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ปัจจัยที่ส่งผลต่อความผิดปกติจากเอกซเรย์คอมพิวเตอร์ในกรณีสมองบาดเจ็บไม่รุนแรงที่มีความเสี่ยงสูง

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Factors Affecting Abnormal CT Scan in Mild Traumatic Brain Injury – High-Risk Patients

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หลักการและวัตถุประสงค์: การบาดเจ็บทางสมองเป็นปัญหาที่สำคัญทั่วโลก สาเหตุของการบาดเจ็บทางสมองส่วนใหญ่เกิดจากอุบัติเหตุจราจรและการพลัดตกหกล้ม ในกรณีสมองบาดเจ็บไม่รุนแรงนั้นมีหลายปัจจัยที่ส่งผลต่อความผิดปกติทางสมอง อย่างไรก็ตาม ยังไม่มีการศึกษาถึงปัจจัยที่มีผลต่อความผิดปกติทางสมองจากการตรวจเอกซเรย์คอมพิวเตอร์ของผู้บาดเจ็บทางสมองในประเทศไทยเท่าใดนัก

วิธีการศึกษา: การศึกษาเชิงพรรณนาในผู้บาดเจ็บสมองไม่รุนแรง (ระดับการรับรู้สติกลาสโกว์ 13-15) ที่มีความเสี่ยงสูงที่จะพบความผิดปกติจากการตรวจเอกซเรย์คอมพิวเตอร์ เพื่อหาอัตราส่วนในการพบความผิดปกติและปัจจัยที่ส่งผลต่อการพบความผิดปกติจากการตรวจเอกซเรย์คอมพิวเตอร์สมอง

ผลการศึกษา: จากการศึกษาผู้บาดเจ็บสมองไม่รุนแรงที่มีความเสี่ยงสูง 117 ราย พบว่า ผู้บาดเจ็บ 41 ราย (ร้อยละ 35) มีความผิดปกติจากการตรวจเอกซเรย์คอมพิวเตอร์ และพบปัจจัยที่มีผลต่อการพบความผิดปกติอย่างมีนัยสำคัญทางสถิติ คือ การมีระดับความรับรู้สติกลาสโกว์ 13-14 หลังจากการติดตามการรักษา 5 ราย (p=0.011) และ อาการแสดงของฐานกะโหลกแตกหรือกะโหลกแตกแบบเปิด 5 ราย (p=0.037)

สรุป: ลักษณะอาการแสดงของฐานกะโหลกแตกหรือกะโหลกแตกแบบเปิดและการมีระดับความรับรู้สติกลาสโกว์ 13-14 หลังจากการติดตามการรักษาสามารถใช้เป็นตัวทำนายที่บ่งชี้ถึงการตรวจพบความผิดปกติในสมองจากเอกซเรย์คอมพิวเตอร์ในผู้บาดเจ็บสมองไม่รุนแรง

คำสำคัญ: การบาดเจ็บที่ศีรษะ; การบาดเจ็บที่สมอง; การถูกกระทบกระแทกในสมอง; การตกเลือดในกะโหลกศีรษะ

Background and Objective: Traumatic brain injury is one of the most significant problems worldwide. Major causes of head injury are caused by traffic accidents and fallings. In mild traumatic brain injury, consider that there are risk factors for abnormalities in the brain. However, there is a lack of study in risk factors for neurosurgical intervention related to abnormal CT findings in Thai people.

Method: Retrospective descriptive study in the patients diagnosed mild traumatic injury (GCS 13-15), with high risk for abnormalities in CT scan. The outcome of the study is to admeasure the ratio of abnormal CT findings and to determine factors that affected abnormal CT findings.

Results: There were 117 mild traumatic brain injury – high-risk patients performed a CT scan. Of those, 41 patients (35%) had abnormal CT findings. Two significant factors affecting abnormal CT findings; GCS 13-14 after observation and signs of open/base of skull fractures with a number of 5 (p=0.011) and 5 (p=0.037), respectively.

Conclusion: Open skull or base of skull fracture and GCS of 13-14 observation were the most two strongest predictors for abnormal CT scan in mild traumatic brain injury – high-risk patients.

Key words: head injury, traumatic brain injury, cerebral concussion, intracranial hemorrhage

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Introduction

Traumatic brain injury is one of the most significant problems worldwide, with an increased incidence every year as the number of motor vehicles in developing countries. There was a population of around 20-50 million people injured or disabled by road traffic injuries across the globe. And [1,2] million people die annually from road traffic injury. Which causes economic damage, with a value of up to 1-2 percent of Gross National Product. The amount of losses from accidents worldwide is up to 518 billion US dollars per year[1,2].

Thailand has the world's number 9 death toll per 100,000 people, according to the World Health Organization Estimates Death 2010 and Global Status Report on Road Safety 2018, the death rate is 36.2 people per 100,000 population per year[3]. According to the statistics, it indicates the public health obligations that must be processed and the burden of health personnel that need to take care of patients from head injuries, including the cost of medical treatment for injured patients in the year 2016, amounting to 2,770 million baht.[4]

Major causes of head injuries are caused by traffic accidents, falling, and body assault. The proportion of cases that occur with the country, the western countries will find that falling place is a common cause of 40% -50%[5,6]. But in developing countries, traffic accidents are a common cause, around 50% -60%[7,8].

The diagnosis of traumatic brain injury includes the history of external forces to the brain with changing of neurological function (e.g., loss of consciousness, retrograde amnesia, neurological abnormality, or mental status change) or pathological evidence that supports brain tissue damage (e.g. physical examination, CT or MRI). Which can classify into 3 groups based on the Glasgow Coma Scale (GCS) score at 30 minutes after injury occurred.[9]

But in practice, we are not able to use CT or MRI to determine the diagnosis in every trauma patient, which can waste lots of resources.

In mild traumatic brain injury (GCS 13-15), consider that there are risk factors for abnormalities in the brain10,11. By dividing risk factors into 3 groups as follows. 1) Low-risk group, providing supportive treatment and can be discharged from the emergency room, 2) Moderate-risk group, consider to admit and observe neurological status at least 6 hours or sent for CT brain, and 3) High-risk group, consider to CT brain in every patient. The risk for neurosurgical intervention is as shown in Table 1.

In practice, all of the high risks and some of the moderate risks for neurosurgical intervention became an indication for CT brain implicitly. However, there is a lack of study in risk factors for neurosurgical intervention related to abnormal CT findings in Thai people. The authors, therefore, study which factors affect the abnormal CT finding of mild traumatic brain injury – high-risk patients.

Methods

This retrospective descriptive study was conducted at Srinagarind Hospital, Khon Kaen University, Thailand. Medical records of all admitted patients with the diagnosis of mild traumatic brain injury – high risk from January 1st to December 31st, 2018 were reviewed.

Diagnosis of mild traumatic brain injury – high-risk was made by criteria as described in Table 1. We excluded the patient who was unable to retrieve the complete data.

The outcome measurement is to admeasure ratio of abnormal CT findings (e.g. intracranial hemorrhage, parenchymal lesion) in patients with mild traumatic brain injury – high risk, and to determine factors affected the abnormal CT findings.

The required sample size for the study was calculated to be 117 patients. The ratio of positive abnormal CT (proportion) was estimated to be 0.43, the desired precision was 0.09, and the confidence level was 0.95.12,13 All continuous data were presented in mean with SD and compared using Student T-test or Mann-Whitney U-test, and categorized data were calculated using Chi-square and Fisher exact tests. Only independent predictors ($p < 0.05$) were considered significant. STATA software version 10 was used in all statistical analyses.

The Ethic Committee of Khon Kaen University approved this study on July 17th, 2019 (reference HE611327)

Results

324 traumatic brain injury patients were admitted to Srinagarind hospital in 2018. With the exclusion of the moderate-risk and the high-risk who cannot retrieve a complete medical record, the remaining mild traumatic brain injury – high-risk with complete medical records 117 patients were in the study. The

demographic data was shown in Table 2.

In the study population, who were at risk of intracranial hemorrhage according to the high-risk group. There were 41 patients (35%) had abnormal CT findings, brain infarction in 17 patients (41.46%), subdural hemorrhage in 9 patients (21.95%), subarachnoid hemorrhage in 4 patients (9.76%), intracerebral hemorrhage in 4 patients (9.76%), epidural hemorrhage in 2 patients (4.88%), combination of subdural and subarachnoid hemorrhage in 4 patients (9.76%), and combination of subdural and intracerebral hemorrhage in 1 patient (2.44%).

Out of eight indications for requesting the CT brain in mild traumatic brain injury patients, there were two significant factors regarding the abnormal CT findings: GCS 13-14 after observation and open or depressed skull fractured (Table 3).

Another factor is the history of loss of consciousness after the accident as shown in Table 4. The Odds ratio was 7.951, with the 95% of confidence interval of 0.36-1.76 (p=0.57).

In the abnormal CT finding group of 41 patients, 2 patients (2.88%) were treated by operative management, and 39 patients (95.12%) were treated by non-operative management. The mean of hospital stay was 3.41 (SD=3.98) days.

Discussion

The Royal College of Surgeons of Thailand (RCST) announced the clinical practice guidelines for traumatic brain injury patients in 2013 that the high-risk group of mild traumatic brain injury consists of 1. GCS 13-14 after the observation at 1-2 hours after injury, 2. suspected open or depressed skull fracture, 3. vomiting more than 2 episodes, 4. decrease of GCS score 2 points, not cause by seizure, drugs, decrease cerebral perfusion or metabolic factors, 5. focal neurological deficit, 6. post-traumatic seizure, and 7. age more than 60 years old. It is recommended that the patients undergo a CT brain on admission.

The study of Mahdi Sharif-Alhoseini et al[14] conducted a study in mild traumatic brain injury patients with age > 2 years with GCS > 13, who was sent to the emergency room found that 642 patients were sent to CT scan and 20 cases (3.1%) were positive. Albers et al[15] performed a retrospective study in 3688 mild traumatic brain injury patients with GCS 14-15, the mean age was 44 years old (7-99 years). The results that 149 patients (4.8%) had intracranial hemorrhage after performed CT brain according to the "Canadian CT head rules". Mishra et al16 studied 453 mild traumatic brain injury patients with GCS 15, found that 195 patients (43%) had abnormal CT scans. When compare with our research based on the high-risk criteria of RCST guidelines found that 41 of 117 patients (35%) had abnormal CT scans.

One of the more common observations is the relatively high age of the injured in our research. 95 of the patients (81%) were over 60 years old and the average age was 67.8. Which, when compared with other studies have an average age of 29.9 years

Table 1 Risk for neurosurgical intervention.

Indications for CT scanning in patients with mild traumatic brain injuries.
High risk for neurosurgical intervention:
- GCS score less than 15 at 2 hours after injury
- Suspected open or depressed skull fracture
- Any sign of basilar skull fracture (e.g., hemotympanum, raccoon eyes, CSF otorrhea or rhinorrhea, Battle's sign)
- Vomiting (more than two episodes)
- Age more than 65 years
- Anticoagulant use
Moderate risk for brain injury on CT
- Loss of consciousness (more than 5 minutes)
- Amnesia before impact (more than 30 minutes)
- Dangerous mechanism (e.g., pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height more than 3 feet or 5 stairs, dead passenger in the same cabin)

Table 2 Demographic data.

Patient characteristic	No. of patients (%)	Abnormal CT (%)	p-value
Total	117	41 (35%)	
Gender			0.91
Male	55 (47)	19 (46.34)	
Female	62 (53)	22 (53.66)	
Age (years)			0.116
15-45	13 (11.11)	4 (9.76)	
46-59	9 (7.69)	6 (14.63)	
> 60	95 (81.20)	31 (75.61)	
Alcohol use	13 (11.11)	5 (12.2)	0.748
Loss of consciousness	44 (37.61)	14 (34.15)	0.57
Cause of injury			
Traffic injuries	32 (27.35)	17 (41.46)	
Car	6 (5.13)	2 (11.76)	
Motorcycle	22 (18.80)	13 (76.47)	
Bicycle	3 (2.56)	1 (5.88)	
Pedestrian	1 (0.85)	1 (5.88)	
Driver	25 (21.37)	15 (88.24)	
Passenger	7 (5.98)	2 (11.76)	
Falls	81 (69.23)	24 (58.54)	
Same level falls	62 (52.99)	20 (83.33)	
Fall from high	19 (16.24)	4 (16.67)	
Body assault	2 (1.71)	0	
Undetermined intent	2 (1.71)	0	
Type of injuries			0.305
Pure head injury	97 (82.91)	32 (78.05)	
Multiple organ injuries	20 (17.09)	9 (21.95)	

Table 3 Indications for requesting CT in mild traumatic brain injury patients.

Indications for CT	Normal findings (%) n = 76	Abnormal CT (%) n = 41	p-value
GCS 13-14 after observe neuro sign 1-2 hrs.	1 (1.32)	5 (12.20)	0.011
Open skull fracture / Skull base fracture	2 (2.63)	5 (12.20)	0.037
Vomiting > 2 episodes	6 (7.89)	0	0.065
Focal neurological deficit	1 (1.32)	1 (2.44)	0.655
Post-traumatic seizure	1 (1.32)	0	0.461
Aged ≥ 60 yrs.	63 (82.89)	30 (73.17)	0.214
Decrease GCS 2 points not clearly cause by drugs / seizure	0	0	N/A
High mechanism of injury	2 (2.63)	0	0.295

Table 4 Odds ratio of history of loss of consciousness with the positive findings on CT.

	Abnormal on CT	Normal CT finding
History of unconsciousness	14	30
No loss of consciousness	27	46

[14], 41 years[15] and 32.84 years[16]. There are more likely in the middle age group of patients. This could result in our research finding 37% of the abnormal CT pathologies were subdural hemorrhage and 20% for multiple hemorrhages. Subdural hemorrhage is often associated with aging brain atrophy, unlike Albers, et al[15] found that 51% were intracerebral hemorrhage and 26% were subarachnoid hemorrhage.

Another observation that our research has found different from other research is genders of the patient were distributed equally among both men and women (male: female = 47: 53), unlike other studies where the number of male: female was 3:1 or 4:1. This may due to the age of the patients in other studies is middle-aged and is mostly due to road traffic accidents, unlike our research that found that the mechanism of injury is 69.2% fall and 27.4% traffic injury. This is likely opposite to the research of Mahdi Sharif-Alhoseini et al[14] that found to be caused by road traffic injury 53% and falls 31%.

According to our research, the unconsciousness among trauma patients was not statistically significant (p=0.5706) as a pathogenic factor in the CT brain. The most common guideline for CT brain implications in this study was aged over 60 years old (79.4%), however, it was not found to be statistically significant when using the univariate analysis. But found that the statistically significant factors were open or depressed skull fractured, and GCS after observation. When compared to the research of Mahdi Sharif-Alhoseini et al[14] that the significant factors were headache (p=0.006), loss of consciousness/amnesia (p=0.024), and alcohol intoxication (p=0.036). Albers et al[15] found that significant factors were age group (p<0.001) and anticoagulant use (p<0.001). Mishraet al16 also found that the traumatic brain injury patient with GCS of 15 at 12 hours after injury who had vomiting symptoms was the risk for abnormal CT scans.

The limitation of this study is the data collection in the retrospective study. The collection of data may be required to separate into subgroup depend on the mechanism of injuries. But because of the relatively small number of population in this research, subgroup analysis may yield a blurred conclusion.

Conclusion

The use of GCS 13-14 after observation and any signs of open or base of skull fractures can be useful to the prediction of abnormal CT scan in mild traumatic brain injury – high-risk patients. However, the clinical correlation should be used for diagnosis. Further studies of the factors affecting the abnormal CT should be conducted.

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