CHAPTER I

INTRODUCTION

1.1 Background and rationale:

The neurological assessment in identifying patients who might require escalation to a critical care area and in the prediction of outcome is very important. For these purposes, many different scoring systems have been described, of which eight have been in common use: The Comprehensive Level of Consciousness Scale(1), The Clinical Neurologic Assessment Tool(2), 100 point head injury scale(3), The Maryland Coma scale(4), The Innsbruck Coma Scale(5), Glasgow Liege Scale(6), The Full Outline of Unresponsive scale (FOUR)(7), and The Glasgow coma scale (GCS). However the Glasgow Coma Scale (GCS) has been accepted as a standard for neurological assessment since early 1970s(8). At the beginning it was constructed to record and monitor change in the level of consciousness of traumatic patients(8). Nowadays it has been widely utilized beyond the original intentions in the context of outcome predictor(9), neurosurgical prognostic indicator(10), cerebral dysfunction measurement in many fields of critical care or emergency medicine(11) and consciousness evaluation among the neurological patients(12). Although the devisors of the GCS have proved the practical and consistent means of monitoring the state of consciousness(13) but other shortcomings have been recognized. Subsequence researches on the GCS had revealed disagreement among the raters especially between the experienced and inexperienced users(14-17) even it has been accepted as a standard scale for consciousness evaluation. Moreover, the GCS itself does not include the clinical brainstem indicators which could reflect severity of coma such as cough reflexes, corneal reflexes, papillary reflexes, and breathing patterns. In some situation the verbal response evaluation may possibly be obscured by intubation, aphasia or even language barrier (Figure 1). A number of approaches have been used to assign the verbal response to such patients like eliminating the verbal subscale, pseudoscoring with one(18), predicting with eye and motor components(19) but there were sophisticated and somewhat be specific on limited patient subgroup

Figure 1: Conditions that affect Glasgow Coma Scale(8)

Eye Opening

- Periorbital edema
- Ocular trauma
- Cranial nerve injury
- Pain

Verbal response

- Endotracheal intubation/Tracheostomy
- Laryngectomy
- Maxillary facial trauma
- Mutism
- Edematous tongue
- Hearing loss
- Aphasia
- Dementia
- Psychiatric disorder
- Inability to comprehend language spoken
- Medications (sedation, neuromuscular blockers, anesthetics)
- Developmental delays
- Alcohol and drug toxication

Motor response

- Spinal cord/Peripheral nerve injury
- Extremity injury with immobilization
- Pain
- Inability to comprehend language spoken
- Dementia
- Psychiatric disorder
- Developmental delay
- Medications
- Alcohol and drug toxication

To overcome of the GCS perceived deficiencies, the competing scales have been developed. Wijdicks et al have validated a new coma scale, the FOUR (Full Outline of UnResponsiveness) score which is composed of four testable components i.e, eye response, motor response, brainstem reflexes and respiration, each with a scale of 0-4 (0=worst; 4=best) (7). The FOUR score is uncomplicated, specifically distinguishes certain unconsciousness states, provides important details such as brainstem reflexes, and includes the minimal necessities of neurological testing in impaired consciousness(7). All patients could be assessed the alertness using the FOUR score in contrast with the GCS which was less useful in 20% of the patients because they were intubated. Furthermore it recognizes uncal herniation, a locked-in syndrome, and the beginning of a vegetative state which is not provided by the GCS(20).

This new scale has shown the refinement of neurological evaluation when confronted with the impaired consciousness patients nevertheless it was focused on the generalized critically ill of both neurological and neurosurgical patients. Furthermore the originators have not demonstrated the correlation of its scale with the rank of high, intermediate and low risk prognostic groups which is beneficial to make a determination of medical treatment(21).

Validity and reliability among the users are significant for establishing the viability of the score. Either attempt has been made with the FOUR score; however, it was done exclusively by neuroscience professionals(7). This study is primarily aimed to endorse the FOUR score in practical environment exclusively on neurosurgical patients who have different natural history from neurological and then to compare the FOUR score with the GCS.

1.2 Literature reviews:

Through "Pubmed" searching engine, the keywords "score AND coma [mh] AND evaluation" were searched. There was 1 article justifying the FOUR score. To review the related article, the keywords ""FOUR score" AND Glasgow coma scale [mh]" together with "Neurosurg* AND predict* AND (mortality OR morbidity OR outcome OR prognosis) AND score AND Glassgow coma scale [mh]" were searched. The articles

which seemed to be well matched or related to the clinical question were selected and reviewed as followed.

Fischer et al reviewed the implications for practice of the Glasgow coma scale(8). The GCS was developed by Jennett and Teasdale in Glasgow, Scotland. It had been used in head injury patients initially and become widely accepted in a variety of neurological, neurosurgical and critically ill patients to assess the level of consciousness and predict functional outcome. This article summarized the components of the GCS, principles of scoring, the limitations, and enclosed with the case presentation exercise.

Rordorf et al studied the Acute Physiology and Chronic Health Evaluation (APACHE) II score for the prediction of mortality in 63 ischemic stroke patients and found the mean APACHE II score for 50 survivors (6.9) was statistically significantly lower than 13 deaths (17.2)(9). The univariate analyses of APACHE II score showed four modules (Glasgow Coma Scale score, temperature, pH, and white blood cell count) which could predict mortality. The GCS was a highly important component with odds ratio of 65.4, 95% confidence intervals 3.3-1293.0 and p-value of <0.0002.

Study in 765 patients undergoing aneurysm surgery by Gotoh et al showed that the GCS could predict the outcome after early surgical intervention(10). The higher the GCS score before the operation, the better Glasgow outcome scale score. Both scores were correlated significantly with Spearman's rank correlation coefficient of 0.62, p-value < 0.001. However, the difference in outcomes was not clear between the GCS scores of 13 and 12 or between 7 and 6.

Rowley et al revealed the reliability and accuracy of the GCS with 4 clusters composing of 1 group of experienced nurses, 1 group of new graduates and 2 groups of student nurses(14). Two conclusions were made. First, experienced and well-trained practitioners could maintain a high level of reliability and accuracy. Reliability coefficient was 0.944 and their average agreement with the expert was 96.4%. Second, practitioners with limited training and experience could use this instrument with high reliability, but suspected accuracy. Reliability coefficients were 0.860 to 0.946 while the observer agreements with expert were approximately 61.6-78.1%.

Rutledge et al performed the prospective study to assess the association of the GCS eye and motor components with the GCS verbal score(19). They included 2521 complete GCS sum score measurements with 665 nonintubated patients from surgical intensive care unit data base. The Linear regression analysis was applied to derive a model. Estimated GCS verbal scale were calculated from the paradigm [2.3976 + (-0.9253) GCS motor + (-0.9214) GCS eye + 0.2208 $(\text{GCS motor})^2$ + 0.2318 $(\text{GCS eye})^2$] where Spearman's rank correlation coefficient = 0.91, p value = 0.0001.

Wijdicks et al devised the FOUR score from 120 neurointensive care unit patients and compared with the GCS by neuroscience specialists(7). They found good to excellent agreement among the raters with weighted K of 0.82, 95% confidence interval 0.77-0.88 and excellent correlation between the GCS and FOUR score (Spearman's rank correlation coefficient = 0.92). Considering the total FOUR scale score, they also found that for every 1 point increase in total score, there is an estimated 20% reduction in the odds of in-hospital mortality (Odds ratio 0.80, 95% confidence interval 0.72-0.88).

Bastos et al demonstrated the relationship between the GCS and the subsequent mortality rate in 15,973 nontrauma intensive care unit admissions and found that the patients with the GCS 12-15 had low mortality rates 23.6-9.7%, the GCS 7-11 had intermediate mortality rates 38.6-31.3%, and the GCS 3-6 had high mortality rates 73.1-46.4%(21).

Davis et al identified 12,882 patients from trauma registry over a 16-year period and advocated the values of field GCS are highly predictive of arrival GCS, and both are associated with outcome from traumatic brain injury(22). The area under the Receiver-operative curve was 0.84 for both field GCS and arrival GCS as predictive of mortality.

In 2005, Eftekhar et al studied logistic models based on the GCS and modified GCS motor component in prediction of mortality in 7,226 trauma patients. The study reemphasized the role of the GCS and the motor response in prediction of outcome with the area under the Receiver-operative curve values of 0.907 and 0.899 subsequently(23).

Oshiro et al reviewed 291 consecutive patients with aneurysm treated between January 1992 and January 1996 and compared the admission grades from the GCS with outcome measures at discharge from hospitalization. The results showed GCS grading system correlated statistically with Glasgow outcome score and mortality data with the odds ratio value of 2.859 denoted p value of 0.0001(24).

Tien et al studied in-hospital mortality with the GCS combined with the pupils' light reaction and reported that the patients with an initial GCS of 3 and bilateral fixed and dilated pupils had a 100% in-hospital mortality rate in contrast with those with reactive pupils had a 42% mortality rate(11).

1.3 Research questions:

1.3.1 Primary question:

Is there any correlation between the FOUR score and the GCS to evaluate consciousness of neurosurgical patients?

1.3.2 Secondary question:

What is the cut off point of the FOUR score compared to the GCS cut off point for outcome prediction?

1.4 Research objectives:

1.4.1 To assess reliability of the FOUR score in comparison to the GCS score for consciousness assessment in neurosurgical patients.

1.4.2 To estimate validity of total FOUR score compared to total GCS score ranged 3-6, 7-11 and 12-15.

1.4.3 To assess the practical feasibility of the FOUR score and the GCS.

1.5 Research hypothesis:

The FOUR score is reliable and valid for consciousness evaluation in neurosurgical patients.

1.6 Research design:

Descriptive study, diagnostic test on reliability and validity.