Effect of using a head injury fast-track system on reducing the mortality rate among severe head injury patients in Southern Thailand: A retrospective study with historical control

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ABSTRACT

Context: Head injuries are the leading cause of traumatic morbidity and mortality. Timely proper management can reduce the mortality rate.

Aims: This study aimed to examine the effects of a fast-track system on reducing head injury mortality using the data in Southern Thailand.

Settings and Design: A retrospective study of data from the medical records of severe head injury patients admitted to Hatyai Hospital from October 2012 to May 2017.

Subjects and Methods: The records of subjects were selected for participants aged more than 11 years, having Glasgow Coma Score (GCS) <9, no injuries in other organs, and neither hypoxemia nor hypotension. A total of 193 participants fulfilling these criteria were analyzed. Of these, 108 participants were managed in the fast track.

Statistical Analysis Used: The fast-track group was compared with normal track participants by using logistic regression after preliminary analysis to identify the risk factors using the Chi-squared tests.

Results: After adjustment for confounders, namely acute subdural hematoma, linear skull fracture and diffuse brain injury, and mortality in the fast-track group (13%) was significantly lower than that in the nonfast track group (22.4%).

Conclusions: Using the fast-track system can reduce mortality from severe head injuries and should be implemented in the health services system.

Key Words: Fast-track system, general hospital, head injury, health services, mortality

INTRODUCTION

Traumatic brain injury (TBI), a substantial head injury, is a major public health problem worldwide, especially in low- and middle-income countries (LMICs). Among all injuries, head injury is the leading cause of morbidity and mortality. Globally, it is estimated that 69 million people are affected annually by TBI from all causes and approximately 1.5 million die. Motor vehicle collision is the leading cause of TBI in developing countries with the highest rates in Asia. Proper
attention, surveillance, and interventions are needed to reduce mortality.\[1\] A study on patient outcome after TBI between high-income countries (HICs) and LMIC across 46 countries revealed that higher mortality was found in LMIC, whereas higher disability was found in HIC, concluding that the differences in medical care may affect the outcomes.\[6\] Between 60% and 80% of mortality depends on the implemented treatment and could reach 90% with a delay in appropriate treatment.\[7\] Therefore, setting up a system in the hospital to help TBI patients getting timely diagnosis and treatment, such as a fast-track system could increase survival rates and reduce mortality from TBI.

In Thailand, age-standardized incidence and age-standardized prevalence rates of TBI were 352 and 812/100,000 population, respectively.\[8\] The fast-track system has been launched in several hospitals in Thailand to reduce TBI mortality. However, as yet there has been no evaluation of the effectiveness of the system in southern Thailand. This study aimed to investigate the effects of using a head injury fast-track system on the mortality rate among severe head injury patients in Southern Thailand.

SUBJECTS AND METHODS

This study was a retrospective before/after observational study with historical controls. All severe head injuries admitted to Hatyai Hospital from October 01, 2012, to May 30, 2017, were retrieved from the medical record files. All discharged patients were followed up for 1 month using the Glasgow Outcome Score. The fast-track system was introduced in the hospital in January 2015, with criteria being patients referred within 1 h, getting computed tomography (CT) scan within 1 h, and operation within 2 h. Severe head injury patients aged 12 years or older with Glasgow Coma Score (GCS) 3–8 were included in the study. Patients with multiple injuries, either with or without hypoxia and/or hypotension, and patients with severe head injury who died from kidney disease, heart disease, hypotension or hypoxemia, were excluded from the study. These exclusion criteria were used in a study conducted by Techakosol\[9\] that excluded those with multiple injuries, shock, and brain death. Our study used a sample of 193 severe head injury patients. A standard form for data collection was used to collect the information on covariates, including age, gender, mechanism of injury, severity of injury, use of mannitol 20% for treatment, referral status, head injury characteristics, timing of getting CT scan, time of getting operation, and GCS. Patients were classified into two groups: before (October 2012–December 2014) and after (January 2015–May 2017) the commencement of the fast-track system. Patients’ age were divided into three groups: <25 years, 25–49 years, and 50 years and older. The mechanism of injury was classified as injury caused by motorcycle accident, car accident, fall, and assault/other. The use of mannitol 20% to reduce brain swelling after head injury and referral status from other hospitals were included as binary factors. GCS was divided into three groups: scores 3–4, 5–6, and 7–8. The binary outcome was survival status (died or survived).

This study was approved by the Research Ethics Committee of Hatyai Hospital, Hatyai Hospital (Institutional Review Board [IRB] approval number 11/2563).

Statistical analysis

In preliminary analysis, the Chi-squared tests were used to compare patients’ demographic, injury and treatment characteristics, and the survival outcome before and after the introduction of the fast-track system. Logistic regression was then used to measure the effect of using the fast-track system on mortality after adjusting for variables found to be statistically significant in the preliminary analysis. Sum contrasts were used to compare the results for each variable in the multivariate analysis. All model coefficients were converted to percentages. The results were illustrated by graphing 95% confidence intervals. All statistical analyses and graphs were performed using R program.\[10\]

RESULTS

The majority of patients were males (77.7%) with age ranging from 12 to 92 years (average 40.3 years). Most TBI patients were injured in motorcycle accidents (66.8%), followed by falls (17.6%) and car accidents (6.7%). Almost half of the patents (49.7%) had GCS scores 7–8. Most patients (85.5%) were referred from other hospitals. Operations were performed in 57.5% of patients, with 20.7% receiving an operation within 2 h. There were 67.4% of patients who received mannitol 20% for treatment. The in-hospital mortality rate was 17.1% [Tables 1 and 2].

Focal brain injury was reported for 97.4% of patients, including epidural hematoma (29%), acute subdural hematoma (ASDH) (61.1%), and cerebral contusion (34.2%). Intracerebral, subarachnoid, intraventricular, and chronic hemorrhage accounted for 22.8%, 34.2%, 9.8%, and 1%, respectively. Linear skull fracture and depressed skull fracture were found for 6.2% and 9.8%, respectively; 9.8% of patients had diffuse brain injury; and 71.5% had brainstem compression [Table 3].

In the preliminary analysis, demographic, injury, and treatment factors of patients were not statistically significant, except for having linear skull fracture and diffuse brain injury. The fast-track group had a higher percentage of linear skull fracture (38.9%) and lower...
diffuse brain injury (4.6%) than the control group (20% and 16.5%, respectively). A borderline significant difference for ASDH was found in controls (52.9%) and in fast-tracked participants (67.6%). However, no evidence was found for a difference in mortality rates (22.4% in controls and 13% in those fast tracked) [Table 3].

Confidence intervals based on the logistic regression model appear in Figure 1, which also graphs crude rates as filled dots, showing no evidence of confounding. Mortality is seen to be lower in the fast-tracked group ($P = 0.035$). Moreover, after adjusting for other variables, patients with ASDH had higher mortality than those with no ASDH.

![Figure 1: Effects of using fast-track system on head injury mortality after adjusting for having acute subdural hematoma, having linear skull fracture, and diffuse brain injuries](image)

Table 1: Patients’ demographic factors, injuries, and treatment status

| Characteristics | n (%) |
|-----------------|-------|
| Sex             |       |
| Male            | 150 (77.7) |
| Female          | 43 (22.3)  |
| Age (years)     |       |
| <25             | 62 (32.1)  |
| 25-49           | 67 (34.7)  |
| 50+             | 64 (33.2)  |
| Cause of head injuries |       |
| Motorcycle accident | 129 (66.8) |
| Car accident    | 13 (6.7)   |
| Fall            | 34 (17.6)  |
| Assault/other   | 17 (8.8)   |
| GCS             |       |
| 3-4 scores     | 38 (19.7)  |
| 5-6 scores     | 59 (30.6)  |
| 7-8 scores     | 96 (49.7)  |
| Refer cases from |       |
| ER              | 28 (14.5)  |
| Other hospitals | 165 (85.5) |
| Using mannitol 20% |       |
| No              | 63 (32.6)  |
| Yes             | 130 (67.4) |
| Survival status |       |
| Survived        | 160 (82.9) |
| Died            | 33 (17.1)  |

ER: Emergency room, GCS: Glasgow Coma Score

Table 2: Severe head injury characteristics

| Characteristics          | n (%)   |
|--------------------------|---------|
| Focal brain injury (yes)  | 188 (97.4) |
| Epidural hematoma (yes)   | 56 (28.0)  |
| ASDH (yes)                | 118 (61.1) |
| Cerebral contusion (yes)  | 66 (34.2)  |
| Intracerebral hemorrhage (yes) | 44 (22.8) |
| Subarachnoid hemorrhage (yes) | 66 (34.2) |
| Intraventricular hemorrhage (yes) | 19 (9.8)  |
| Chronic subdural hematoma (yes) | 2 (1.0)   |
| Linear skull fracture (yes) | 59 (30.6) |
| Depressed skull fracture (yes) | 12 (6.2)  |
| Diffuse brain injury (yes) | 19 (9.8)   |
| Brainstem compression (yes) | 138 (71.5) |

ASDH: Acute subdural hematoma

Most (77.7%) severe head injury patients in our study were males. This is consistent with studies conducted in India[11] and Brazil[12] that found 75.9% and 84% of head injury victims were males, possibly because they are more likely to drive at faster speeds or under the influence of alcohol than females.[13,14] Ditsuwan et al.[15] reported that alcohol-related accidents among Thai males and females aged 15–69 years were 36% and 5.8%, respectively.

The average age of participants in our study was 40.3 years, which is slightly higher than patients from a study conducted by Rujimethapass[16] where the average age was 37.8 years. The dominant cause of severe head injuries in our study was motorcycle accidents at 66.8%, consistent with studies conducted by Li et al.[5] and Puvanachandra and Hyder.[1] The major cause of severe mortality in developing countries is from traffic accidents,[1] whereas the major cause of head injuries in developed countries is from falls.[17] Wearing a helmet is 67% effective in preventing head injuries of motorcyclists involved in traffic crashes.[18] However, less than half (43.7%) of motorcyclists in Thailand wear helmets,[19] contributing to excessive head injuries from the accidents.

After adjusting for having ASDH, linear skull fracture, and diffuse brain injury, we found that using the fast-track system reduced mortality from 23.1% before using the system to 12.4% after using the system. Our finding supports previous studies[9,20] showing that a fast-track system reduces mortality. A study conducted by Techakosol[9] reported 33.3% mortality before using a fast-track system and 20% after. However, no significant effect of using a fast-track system in reducing mortality was found in the study of Techakosol,[9] possibly due to inadequate sample size. Using a fast-track system has the potential to improve the outcomes because the delay to operation for surgery increases the recovery rate and decreases the length of hospital stay.[9]
In the multivariate logistic model, after adjusting for injury characteristics, higher mortality was found for those who had ASDH. This finding agrees with the finding by Meissner et al.[21] that ASDH caused 45% of complications. ASDH is an important factor related to mortality for 45%–63%.[22]

There are some limitations in our study. First, with retrospective data, some factors that could affect mortality were not recorded, such as time to arrive at the hospital, nursing practice, operation skill of surgeons, and facility characteristics. Second, this study analyzed the data from a single hospital, which limits its external validity to be generalized to other settings.

CONCLUSIONS

In conclusion, using a fast-track system can reduce mortality among severe head injury patients, and it should be implemented in health services systems.

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Conflicts of interest

There are no conflicts of interest.

Ethical conduct of research

This study was approved by the local Institutional Review Board / Ethics Committee. The authors followed applicable EQUATOR Network (http://www.equator-network.org/) guidelines, during the conduct of this research project.

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