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STUDY OF SERUM ALBUMIN, FIBRINOGEN, AND TRANSFERRIN AS PROGNOSTIC MARKERS IN HEAD INJURY PATIENTS

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Abstract

Introduction: Head injury is a global issue as a result of industry and transportation development that causes a large number of accident victims. Head injury still constitutes a serious health problem nowadays. The number of incidents, level of disability, and mortality rate are still high 75- 80% of the total number of head injury are mild, moderate, and severe.

Aim and Objectives: To study the role of serum albumin, fibrinogen and transferrin as prognostic markers in Head injury.

Methods: Clinically diagnosed Head injury patients and admitted to Neurosurgery department at the National Institute of Medical Science & Research, Jaipur. Blood sample was taken within 24 hrs. as per protocol.

Results: The severity of head injury with Glasgow coma scale (GCS). The status of the parameters compared as well as their association and role in prognosis analyzed.

Conclusion: Serum albumin, fibrinogen and transferrin can become useful biomarkers in predicting outcomes in patients with Head injuries.

Keywords: Head injury, Albumin, Fibrinogen, Transferrin, GCS, GOS

INTRODUCTION

Head injury has become a widespread concern due to the advancement of industry and transportation, resulting in a significant number of accident victims. Even today, head injury remains a critical health issue. The incidence, disability level, and mortality rate are still high, with 75-80% of all head injuries being classified as mild, moderate, or severe.[1-4]

A Traumatic brain injury (TBI) occurs when an external force or blow to the head disrupts brain function. This can result in a decreased level of consciousness, memory loss before or after injury, alteration of mental status, neurologic deficits, or intracranial lesions.[5] Males are four times more likely to experience a TBI[6] and are at higher risk of TBI-related hospitalization than females across all mechanisms of injury.

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Albumin is the major protein of human plasma and one of the negative acute phase reactants reported to fall as a component of metabolic response to injury independent of the nutritional status.[7,8] Only a few biochemical markers have been identified to prognosticate the severity of trauma at the tissue level.[9] Albumin is the major protein in human plasma accounting for about 60% of the total plasma protein. Albumin is produced by the liver at a rate of 9-12 g/day. As serum albumin levels more than 3.4 g/dL predict a favourable prognosis, maintaining serum albumin levels above 3.5g/dL is a pathway for a speedy recovery.[10]

Fibrinogen is a type of protein found in the blood that, when activated by thrombin, transforms into fibrin. This process creates a mesh-like structure that helps to bind platelets and contributes to the formation of a blood clot.[11] Fibrinogen can interact with various cell receptors found on different types of cells, each with unique cellular membrane protein compositions and gene expression profiles. This could be due to the nature of its molecular structure with multiple binding sites for cell receptors with different biological functions.[12] The coagulation and fibrinolysis systems are in a state of dynamic equilibrium under physiological conditions. When the body sustains an injury, the balance system gets disturbed, and the coagulation and fibrinolysis systems are triggered.[13]

The primary function of Transferrin (Tf) is to transport iron from absorption in the duodenum and in white blood cell macrophages to all tissues.[14] Tf plays an important role in the somatic regions such as erythropoiesis and active cell division occurs.[15]

Changes in transferrin levels can impact iron metabolism, which is crucial for optimal bodily function. Abnormalities in iron levels, such as deficiency or overload, can lead to negative health consequences. For instance, iron deficiency can reduce cytochrome oxidase activity in the brain, particularly in the hippocampus and prefrontal regions.[16]

The GCS score is a helpful tool to evaluate the consciousness level of trauma patients. However, it can be unreliable due to the effects of sedation and intubation. Additionally, the GCS score is not effective in assessing mild head injuries, such as concussions, which make up a significant proportion of cases. However, for a mild head injury, CT may fail to detect more subtle anatomic findings of acute injury. Specific criteria should be present to warrant CT or MRI use for mild injuries with GCS scores of 13-15.[17]

AIM OF THE STUDY

The present study aims to study the role of serum albumin, fibrinogen, and transferrin as prognostic markers in Head injury

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MATERIALS AND METHODS

The present study included 435 patients aged 18 to 70-year of both genders with a clinically diagnosed head injury, after Institutional ethical approval, the present study was conducted in the Department of Biochemistry in association with the Department of Neurosurgery at NIMS Medical College & Research, Jaipur.

The Glasgow Coma Scale (GCS) was used to assess the severity of the head injury. The severity of traumatic brain injury is classified into mild, moderate, and severe based on the Glasgow Coma Scale score at admission (13-15 for mild, 9-12 for moderate, and less than 8 for severe). To determine the serum albumin, fibrinogen, and transferrin status, blood samples were collected according to the protocol and analysed at the Central Laboratory of NIMS Hospital, Jaipur. The Blood sample for serum albumin was collected for quantitative determination of serum albumin within 24 hours of admission in the hospital. The serum samples were analysed by using the bromocresol green dye (BCG: Bromocresol Green) binding method. Fibrinogen was estimated by the immunoturbidimetric method and Blood was collected in 3.2% trisodium citrate. Serum transferrin level by immunoturbidimetric method.

Inclusion criteria

Age 18 to 70-year with both sexes, clinically diagnosed head injury patients who admitted in Neurosurgery department at National Institute of Medical Science & Research, Jaipur

Exclusion criteria

Patients having Solid organs disease, Chronic diseases such as Tuberculosis and chronic renal disease, patients on anticoagulants and antiplatelet therapy, pre-trauma fever, pre- existing hepatic insufficiency, any hemolytic disorders, HIV and Pregnant woman were excluded from the study.

STATISTICAL ANALYSIS: Categorically data was presented as frequency and percentage (%), and measurement data with normal distribution were presented as mean ± S.D. The independent predictors of head injury were determined by univariate and multivariate logistic regression analysis odds ratio (OR) and 95% of confidence of interval (CI) calculated. P value <0.05 was considered as significant.

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RESULTS

The severity of head injury with GCS. the status of the parameter compared as well as their association and role in prognosis. A total 435 patients (80 males and 355 females) with clinically diagnosed head injury.

Table 1: Shows the Mean ± SD values of serum albumin, plasma fibrinogen, and serum transferrin in head injury patients.

Albumin Level (g/dL)	Mean ± SD of Albumin (g/dL)	Fibrinogen Level (g/L)	Mean ± SD of Fibrinogen	Transferrin Level (mg/dL)	Mean ± SD of Transferrin
0-3.5	2.8±0.4	<2	1.3±0.3	<200	154.6±36.8
>3.5	4.1±0.5	2-4	2.8±0.4	>300	310.4±6.9
Grand Total	3.2±0.7	2.2±0.8		195±57.7	

Table 1: The Mean ± SD values of serum albumin 303 (69.7%) patients were 2.8±0.4 g/dL and 132 (30.3%) patients were 4.1±0.5 g/dL. Plasma Fibrinogen levels in 172(39.5%) head injury patients were 1.3±0.3 g/L, and in 263(60.5%) head injury patients were 2–4 g/L. The mean ± SD values of serum transferrin 241(55.4%) head injury patients were 154.4±36.8 mg/dL, and 169(38.9%) head injury patients were 235.5±26.6 mg/dL, and 25(5.7%) head injury patients were 310.4±6.9 mg/dL.

Table 2: Shows the distribution of head injury patients depending on GCS score at the time of admission.

GCS Score at the time of admission	No. of Patients
Mild (13-15)	0(0%)
Moderate (9-12)	162(37.2%)

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Severe (3-8)	273(62.8%)
Grand Total	435(100%)

Figure 1: Shows the association between GCS score at the time of admission and at the time of discharge.

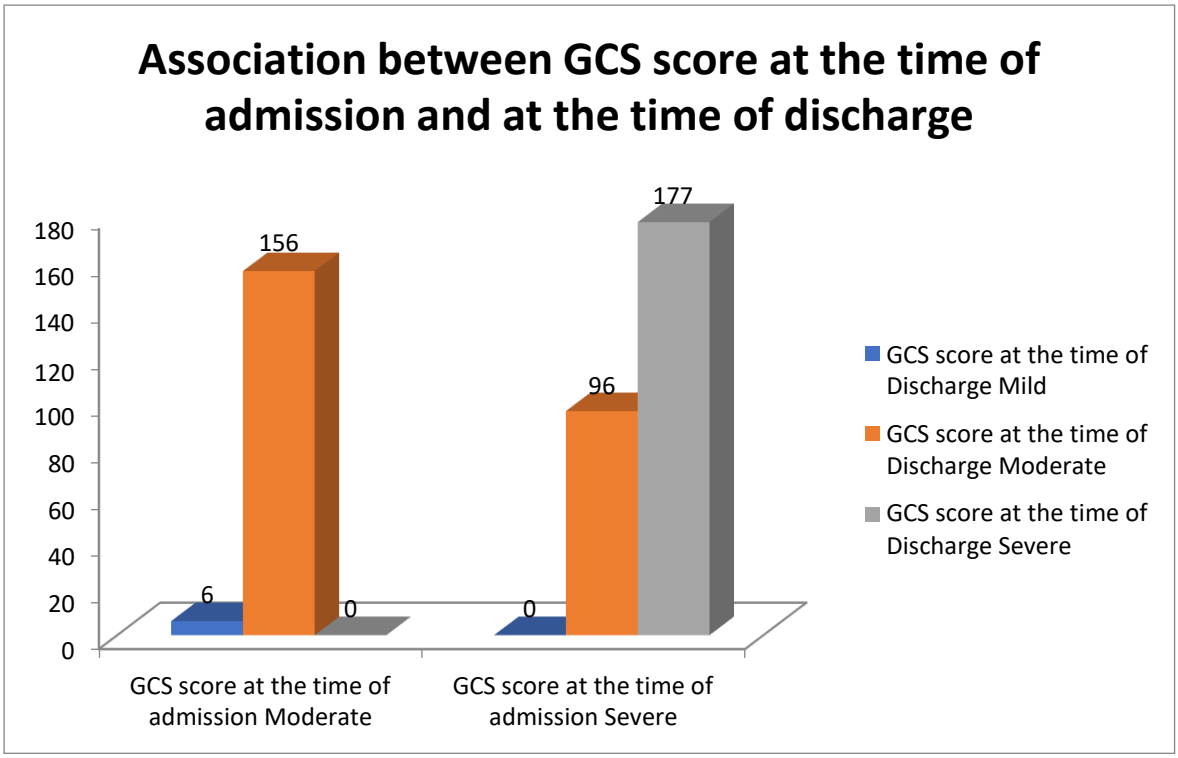

Table 3: Shows the number of head injury patients and the association of serum albumin level at the time of admission and GCS score at the time of discharge.

GCS score at the time of Discharge	Albumin level at the time of Admission		Fibrinogen level (g/L) at the time of admission		Transferrin Level (mg/dL)	
	<3.5	>3.5	<2	2-4	<200	200-300

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Mild (13-15)	1(0.2%)	5(1.1%)	0(0%)	6(1.4%)	2(0.5%)	4(0.9%)
Moderate (9-12)	145(33.3%)	107(24.6%)	32(7.4%)	220(50.6%)	88(20.2%)	143(32.9%)
Severe (3-8)	157(36.1%)	20(4.6%)	140(32.2%)	37(8.5%)	151(34.7%)	22(5.1%)
Grand Total	303(69.7%)	132(30.3%)	172(39.5%)	263(60.5%)	241(55.4%)	169(38.9%)
p-value	p=0.007 Significant		p=0.02 Significant		p=0.02 Significant	

Out of 435 head injury patients 5(1.1%) patients had mild GCS score with increased albumin levels at the time of admission and 252 (57.9%) patients had moderate score at the time of admission but at the time of discharge 145 (33.3%) patients had moderate GCS score had decreased albumin level, in 107 (24.6%) patients had moderate GCS score with increase albumin level and 177(40.7%) had severe GCS score at the time of admission and at the time of discharge 157(36.1%) had severe GCS score with decrease albumin level, 20(4.6%) patients had severe GCS score with low albumin level.

fibrinogen levels, 6(1.4%) patients had mild GCS score and 252(57.9%) patients had moderate score at the time of admission and 177(40.7%) had severe GCS score at the time of admission and at the time of discharge 140(32.2%) had severe GCS score with low fibrinogen level at the time of admission, and 37(8.5%) patients had severe GCS score with normal fibrinogen level at the time of admission.

Transferrin levels 6(1.4%) patients had mild score at the time of admission but at the time of discharge 2(0.5%) mild GCS score and 252(57.9%) patients had moderate score at the time of admission but at a time of discharge 88(20.2%) patients had moderate GCS score and low level of transferrin, and 21(4.8%) patients had moderate GCS score with increase transferrin level and 177(40.7%) had severe GCS score at the time of admission and at the time of discharge 151(34.7%) had severe GCS score with decrease transferrin level at the time of admission. Thus, the association of GCS score at the time of admission and at the time of discharge was

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statistically significant. Thus, the association of GCS score at the time of discharge and after one month of discharge was statistically significant p-value <0.02.

Table 4: Shows the Mean ± SD values of depending parameters in head injury patients according to GCS score at the time of admission and statistical significance.

Mean ± SD of Parameters (at the time of Admission)	GCS score at the time of admission		p-value & Statistical Significance
	Moderate	Severe	
Albumin (g/dL)	3.6±0.7	3±0.6	$\mathbf{0.006 \times 10^{-18}}$ **(<0.05) Significant**
Fibrinogen (g/L)	2.8±0.5	1.9±0.8	$\mathbf{0.01 \times 10^{-13}}$ **(<0.05) Significant**
Transferrin (mg/dL)	221.7±47	179.2±57.8	$\mathbf{0.01 \times 10^{-34}}$ **(<0.05) Significant**

Table 5: Shows the Mean ± SD value of depending parameters of patients at the time of admission according to GCS score at the time of discharge and statistical significance.

Mean ± SD of Parameters (at the time of Admission)	GCS score at the time of Discharge			p-value & Statistical Significance
	Mild	Moderate	Severe	

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Albumin (g/dL)	4.4±0.6	3.5±0.7	2.8±0.6	$\mathbf{0.001 \times 10^{-20}}$**(<0.05) Significant**
Fibrinogen (g/L)	2.9±0.6	2.7±0.6	1.6±0.7	$\mathbf{0.02 \times 10^{-22}}$**(<0.05) Significant**
Transferrin (mg/dl)	202.9±46.5	217.9±50.2	162.2±52.3	$\mathbf{0.02 \times 10^{-46}}$**(<0.05) Significant**

Table 6: Shows the Mean ± SD value of parameters of patients at the time of admission according to GCS score after one month of discharge and statistical significance.

Mean ± SD Parameters (at the time of admission)	**GCS score after one month discharge**			**p-value & Statistical Significance**
	Mild	**Moderate**	**Severe**	
Albumin (g/dL)	3.7±0.7	3.2±0.7	2.7±0.5	$\mathbf{0.009 \times 10^{-21}}$**(<0.05) Significant**
Fibrinogen (g/L)	2.8±0.5	2.3±0.8	1.5±0.7	$\mathbf{0.03 \times 10^{-23}}$**(<0.05) Significant**
Transferrin (mg/dl)	221.9±45.8	203.2±55.8	147.8±45.1	$\mathbf{0.008 \times 10^{-32}}$**(<0.05) Significant**

Table 7: Shows the frequency (percentage) of patients in different GOS score after one month of discharge.

GOS score	**GOS score after one month of discharge**
GOS 1	13(3%)
GOS 2	22(5.1%)
GOS 3	147(33.8%)

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GOS 4	240(55.2%)
GOS 5	13(3%)
Grand Total	435(100%)

Table 8: Outcomes of head injury patients after discharge

Outcomes	After one month of discharge
Unfavourable	182(41.8%)
Favourable	253(58.2%)
Total	435(100%)

Table 8: The outcomes of the head injury patients after one month 182 (41.8%) head injury patients had unfavourable outcomes and 253(58.2%) patients had favourable outcomes after one month of discharge.

DISCUSSION

Head injury remains a critical health issue in our society. A head injury occurs when an external force or blow to the head disrupts brain function. This can lead to a reduced level of consciousness, memory loss before or after injury, alteration of mental status, neurologic deficits, or development of intracranial lesions.[5]

In the present study, we evaluated a total 435 patients with head injuries both males and females. Head injury patients were classified according to GCS score and we evaluated the association level of serum albumin, fibrinogen level in plasma, and Transferrin level in head injury patients.

The Mean ± SD values of serum albumin in 303 (69.7%) patients were 2.8 ± 0.4 g/dL and in 132 (30.3%) patients were 4.1 ± 0.5 g/dL and the overall mean ± SD albumin of total patients was 3.2 ± 0.7 g/dL. In the present study, we found that patients with severe head injury (GCS score 3-8) had decreased serum albumin level and the mortality was higher. 225 (51.7%) had severe GCS score 3-8 with decreased serum albumin levels (<3.5 g/dL), and fewer head injury patients 48 (11%) had severe GCS score 3-8 levels with increased serum albumin level (>3.5

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g/dL). We found statistically significant association between GCS score and serum albumin levels (p= 0.01).

Aguayo-Becerra OA et al.,[18] the study found serum albumin level at admission may be used as a sensitive and specific biomarker of burn severity patients and also an indicator of mortality in adult patients with burns.

Belayev L, et al.,[19] suggested that serum albumin levels significantly improve blood flow and re-establish the balance between oxygen supply and demand. It was also observed that serum Albumin levels are favourable therapeutic time windows allowing administration within a clinically feasible delay.

The mean ± SD values of plasma fibrinogen level in 172 (39.5%) head injury patients were 1.3 ± 0.3 g/L, and in 263 (60.5%) head injury patients were 2–4 g/L. We observed that the association between plasma Fibrinogen level and GCS score at the time of admission were out of 435 head injury patients 163(37.5%) had severe GCS score (3-8) and decreased fibrinogen level (<2 g/L) and few head injury patients had moderate GCS score (9-12) with decreased fibrinogen level (<2 g/L). We found statistically significant the association between GCS score and low level of fibrinogen.

The newer study showed that the relationship between fibrinogen levels at the time of admission and the probability of favourable outcome and mortality was not nonlinear but rather curvilinear. When fibrinogen was < 2.0 g/L, these levels were an independent prognostic factor for 3-month mortality. This is an accordance with **Ke Lv et al.**[20]

The association between transferrin level and GCS score at the time of admission 198(45.5%) had severe GCS score **(**3-8) and decreased transferrin level (<200 mg/dL) and fewer head injury patients had severe GCS score (3-8) with increased transferrin level (>300 mg/dL), and fewer head injury patients had moderate GCS score (9-12) with decreased transferrin level (<300 mg/dL). We found statistically significant association between GCS score and transferrin level (< 0.05).

Yang et al.,[21] study investigated the changes of serum iron and Tf in patients with ICH and demonstrated first both serum iron and Tf levels at day one (admission) in patients with poor outcomes were significantly lower than those in the patients with good outcomes as well as in the control.

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We found that serum albumin level, serum Transferrin and plasma fibrinogen at the time of admission were significantly decreased with severe GCS score (3-8) after one month of discharge than the GCS score moderate (9-12) and mild GCS score (13-15) after one month of discharge.

CONCLUSION

We conclude that a highly significant correlation at the time of admission severity of head injury patients (according to GCS score) had decreased values of serum albumin, transferrin, and plasma fibrinogen. Decreased levels of albumin, transferrin, and fibrinogen upon admission were highly significant impact on unfavourable outcomes (GOS 1-3) of head injury patients at the time of discharge, and one-month follow-up. Thus, the measurement of these biomarkers at the time of admission in patients with head injury will be highly helpful in predicting the prognosis

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