ORIGINAL ARTICLE

Care of Severe Head Injury Patients in the Sarawak General Hospital: Intensive Care Unit Versus General Ward

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SUMMARY

Intensive care for severe head injury patients is very important in the prevention and treatment of secondary brain injury. However, in a resources constraint environment and limited availability of Intensive Care Unit (ICU) beds in the hospitals, not all severe head injury patients will receive ICU care. This prospective study is aimed to evaluate the outcome of severe head injured patients who received ICU and general ward care in Sarawak General Hospital (SGH) over a 6-month period. A total of thirty five severe head injury patients were admitted. Twenty three patients (65.7%) were ventilated in general ward whereas twelve patients (34.3%) were ventilated in ICU. Overall one month mortality in this study was 25.7%. Patients who received ICU care had a lower one month mortality than those who received general ward care (16.7% vs 30.4%), although it was not statistically different. Multivariate analysis revealed only GCS on admission (OR 0.731; 95% CI 0.460 to 0.877; P=0.042) as the independent predictive factor for one month mortality in this study.

KEY WORDS:
Severe head injury, Intensive care, Neurosurgery, Glasgow Coma Scale

INTRODUCTION

Head injury remains the leading cause of death and severe disability in young adults throughout the world[1] and it is also the most important single injury contributing to traumatic mortality and morbidity. In a large study of patients who suffered trauma, it was found that the presence of head injury resulted in a 1.5-times increase in death when compared with the presence of extracranial injuries without head trauma[2]. In Malaysia, head injury is responsible for 48.2% of death due to trauma[3].

Multiple independent risk factors predicting the outcome of patients with severe head injuries have been identified, the most widely accepted ones being age, Glasgow Coma Score (GCS), pupil reactivity, Computed Tomography (CT) findings, and associated extracranial injuries[4,5,6]. In particular, a GCS score of 3 at presentation has been associated with a significantly poor outcome[7,8]. The same study also showed that the mortality rate even approached 100% when the score is associated with bilateral fixed and dilated pupils. Study by Azian AA *et al*.[9] showed that the CT predictors of outcome include intracranial haemorrhage (ICH), extradural haematoma (EDH), intraventricular haemorrhage (IVH), present of subarachnoid haemorrhage (SAH), site of ICH, volumes of EDH and subdural haematoma (SDH) as well as midline shift.

Although there is wide variation in the management of severely head-injured patients reflecting the preferences of individual neurosurgeons, it is generally agreed that the aim of intensive care for these patients is to prevent, identify and treat the causes of secondary brain injury. However, under a resource constraint environment with a limited availability Intensive Care Unit (ICU) beds available in our hospital, the extent and the role of ward managed cases have yet to be assessed in our hospital.

The objective of this study is to identify the management and the outcome of all severe head injury patients admitted to Sarawak General Hospital (SGH) over a 6-month period. It also determines the effect of ward care management in severe head injured patients.

MATERIALS AND METHODS

Patient characteristics:

This prospective study of 6-month period was conducted in SGH from 1st June 2009 till 30th November 2009. Severe head injury patient was defined as a patient who was admitted with Glasgow Coma Score (GCS) of ≤ 8 cumulative points after adequate resuscitation. Inclusion criteria were as follows: blunt traumatic head injury patients referred to SGH within the period of study, age above 12 years old, a GCS score of 3 - 8 on presentation, and brain computed tomography (CT) scan that demonstrated a hemorrhagic lesion. A CT hemorrhagic lesion was defined as the presence of an epidural hematoma (EDH), subdural hematoma (SDH), cerebral contusion, or subarachnoid hemorrhage. Patients were excluded if there was pre-hospital cardiac arrest, absence of brain stem reflexes after resuscitation, or pre-existing medical coagulopathy.

Data collection:

Patient demographics (age, gender, and race), mode of injury, GCS score, pupils size and reactivity, hemodynamic status (hypotension defined as systolic blood pressure < 90 mm Hg on admission, hypoxia defined as oxygen saturation < 90%), associated extracranial injuries (defined as the presence of ≥ 1 other organ with a serious injury with Abbreviated Injury Score (AIS) ≥ 3), head CT scanning findings, need for surgical

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intervention, ICU or general ward care, Glasgow Outcome Score (GOS) on discharge and 1 month mortality outcome were all recorded. Dilated pupils were defined as ≥ 4 mm in diameter and not reactive to light.

Patient interventions:
The practice in managing head injury patients in this hospital was performed according to a standard protocol. All patients, after resuscitation, stabilization and tracheal intubation in the emergency department on presentation, would undergo CT scanning of the brain. All patients were reviewed by neurosurgical team and decision made either for surgical intervention or to treat conservatively. Patients with a surgically treatable mass (SDH, EDH, large contusion with mass effect) were taken immediately to the operating room (either craniotomy and evacuation of clot, or decompressive craniectomy depended on the brain swelling). All patients were sedated and given cerebral protection measures. The decision of ventilating the patients in ICU or in the general ward solely based on the anaesthetic team according to the availability of ICU bed.

Statistical analysis:
The SPSS version 15.0 software (SPSS Inc, Chicago, Illinois) was used for statistical analysis. Measurements are reported as the mean value ± standard deviation. Univariate analysis was performed using the t test for continuous variables and χ^2 tests or Fisher exact test for categorical variables. All variables with a *P* value less than 0.05 on univariate analysis were entered into multivariate logistic regression analysis. Adjusted Odd Ratio (OR) with 95% confidence intervals (CI) were derived from logistic regression analysis and statistical significance was set at P values less than 0.05 after adjustment for risk factors.

RESULTS

A total of 35 severe head injury patients were included in this study over a 6-month period. Table I summarized the demographic and clinical characteristics of the 35 severe head injury patients. The mean age of these patients was 37.1 ± 18.8 (range 13 – 75 years old). Fifteen patients (42.9%) underwent neurosurgical intervention (6 patients underwent craniotomy and evacuation of clot whereas 9 patients underwent decompressive craniectomy). Twenty three patients (65.7%) were ventilated in the general ward whereas only 12 patients (34.3%) were ventilated in ICU. The patients who were initially admitted to ICU and subsequently transferred out to general ward for continuation of care would be put under ICU group in this study for analytical purposes.

For comparison purpose, the patient population was then divided into 2 groups: (a) survived; and (b) fatal, based on one-month mortality. There were 9 patients died within 1-month period and this gave an overall 1-month mortality rate of 25.7%. Table II summarized the demographic, clinical, radiographic, and treatment parameters in relation to 1-month mortality. Univariate analysis showed that the age (p=0.027), GCS on admission (P=0.030), one or more extracranial injury (p=0.047), traumatic subarachnoid hemorrhage (p=0.045), and two (or more) types of brain

Table I: Demographic and clinical characteristics of severe head injury patients (n=35)

Age (year)	37.1 ± 18.8
Gender	
Male	32 (91.4%)
Female	3 (8.6%)
Race	
Malay	11 (31.4%)
Bidayuh	10 (28.6%)
Chinese	7 (20.0%)
Iban	6 (17.1%)
Foreigner	1 (2.9%)
Admission vital signs	
Systolic blood pressure (mmHg)	146.8 ± 25.5
Diastolic blood pressure (mmHg)	77.7 ± 15.5
Pulse rate (beats / minute)	95.7 ± 23.5
Oxygen saturation (SaO2, %)	98.9 ± 29.37
Pupils reactivity	
Equal and reactive	24 (68.6%)
Unilateral dilated	9 (25.7%)
Bilateral dilated	2 (5.7%)
Mode of injury	
Road traffic accident	28 (80.0%)
Fall	5 (14.2%)
Assault	1 (2.9%)
Hit by object	1 (2.9%)
≥ One extracranial injury	
Yes	14 (40.0%)
No	21 (60.0%)
Types of intracranial bleed	
Contusion bleed	
Yes	23 (65.7%)
No	12 (34.3%)
Subarachnoid hemorrhage	
Yes	14 (40.0%)
No	21 (60.0%)
Subdural Haemorrhage	
Yes	21 (60.0%)
No	25 (71.4%)
Extradural haemorrhage	
Yes	8 (22.9%)
No	27 (77.1%)
Two or more types of brain injury	
Yes	14 (40.0%)
No	21 (60.0%)
Blood volume > 25 ml	
Yes	5 (14.3%)
No	30 (85.7%)
Mean blood volume (ml)	11.7 (14.1%)
Midline shift > 5 mm	
Yes	17 (48.6%)
No	18 (51.4%)
Basal cistern	
Open	24 (68.0%)
Obliterated	11 (32.0%)
Surgical intervention	
Yes	15 (42.9%)
No	20 (57.1%)
Site of management	
ICU	12 (34.3%)
General ward	23 (65.7%)
Glasgow Outcome Score (GOS)	
Good recovery	14 (40.0%)
Moderate disability	4 (11.4%)
Severe disability	7 (20.0%)
Persisted vegetative	1 (2.9%)
Dead	9 (25.7%)

Table II: Univariate analysis of various demographic, clinical, radiographic and treatment parameters in relation to 1-month mortality

Continuous variables	Survived (n=26) M ± SD	Fatal (n=9) M ± SD	*P*
Age	33.0 ± 16.9	48.7 ± 19.7	0.027*
GCS	6.2 ± 1.6	4.8 ± 1.9	0.030*
Systolic blood pressure	147.1 ± 24.3	145.8 ± 30.4	0.891
Diastolic blood pressure	76.5 ± 15.0	81.1 ± 17.4	0.440
Pulse rate	93.4 ± 21.1	102.4 ± 29.8	0.314
Oxygen saturation	98.9 ± 2.41	98.7 ± 2.4	0.729

Categorical variables	Survived (n=26)	Fatal (n=9)	P-value	OR (95% CI)
Pupils				
Normal (Equal & Reactive)	19 (79.2%)	5 (20.8%)	0.329	3.14 (1.65-6.02)
Abnormal (Uni/Bilateral Dilated)	7 (63.6%)	4 (36.3%)		
Polytrauma				
Yes	8 (57.1%)	6 (42.9%)	0.047#	1.02 (0.70-1.47)
No	18 (85.7%)	3 (14.3%)		
Contusion bleed				
Yes	17 (73.9%)	6 (26.1%)	0.944	0.49 (0.29-0.80)
No	9 (75.0%)	3 (25.5%)		
SAH				
Yes	8 (57.1%)	6 (42.9%)	0.045#	4.45 (3.02-6.27)
No	18 (85.7%)	3 (14.3%)		
SDH				
Yes	6 (60.0%)	4 (40.0%)	0.221	2.91 (2.08-4.16)
No	20 (80.0%)	5 (20.0%)		
EDH				
Yes	5 (62.5%)	3 (37.5%)	0.385	0.24 (0.11-0.52)
No	21 (77.8%)	6 (22.2%)		
2 brain pathology				
Yes	8 (57.1%)	6 (42.9%)	0.045#	0.045#
No	18 (85.7%)	3 (14.3%)		
Midline Shift (> 0.5 cm)				
Yes	5 (50.0%)	5 (50.0%)	0.627	2.78 (1.94-3.98)
No	21 (70.0%)	4 (22.2%)		
Blood Volume (> 25 ml)				
Yes	5 (100%)	0 (0.0%)	0.355	1.86 (1.22-2.47)
No	21 (70.0%)	9 (30.0%)		
Basal Cistern Open				
Yes	19 (58.3%)	5 (41.7%)	0.329	2.32 (1.76-3.31)
No	7 (36.4%)	4 (63.6%)		
Ventilation				
ICU	10 (83.3%)	2 (16.7%)	0.376	0.376
Ward	16 (69.6%)	7 (30.4%)		

* t-test; # Chi square test

injury (p=0.045) were associated with 1-month mortality. The 1-month mortality rate was higher in general ward compared to ICU (30.4% vs 16.7%); however this was not statistically significant. A multivariate analysis was performed and showed that GCS on admission (OR 0.731; 95% CI 0.460 to 0.877; P=0.042) was an independent predictive factor of survival, while other factors did not appear to have a significant influence.

DISCUSSION

The primary clinical objective after severe brain trauma is to prevent secondary brain injury. Besides the airway, respiratory and haemodynamic supports, it is important to prevent cerebral hypoxia by maintaining sufficient oxygen delivery to meet the oxidative metabolic needs of the intracranial neural tissues. This can be achieved by maintaining adequate cerebral blood flow, arterial oxygen saturation, and hemoglobin concentration to the patient. All of these measurements require closed monitoring by a group of trained staff best accomplished in ICU. Study by Clayton *et al.*[10] showed that the introduction of an evidence-based protocol to guide the ICU management of patients with severe head injury has been associated with a significant reduction in both ICU and hospital mortality.

There is just no enough ICU bed as the general ICU needs to cater for more patients than the available beds. It requires a vast use of up to date resources such as advanced monitors, organ support equipments and highly skilled staff. In most

developing countries where the financial constraint is an issue, there is often a limit to the availability and specialization of this form of care. However in the ward the patient will not have both the complete ICU setup nor the staff compared to the management in the ICU.

This similar situation happened in Sarawak General Hospital as well. All severe head injury patients were referred to Anesthetic team for mechanical ventilator support. However, the decision whether the patient should be admitted and ventilated in ICU or in general ward solely depends on the Anesthetic team based on the availability of ICU bed.

In this study, only 12 patients (34.3%) were admitted and ventilated in ICU. The rest of the 23 patients (65.7%) were ventilated in the general ward with basic general ward management. In ICU, the nursing staff to patient ratio is 1:1 in contrast with 1:6 in the general ward. Combining the advanced monitoring facilities and the well-trained staff in ICU, it is expected that the ICU care would give a better outcome in the management of severe head injury patients compared to general ward care. This was proven by a lower 1-month mortality rate of 16.7% in patients who received ICU care compared to those who received general ward care with the 1-month mortality rate of 30.4%. The no significant findings could be due to the small sample size in this study. Moreover the ICU patients who were subsequently sent to the ward were still considered as under the ICU category which likely worsens the results of this group. Ironically, patients who were selected to receive ICU care in this study had a higher mean GCS (6.1 ± 1.7) compared to those in general ward with a lower mean GCS (5.7 ± 1.8). This could be due to selection of the cases deemed likely to give a more favorable outcome by the anaesthetic team. The mean age of patient treated in ICU (29.3 ± 14.4) was younger that those treated in general ward (41.1 ± 19.7). These could be other reasons why the mortality was higher in the patients who received general ward care.

In our study, the GCS on admission was the only independent predictive factors for poor outcome in severe head injury. This result was in agreement with few previous studies which reported the same findings. Lannoo E *et al.*[11] studied mortality and morbidity in 158 patients with a severe head injury and found that the GCS was one of the best predictors of outcome. In a study of 93 patients with a severe closed-head injury, Bishara SN et al.[12] demonstrated a strong correlation between the GCS on admission to the hospital and outcome. Demetriades D *et al.*[13] reported that in 7762 patients with a traumatic brain injury, a GCS score of 3 was found in 10% and that 66% of that 10% died during their hospital stay. Another study of 200 patients admitted to a neurosurgical ICU revealed that the mean GCS score was 8.8±3.2 for survivors and 4.9±2.2 for non-survivors[14].

The above results show how our ward based management has produced benefits to the patients despite working in difficult circumstances. The problems faced in the ward include sharing oxymeter in ventilated patients, inability to do invasive monitoring, nurse-patients ratio of 1:6 and inability to provide treatments based on intracranial pressure (ICP) and cerebral perfusion presure (CPP) protocol. We have requested for more monitors and ventilators in the ward to help this group of patients who are not able to get into ICU.

There are several study limitations. A larger group of patients is needed to confirm the observations in this study. Furthermore, quality of life and Glasgow Outcome Score assessment at six months may give more useful information in respect to outcome.

CONCLUSION

Severe head injury patients who received ICU care had a lower 1-month mortality compared to those who received general ward care (16.7% vs 30.4%) although it is not statistically significant. Despite the many short comings we had for the ward management of the severe head injury patients we still achieved a survival rate of 69.6 percent. We believe that more ICU care will produce an even better outcome for the severely head injured patients admitted to our hospital.

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