Modified Glasgow Coma Scale and Brainstem Reflexes in Predicting Survival and Outcome in Children with Non-Traumatic Coma: A Descriptive Study

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ABSTRACT

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Background: The modified Glasgow Coma Scale (MGCS), in spite of its various drawbacks has been widely used for assessing pediatric coma, though only few studies are available to support its use in pediatric coma as a whole. . This study is to evaluate the relation between Modified Glasgow coma scale and Brainstem reflexes in predicting survival and outcome in children with non-traumatic coma.

Materials and Methods: A hospital based descriptive study among 100 consecutive children of 5 months to 15 years with non-traumatic coma admitted in paediatric intensive care unit (PICU) of a tertiary care teaching hospital, during the period of January 2006 to January 2007.

Results: Individual components of modified Glasgow Coma Scale (MGCS) were analysed with individual scores. It showed that low individual scores were associated with adverse outcome (death in acute non-traumatic coma). Those children with score of <8 was more prone for adverse outcome in terms of death with significant association (P < .001). Brainstem reflex score was found to be a better predictor of outcome in terms of death in patients with acute non-traumatic coma. The score of more than 2 is predictive of better outcome (P = <0.001).

Conclusion: MGCS scoring is simple, easy, can be applied at bed side and does not need any investigations. Its application in developing countries like India with limited investigative and intensive care facilities can help treating pediatrician to decide regarding management or referral and counseling the parents regarding probable outcome.

Keywords: MGCS, GCS, Coma, Stupor, Coma Scale

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BACKGROUND

Acute non-traumatic coma is a common problem in pediatric practice accounting 10-15% of all hospital admissions and is associated with significant mortality.[1] Assessment of the severity of coma is essential to comment on the likelihood of survival in comatose children. The modified Glasgow Coma Scale (MGCS), in spite of its various drawbacks has been widely used for assessing pediatric coma, though only few studies are available to support its use in pediatric coma as a whole. The scale is simple easy, can be applied at bed side and does not need any investigation. Its application in developing countries like India with limited investigative and intensive care facilities can help to decide on whether to manage or referred to higher centers, and also help in counseling the parents regarding probable outcome.

The Glasgow Coma Scale (GCS) permits 120 possible mathematical combinations of eye, verbal and motor scores. Out of these only 15 are clinically valid and useful in the assessment of altered consciousness (2). It is a practical scale with high validity and good sensitivity to changes in level of consciousness. The three components that make up the GCS – motor, eye-opening and verbal; though one or more may not be testable in clinical practice, limiting the usefulness of the aggregate score. Despite these limitations, the GCS continues to be universally used and accepted.[3]

The GCS seems straight forward. It is simply the sum of three added values that describe a patient's motor

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(1-6), Verbal (1-5) and Eye (1-4) level of response to speech or pain. Since its creation, the GCS has been widely used. Not only is it used to describe the individual trauma of patients in the ambulance, the emergency room and the intensive care unit, but it is also used as a component of several other outcome prediction scores.[4] Modified Glasgow Coma Scale (MGCS) score can be assessed at the bedside, does not need any equipment or investigations but require only the knowledge and clinical acumen for application.[5]

Very little information is available particularly so from developing countries, including India. In a prospective study, the authors have therefore examined the etiology, clinical signs and severity of non-traumatic coma in children with a view to define predictors of outcome. This study is to evaluate the relation between Modified Glasgow coma scale and Brainstem reflexes in predicting survival and outcome in children with non-traumatic coma.

MATERIALS AND METHODS

This study was a hospital based descriptive study among 100 consecutive children belonging to the age group of 5 months to 15 years, with non-traumatic coma admitted in paediatric intensive care unit (PICU) of a tertiary care teaching hospital, during the period from January 2006 to January 2007. Those children with coma secondary to trauma, children with neuro-developmental delay and any other pre existing neurological illness were excluded from this study. All children belonging to the age group of 5 months to 15 years, admitted with non -traumatic coma were evaluated with appropriate history and relevant investigations as per the clinical suspicion. Biochemical investigations like complete blood count, urine analysis, blood sugar, serum electrolytes, scrum ammonia, calcium, arterial blood gas analysis, serology, CSF analysis in suspected infection, toxic and metabolic screening, and imaging studies if required, were performed.

Simultaneously all these patients underwent focused and serial neurological examination as per the standard protocol (MGCS and Brainstem reflexes at 6 hourly intervals from the time of admission to 72 hours after admission and findings were recorded in proforma). The lowest score of MGCS and worst Brainstem reflexes score (based on the number of reflexes present) were used for analysis. Data was entered in Microsoft excel, and analysis was done by using SPSS software. Written ethical consent was obtained from institution ethical committee before the commencement of the study.

RESULTS

Consecutively, 100 children between age group of 5 months to 15 years were admitted with acute non-traumatic coma during the study period. Out of the 100 children studied, 57 were male and 43 were female. 39% were within the age group of 5 to 9 years, and 38% , 1 to 4 years **(Table 1).**

Table 1. Age distribution of cases

Age group (Years)	Number of cases
< 1	9
1-4	38
5-9	39
10-14	14
Total	100

In total, 79% of the cases belonged to the age group of 1 to 9 years.

Most common presenting symptoms were fever, 86% of the cases and convulsion, in 73% of the cases **(Table 2).**

Table 2. Presenting symptoms

Presenting symptoms	Number of cases
Fever	86
Headache	25
Vomiting	02
Convulsion	73
Rashes	16
Ingestion of toxins	
Kerosene	04
OP Poison	04
Others	
Icterus	02
Animal bite	02
Edema	01

Assessment based on the level of consciousness, 96% of cases were found to be either stuporous or comatose **(Table 3).** 55% were in coma and 41% were in stuporous stage.

The MGCS score < 8 was associated with poor outcome in terms of death. 90% cases with MGCS

Table 3. Level of consciousness

Level of consciousness	Number of cases
Drowsy	04
Stupor	41
Coma	55
Total	100

Table 4. Total MGCS score and outcome

Total score	No. of children	Survived	Death
13	02	2 (100)	0
12	01	1 (100)	0
11	06	6 (100)	0
10	11	11 (100)	0
9	20	20 (100)	0
8	20	18 (90)	2 (10)
7	12	7 (58.3)	5 (41.7)
6	11	1 (9.1)	10 (90.9)
5	8	0	8 (100)
4	5	0	5 (100)
3	4	2 (50)	2 (50)

score of eight survived, and 90.9% succumbed to death when MGCS score was six. 100% of the children with MGCS score of nine survived in this study.

In order to identify the factors that independently predicted the outcome, individual components of MGCS were analysed with individual scores. It showed that low individual scores were associated with adverse outcome (death in acute non-traumatic coma) (Table 5). In 81.8% of the deaths, the ocular response was one. 100% of the cases with ocular response score of 3 survived. There was a significant association between increase in ocular response and survival rate (p= <0.01). High survival rate was found in motor response of 2 or more. Highly significant association was found in motor response and outcome (p= <0.001). In case of verbal response also, there is a significant association between score and outcome (p=<0.01).

Table 5. MGCS scores individual components and outcome

MGCS components	No. of children (100)	Survived (68)	Death (32)	Chi-square	p-value
Ocular response					
1	33	6(18.2)	27 (81.8)	56.6	< 0.001 (HS)
2	53	48 (90.6)	5 (9.4)		
3	13	13 (100)	-		
4	01	01 (100)	-		
Motor response					
1	08	02 (25)	06 (75)	63.7	< 0.001
2	17	-	17 (100)		
3	31	22 (71)	09 (29)		
4	33	33 (100)	-		
5	11	33 (100)	-		
6	-	-	-		
Verbal response					
1	07	3 (42.9)	4 (57.1)	17.7	< 0.01
2	27	11 (40.7)	16 (59.3)		
3	54	43 (79.6)	11(20.4)		
4	11	10 (90.9)	01 (9.1)		
5	01	1 (100)	-		

Table 6. Grouping of MGCS and outcome

Grade	No. of children	Survived	Death	Chi-square	p-value
Mild (13-15)	2	2 (100)	-	56.7	< 0.001 (HS)
Moderate (8-12)	58	56 (96.6)	2 (3.4)		
Severe (< 8)	40	10 (25)	30 (75)		
Total	100	68	32		

MGCS scores were analysed by grading, and those with score of <8 were more prone to adverse outcome in terms of death with significant association (P < .001) **(Table 6).**

Table 7. Brainstem reflexes scores and outcome

Total score	No. of children	Survived	Death	Chi-square	p value
1	12	-	12 (100)	95.6	< 0.001 (HS)
2	21	1 (4.8)	20 (95.2)		
3	22	22 (100)	-		
4	45	45 (100)	-		

Brainstem reflex score was found to be a better predictor of outcome in terms of death in patients with acute non-traumatic coma. The score of more than 2 is predictive of better outcome (P = < 0.001) **(Table 7).** Brainstem reflex in its various components were analysed, and it was found that the absence of Brainstem reflexes in acute non-traumatic coma was associated with adverse outcome in terms of death (p < 0.001) **(Table 8).**

Table 8. Brainstem reflexes score and outcome

Components	No. of children	Survived	Death	Chi-square	p-value
Respiratory pattern					
Normal (1)	59	56 (94.9)	3 (5.1)	47.9	< 0.001 (HS)
Abnormal (0)	41	12 (29.3)	29 (7.7)		
Pupils					
Reactive (1)	72	58 (80.6)	14 (19.4)	18.6	< 0.001 (HS)
Non reactive (0)	28	10 (35.7)	18 (64.3)		
Corneal reflex					
Present (1)	94	68 (72.3)	26 (27.7)	13.6	< 0.001 (HS)
Absent (0)	06	0	06 (100)		
Doll's eye movement					
Present (1)	75	66 (88.0)	9 (12.0)	55.1	< 0.001 (HS)
Absent (0)	25	2 (8)	23 (92)		

Table 9 Brainstem reflexes in relation to MGCS

	MGCS		
Brainstem	< 8	≥ 8	Total
1-2	31 (77.5)	2 (3.3)	33
3-4	9 (22.5)	58 (96)	67
Total	40	60	100

In this study we have noted that there is a statistically significant correlation of MGCS to Brainstem stem reflexes in predicting the immediate outcome ($p < 0.001$) with spearman correlation coefficient of + 0.724 ($p < 0.01$). When both MGCS and brainstem reflexes were used together they have sensitivity and specificity of 78% and 97% respectively in predicting the immediate outcome in case of non-traumatic coma **(Table 9).**

DISCUSSION

It is a well know fact that the prognosis in coma depends on its severity. Assessing the severity of coma is subjective, and poorly defined in terms such as stupor, semi-coma and deep coma. This was ineffective in predicting the outcome and there was a great deal of inconsistency when different observers carried out assessment.[6] The Glasgow coma scale is a standardized system developed initially in traumatic coma to assess the degree of coma and to identify the seriousness of brain injury in relation to outcome.[7] It has gained wide spread use as it is highly reproducible, can be quickly performed at the bedside and provides useful information on the progress and prognosis of a comatose individual.[8]

In the present study, more children were affected within the age group of 5-9 years (39%). Also in a study done at JIPMER, Pondicherry, more children were affected within the age group of 3-36 months (37%).[9] In another study at PGI Chandigarh, 34% cases were within the age group of 4-5 years.[10]

In our study, low total MGCS score was found to be significantly associated with adverse short-term outcome in terms of death. The likelihood of death in patients with MGCS score less than 8 was much higher than when the MGCS was >8 (odds ratio 21.4, $p < 0.0001$). Similar findings were noted in a study conducted by Prabha PC et al at JIPMER, Pondicherry, who found that mortality was higher in patients with MGCS score < 8 (odds ratio 78.9% and relatively risk 27%).[9]

CONCLUSION

The present study concludes that children with GCS score of less than 8 on admission have the worst prognosis and a very high probability of death. Those with GCS score of more than 8 at the time of admission have good prognosis and better survival and outcome. Thus MGCS scoring is simple, easy, can be applied at bed side and does not need any investigations. Its application in developing countries like India with limited investigative and intensive care facilities can help treating pediatricians to decide regarding management or referral and counseling the parents regarding probable outcome. This is particularly helpful in resource limited countries like India for directing limited resources for maximal benefit and assessing its utility in predicting the immediate outcome in children with non traumatic coma in hospital settings.

The Glasgow Coma Scale is a standardized system. It has gained widespread use as it is highly reproducible, can be quickly performed at the bedside and provides useful information on the progress and prognosis of a comatose individual.

The likelihood of death in patients with GCS less than 8 was much higher than when the GCS was >8. Studies in both traumatic and non-traumatic coma have indicated that mortality is high when the GCS is less than 8.The MGCS recorded at admission had significant association with outcome. Mortality rates progressively increased with decreasing GCS score. Patient with GCS score of 8 or less may require aggressive management including ABC, mechanical ventilation and intracranial pressure monitoring. A good prognosis was observed in patients whose GCS was more than 8 on admission.

END NOTE

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