Comparison between glasgow coma scale and glasgow coma scale -pupil reactivity score in predicting mortality in traumatic brain injury

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Abstract

Introduction: Glasgow Coma Scale (GCS) and the pupillary response are the key indicators of the severity of traumatic brain injury (TBI). Glasgow coma scale- Pupil reactivity (GCS-P) score is a tool to incorporate pupil reactivity and GCS into a simple single index. The main aim of this study was to compare GCS and GCS- P scores in predicting mortality in TBI patients in our institution.

Materials and Methods: All patients admitted to Tribhuvan University Teaching Hospital (TUTH) with moderate to severe head injury from May 2018 to April 2019 were included in the study. Both GCS and GCS- P scores were recorded separately at admission. Outcome was measured with Glasgow Outcome Scale (GOS) at the time of discharge and in three months**.** Diagnostic accuracy of both these scoring systems were calculated using receiver-operating characteristics (ROC) curve, and correlation between them was estimated by using Pearson correlation coefficient.

Results: Out of 136 patients enrolled, 98 patients had favorable outcome, 38 patients had unfavorable outcome at discharge. The Pearson correlation coefficient between GCS and GOS at discharge was 0.721 and GCS-P and GOS was 0.740 showing a good correlation between the GCS and GOS and GCS-P and GOS. The areas under ROC curve for GCS for prediction of mortality was 0.856 (95% CI; $p<0.001$) and for GCS-P is 0.871(95%CI;$p<0.001$) suggesting good discriminatory ability of both models. However, on statistical analysis, the discriminatory ability of GCS-P was not superior to GCS for mortality.

Conclusion: GCS-P is as good as but not superior to GCS in predicting mortality in traumatic brain injury patients.

Key words: Glasgow coma scale, Glasgow coma scale -pupil reactivity score, Glasgow outcome score, prognosis , pupil, traumatic brain injury

Introduction

Traumatic brain injury (TBI) is the leading cause of death and disability worldwide.[1]Considering the high mortality due to TBI as well as high costs of in-patient and long-term treatments, outcome prediction has been a big concern. Therefore, scoring system is of utmost importance for establishing accurate diagnosis, prognostication and management decisions.

Glasgow Coma Scale(GCS) is used to objectively describe the extent of impaired consciousness in all types of acute medical and trauma patients. It allows clinicians to assess and quantify the level of consciousness and to predict outcome and guide treatment decisions. Other methods of adding information to the GCS or its components to extend its spectrum have been described as well like addition of memory[2],Glasgow-Liege Score[3],Innsbruck Coma Scale[4],FOUR score[5]. The Glasgow Coma Scale Pupils Reactivity Score (GCS-P) was described by Paul Brennan, Gordon Murray, and Graham Teasdale in 2018 as a strategy to combine the two key indicators of the severity of traumatic brain injury into a single simple index.[6,7]GCS-P is calculated by subtracting the Pupil Reactivity Score from GCS. GCS-P is a new scoring system proposed in TBI incorporating reactivity of pupils. Though the initial result is promising, it needs to be validated in wider patient population in several parts of the world.

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Materials and methods

This is a prospective observational study conducted at the Department of Neurosurgery, Tribhuvan University Teaching Hospital, Kathmandu, Nepal from May 2018to April 2019. Authorization from Institution Review Committee(IRC) was obtained prior to the start of this study. All patients >/= 16 years of age and admitted within 48 hours of injury with the diagnosis of moderate to severe TBI were included in the study. The patients with do not resuscitate (DNR) status, post cardiopulmonary(CPR) status, previously known pupillary abnormality were excluded from the study. As per the study protocol, GCS and GCS-P scores were recorded at the time of admission. Each component of both scores was tested independently. Informed consent was obtained from the legal guardian. Clinical history was taken and relevant physical examination was done. Patients were managed with the standard head injury protocol and then discharged once they met the discharge criteria. At the time of discharge, the Glasgow Outcome Score(GOS) was noted. All patients were followed up in 1, 4 and 12 weeks. The GOS at 12 weeks was correlated with GCS and GCS-P score in the final analysis.

Collected data was analyzed with the SPSS version 21 Microsoft windows program. Sensitivity and specificity were calculated for the diagnostic accuracy of both scoring systems and they were plotted in the receiver-operating curve (ROC) and the area under the curve (AUC) was calculated to determine the discrimination ability of both the scores. Pearson correlation coefficient test was used to calculate the correlation between two scoring systems. p value less than 0.05 was taken as significant.

Results

There were a total of 150 cases eligible to participate during the study period. Eight were excluded as four patients refused to participate, two left against medical advice and two had do not resuscitate (DNR) status. Out of 142 patients enrolled, six were lost to follow up. Hence, 136 patients constituted the basis for final analysis. Most of the patients belonged to the age group 16-29 years (46.3%) and minimum number of patients belong to 70-79 years age group. There were 115 males and 21 females (M: F = 5.49:1). Eighty-two patients (60.3%) had moderate and 54 (39.7%) had severe head injuries.

The commonest CT finding was contusion and subdural hematoma(SDH) followed by epidural hematoma(EDH). There was almost equal incidence of contusion, SDH and EDH in this study. Mean duration of time of assessment from injury was 11.9 hours. Mean GCS and GCS-P at presentation were 9.51 and 9.13 respectively. Sixty patients (44.1%) underwent craniotomy whereas 76 patients (55.9%) received conservative treatment. Mean duration of hospital stay was 11.9 days. As for survival and mortality at discharge, 116 (85.3%) patients survived and 20 (14.7) patients died. In three months, 114 (98.3%) patients survived and 2 (1.7%) patients died.

As shown in figure 1, number of patients with good outcome increased from 76 at discharge to 93 in 3 months, patients with moderate disability decreased from 22 at discharge and 14 in 3 months. Similarly, number of patients with severe disability decreased from 15 at discharge to 4 in 3 months. The number of patients with persistent vegetative state remained constant. There was in hospital mortality of 20 and mortality in 3 months was two.

As shown in the figure 2,there is good linear correlation between GCS and GOS at discharge.The Pearson correlation coefficient between GCS and GOS at discharge was 0.721. It shows the good correlation between the GCS and GOS at discharge.

As shown in the figure 3, there is also good linear correlation between GCS-P and GOS at discharge . The linear correlation between GCS-P and GOS at discharge was 0.740 which suggests good correlation. Similarly, the correlation between GCS and GOS at 3 months and GCS-P and GOS at 3 months was 0.549 and 0.568 respectively which shows a good correlation.

The area under the ROC curve for GCS and GCS-P for prediction of mortality was 0.856 (95% CI;0.79-0.923; P<0.001), 0.871(95% CI;0.805-0.936; P<0.001) suggesting a good discriminatory ability of both scores in predicting mortality.The predictive ability of GCS-P is slightly better than GCS but without statistical significance.

The sensitivity, specificity, positive predictive value and negative predictive value for GCS was 100%, 61.2%, 30.8%, 100% respectively whereas for GCS-P was 95%, 66.45%, 32.8%, 98.7% for mortality (table 1).

Test Result Variable(s)	Area	Std. Error	p	Asymptotic 95% Confidence Interval		Cutoff	Sensitivity	Specificity	PPV	PVN
				Lower Bound	Upper Bound					
GCS at presentation	0.856	0.034	<0.001	0.79	0.923	9.5	100	61.2	30.8	100
GCS P at presentation	0.871	0.033	<0.001	0.805	0.936	8.5	95	66.4	32.8	98.7

Mortality if less than the cutoff

Table 1: AUC for mortality

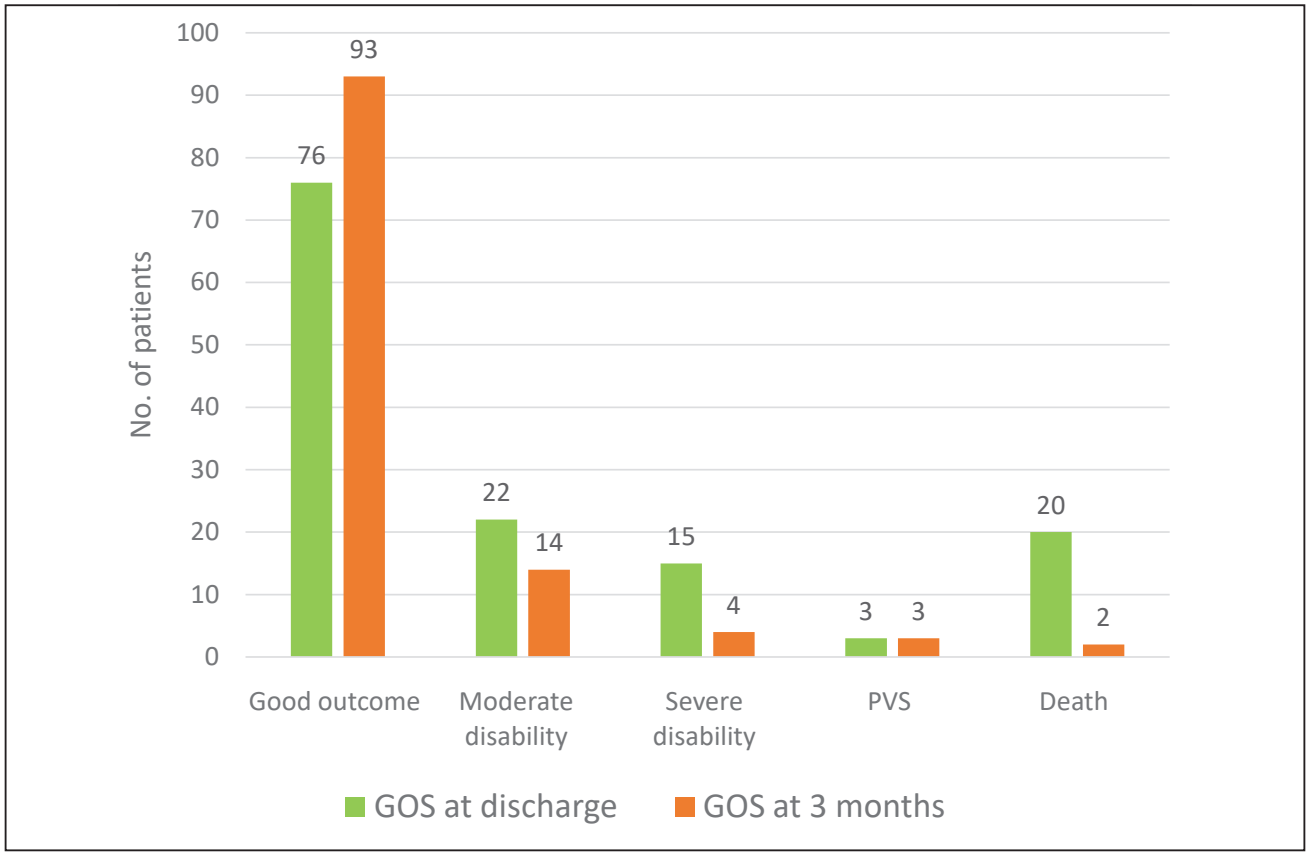

Figure 1: Comparison of GOS at discharge and at 3 months

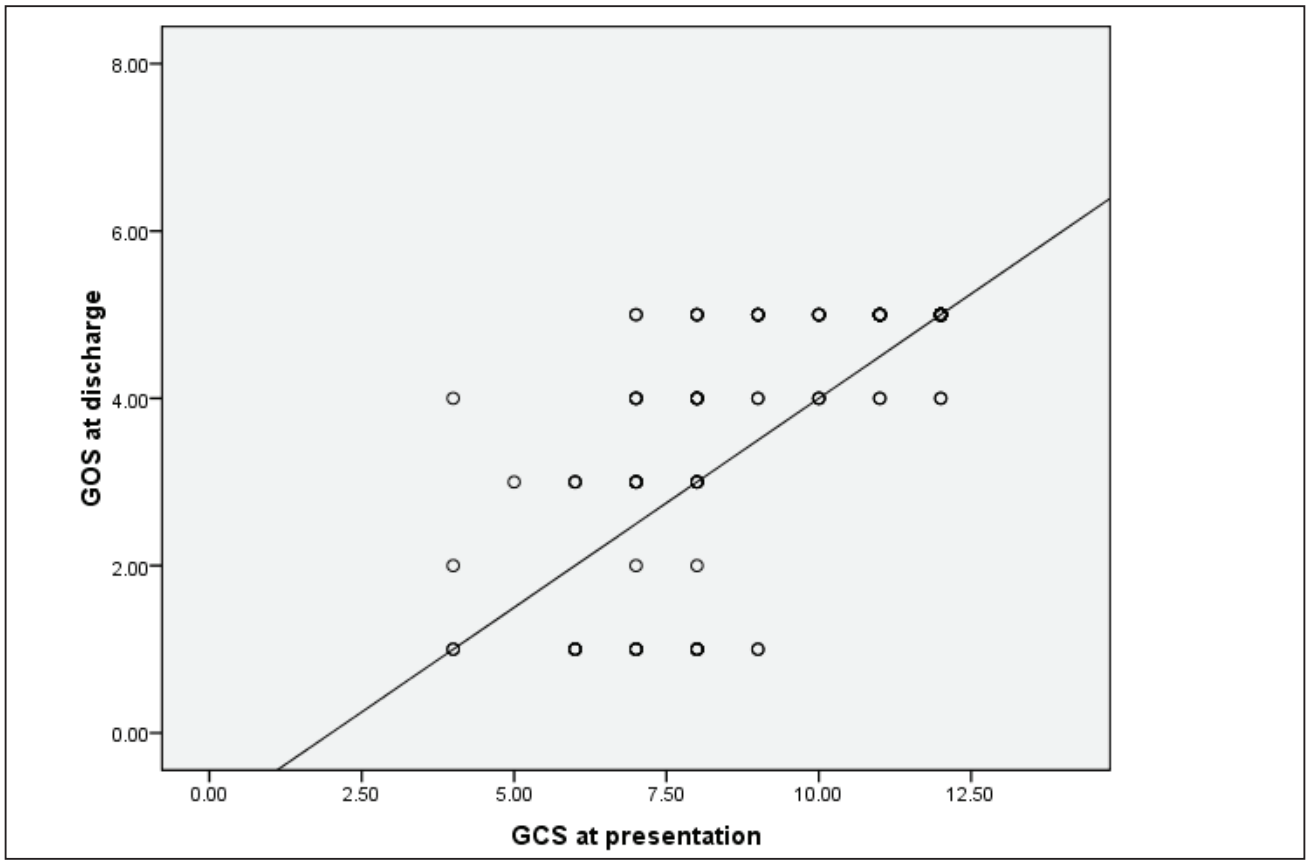

Figure 2: Correlation between GCS at presentation and GOS at discharge

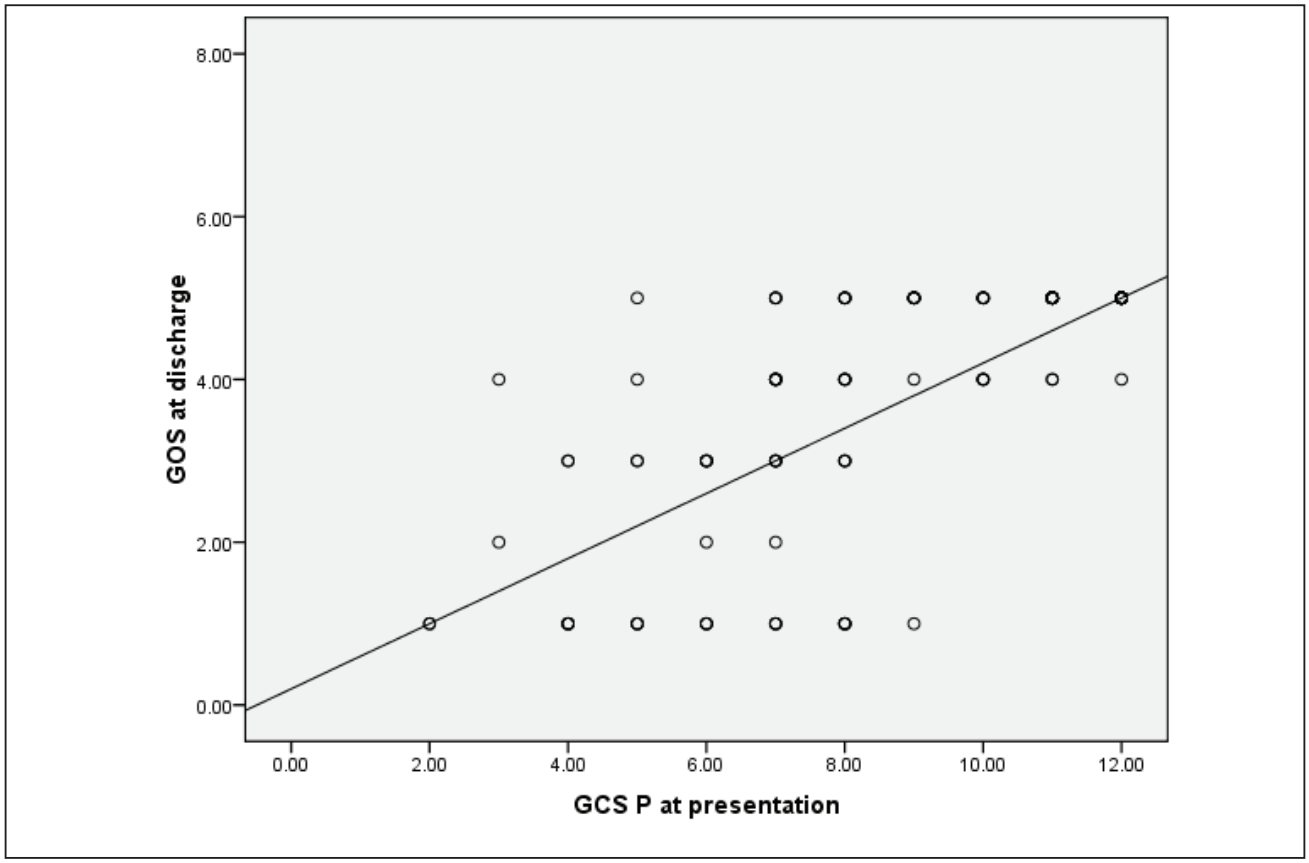

Figure 3: Correlation between GCS-P at presentation and GOS at discharge

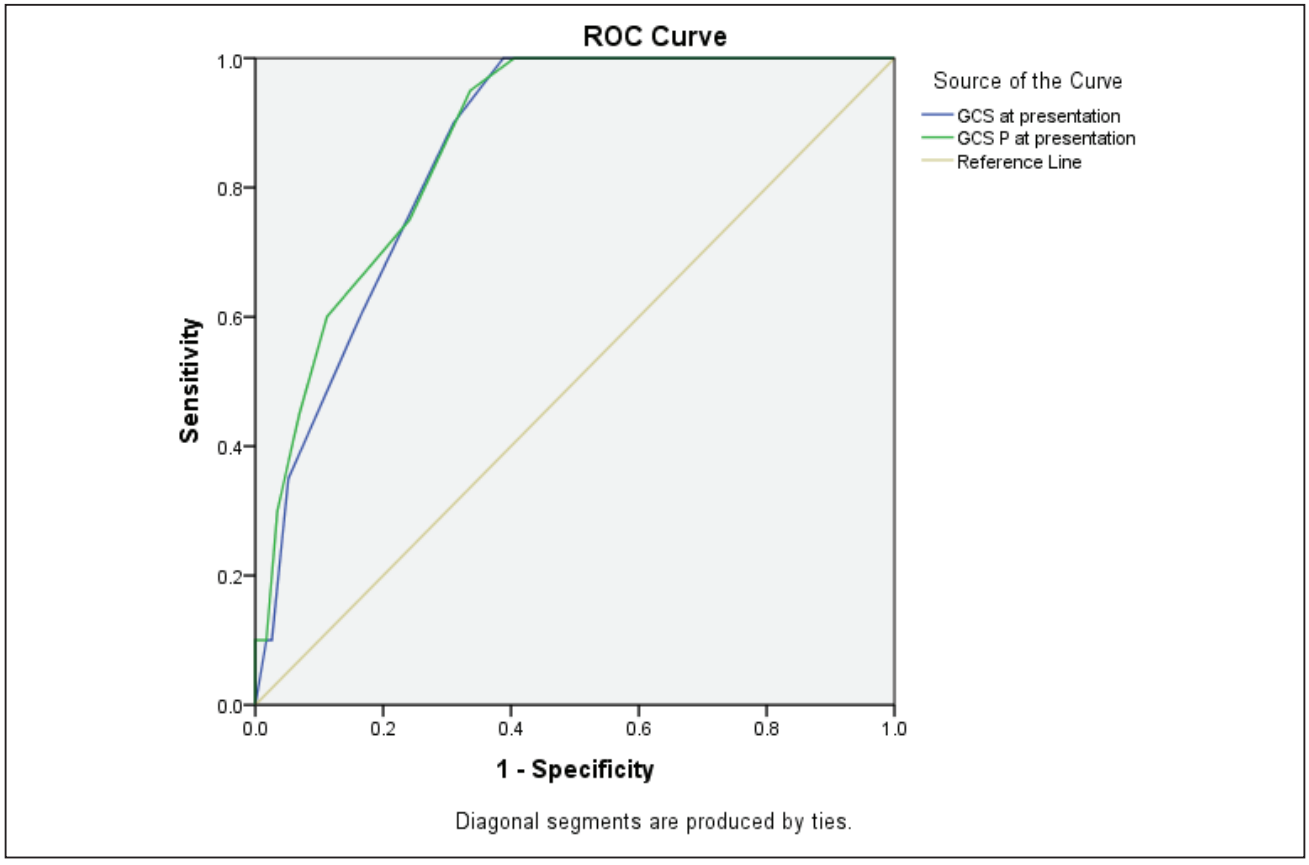

Figure 4: ROC curve for mortality at discharge

Discussion

The GCS was first published in 1974 at the University of Glasgow by Professors Graham Teasdale and Bryan Jennett.[8] Along with GCS, assessment of pupillary reactivity is another standard procedure of neurological evaluation. Acute pupillary dilatation in head-injured patients indicates a neurological emergency[9]. The combined GCS-P is not intended to replace the role of separate assessment and reporting of each component of the Glasgow Coma Scale and pupil response in the care of individual patients.

In this study the relationship between decrease in the GCS-P and deteriorating outcome was seen across the complete range of possible scores .The additional 2 lowest points offered by GCS-Pupils score(GCS-P1 and 2)extended the information about the injury severity from a mortality rate of 51% and an unfavorable outcome rate of 70% at GCS score 3 to a mortality rate of 74% and unfavorable outcome rate of 90% at GCS-P1 .Similarly in this study , there is increase in mortality from 50% at the lowest GCS score (score 4) to 100% at GCS-P 2.This concludes that the GCS- P extends the information provided about the patient outcome. Comparing AUC curve of GCS and GCS-P for mortality, it is found that it is slightly higher for GCS-P than GCS but is not statistically significant (0.856 vs 0.871)). Correlation between GCS and GCS-P was good, with Pearson Correlation coefficient of 0.962($p<0.001$).

The GCS score, together with information about pupil reaction, conveys to the physician most of the clinical predictive information in head-injured patients.[10]Although estimates of prognosis are best made using mathematical methods that combine information about multiple aspects of the patient's condition, these have not been found widespread acceptance in clinical practice[11] Instead, simple scoring systems for stratifying injury severity appeal to clinicians in every field of medicine.[12] GCS-P is a simple scoring system with subtraction of pupil reactivity score from GCS value. The GCS-P retains this simplicity while expanding information about the severity of a patient's clinical state and prognosis. It is thought that GCSP is especially valuable in case of severe head injury. Prognosis, in addition to clinical responsiveness, is influenced by several factors. Although clinicians identify prognosis as a factor in their decision making, it remains exposed to personal subjective opinions.[13] By providing a simple but informative index, the GCS-P may be useful in avoiding biases among clinicians about patient prognosis

This remains the most informative way of determining and sharing a picture of the patient's condition and how it may be changing[14]. It expands on the GCS Score as a simple shorthand index of the severity of a patient's clinical state and prognosis, especially in more severe injuries.

Conclusion

Based on our study, GCS -P scoring system is at least as good as GCS but not superior in predicting outcome in traumatic brain injury patients. This is in contrary to our expectations. Further larger studies involving multiple centers with a long-term outcome evaluation may be required to better clarify the predictive ability of the GCS-P scoring system.

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