most children, 94% (n=58) were brought to the emergency department (ED) by ground ambulance, 12 (20%) by ambulance helicopter and two patients (n=2) were brought in to the ED by caregivers. The patient was more likely to be brought to hospital by ambulance helicopter if the child were less than seven years at the time of the injury (odds ratio 3.25, 95% CI 1.1-8.3) as compared to older children (Odds ratio 0.59, 95% CI 0.29-1.1). More than half of all children (n=35) had a documented initial GCS in the prehospital setting of less than eight (Figure 2).

Documentation of prehospital interventions

Prehospital intervention was documented in eighteen children (31%). There was no correlation between initial duration of unconsciousness or initial GCS whether the child had received prehospital intervention or not (Chi-2=2.09, df=1, P=0.18).

Children less than seven years had less prehospital interventions (Risk=0.66, CI= 0.37-1.1) as compared to older children (Risk 5.55, CI=1.4-21.99). The most common intervention during the prehospital care were controlled airway/tracheal intubation (n=17) (Figure 3).

It was more likely to receive an intervention if the child were brought to hospital by ambulance helicopter (42%) as compared to being brought to hospital by ground ambulance (31%). However, this difference was not statistical significant. In the age group less than seven years and with a GCS of less than eight, two out of six (33%) children received controlled ventilation/tracheal intubation as well as pain treatment. None of the eight children less than seven years received IV fluid treatment to prevent hypotension.

In older children, 16 children (88%) received prehospital interventions. Fifteen of those (93%) received controlled ventilation/endotracheal intubation, two children (12.5%) pain treatment and five children (31%) IV fluid treatment.

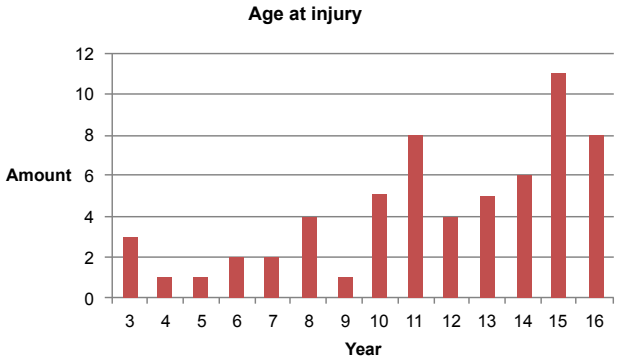

Figure 1: Distribution by age of all children (n=60) with severe brain injury.

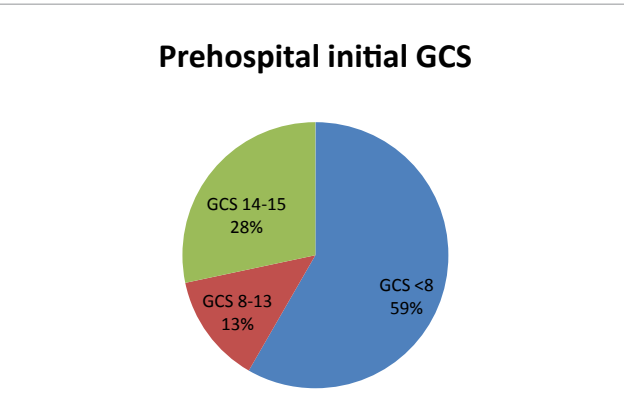

Figure 2: Prehospital documentation of initial Glasgow Coma Score among all children (n=60).

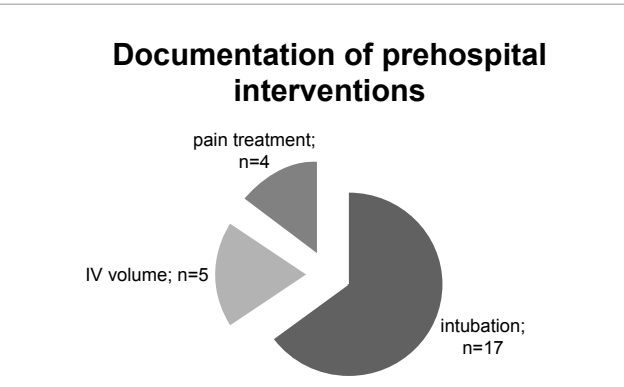

Figure 3: Documentation of prehospital interventions of children (n=18) with Severe Brain injury.

Hospital management

All 60 children were admitted to an Intensive care unit due to a Severe TBI (GCS less than 8 on admission to hospital). A total of 44 children (73%) needed neurosurgical intervention (n=26 intracranial pressure device, n=15 intracranial surgery due to haematoma) but only thirteen of those (39%) had documentation of a prehospital intervention.

Discussion

Our research is an attempt to highlight the importance of prehospital interventions concerning children with traumatic brain injuries as stressed by PRECARN [17]. The result showed that prehospital intervention was found in only one third of the children with a severe TBI, which is well in line with the result from Zebrack et al. [9]. The result of this study shows that the amount of children suffering from a severe brain injury varies from 1-9 children a year during a twelve-year period. As few as 0.2% of all people attending the emergency department with a head injury suffer a fatal outcome which means that 99.8 percent survives and needs both ambulance and hospital care [3]. This low incidence of fatal injuries could have an impact on the health care personals preparedness to care for such children, which has been reported by Houston and Pearson [22]. They showed a likelihood of 54 % that staff with no current qualification specific to paediatrics would respond to a head injured child. Could this be one reason the low frequency of prehospital interventions among the children less than seven years in our study? Or is there just a lack of documentation in the pre-hospital medical records as also described by Staff and Sovik [16]. However, the result from Zebrack et al. [9] also showed less monitoring among the children that were younger as well as sicker which could imply that our result shows a true glance of performed interventions by prehospital staff. Another aspect could be that the EMS staffs focused on treating a life-threatening event and therefore documentation not prioritized. This fact could be one explanation to our result, which shows that 59% of the children had a prehospital GCS less than eight as compared to 100 percent on arrival at hospital; however, a low GCS showed no impact on the frequencies on documented prehospital interventions. This result is well in line with the result from Zebrack et al. [9] that showed that one third of the children were not monitored (hypoxia or hypotension)/or documented in the early phase of prehospital or emergency care.

Staff and Sovik [16] suggest a national standardized medical record manual to improve the quality of documentation and an electronic ambulance record device able to retrieval of data for clinical audit and research. The lack of documentation could be the result of inappropriate system for the EMS to perform their documentation and not the ability to document by the individual EMS staff.

Laudermilch et al. [15] results showed that failure of EMS to document basic measures of physiology at the scene were associated with increased mortality [15]. Could this imply that when EMS staff is aware of the importance of documentation they also monitor and perform assessment and initiate treatment to prevent secondary insults? For the future, focus should be on EMS staff ability to perform their documentation and to investigate the knowledgebase of the EMS staff concerning the importance of documentation.

Our result shows that it was more likely for the children to receive a prehospital intervention if they were brought to hospital by ambulance helicopter. However, when the children were divided into different age groups our result showed that children less than seven years showed less intervention during the pre-hospital care despite that they were brought to the emergency department by helicopter ambulance. This result could be well in line with the result of Berlot et al. [23], who showed that patients who have brought to hospital by helicopter emergency medical service (HEMS) have a shorter time between admission and to definite care as compared to the patients brought to hospital by an ambulance team [23]. Could this mean that time have a crucial impact on the ability for pre hospital care as well as documentation? Further investigations to address this question should be in focus, especially in the paediatric setting.

Limitations

There are several limitations in our study; the studied population are children surviving a severe brain injury who took part of an in-hospital rehabilitation which implies that there are children who either not survive the initial injury or the initial care. Therefore, we could not speculate on the incidence of severe TBI in the Stockholm region. However, the children receiving prehospital and emergency care as well as rehabilitation could help to improve the management and care by describing documented management and interventions according to guidelines.

The small amount of children included in this study as well as a long study period could have had an impact on our result; a larger sample size with a multicentre approach could improve the results and should be considered for the future. The long study period could have had an impact on the frequencies of interventions due to differences in guidelines over time and competences in the ambulances. However, no such difference was found.

The fact that medical records were studied retrospectively could also compromise the reliability of the results, as the patients were not seen in person but only from documentation. On a general level, the medical records appeared relatively unsystematically documented, but this does not necessarily imply that the prehospital care was unsystematic.

However, the impact of the prehospital care on the outcome could be hard to determine as both primary injury and the in-hospital care has an impact on the patient outcome.

However, by increasing knowledge concerning treatment and successful interventions for the severely TBI patient during the whole chain of care may more patients survive as well as experience a reduction of long-term consequences.

Conclusion

One third of the children with a severe brain injury had documentation of prehospital interventions. There was no correlation between initial duration of unconsciousness or initial GCS whether the child had documentation of prehospital intervention or not. Further investigations to elaborate the true incidence of prehospital interventions in children with severe brain injuries are necessary.

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