

# Correlation of Computed Tomography findings with Glasgow Coma Scale in patients with acute traumatic brain injury

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## ABSTRACT

### OBJECTIVE

To correlate Computed Tomography (CT) findings with Glasgow Coma Scale (GCS) in patients with acute traumatic brain injury attending in Chitwan Medical College teaching hospital Chitwan, Nepal.

### MATERIALS AND METHODS

A cross-sectional study was performed among 50 patients of acute (less than 24 hours) cases of craniocerebral trauma over a period of four months. The patient's level of consciousness (GCS) was determined and a brain CT scan without contrast media was performed. A sixth generation General Electric (GE) CT scan was utilized and 5mm and 10mm sections were obtained for infratentorial and supratentorial parts respectively.

### RESULT

The age range of the patients was 1 to 75 years (mean age  $35.6 \pm 21.516$  years) and male: female ratio was 3.1:1. The most common causes of head injury were road traffic accident (RTA) (60%), fall injury (20%), physical assault (12%) and pedestrian injuries (8%). The distribution of patients in accordance with consciousness level was found to be 54% with mild TBI (GCS score 12 to 14), 28% with moderate TBI (GCS score 11 to 8) and 18% with severe TBI (GCS score less than 7). The presence of mixed lesions and midline shift regardless of the underlying lesion on CT scan was accompanied by lower GCS.

### CONCLUSION

The presence of mixed lesions and midline shift regardless of the underlying lesion on CT scan were accompanied with lower GCS. Patients having single lesion had more GCS level than mixed level and mid line shift type of injury.

**Keywords:** Glasgow coma scale, traumatic brain injury.

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## INTRODUCTION

Trauma is a major health problem and is a leading cause of death in the age group 1 to 45 years. Head injuries cause or contribute to death in most trauma fatalities. Motor vehicle accidents (MVAs) are the leading cause of head injury followed by falls, assaults, firearm wounds and others.<sup>1, 2, 3</sup> Traumatic brain injury constitutes one of the main health problems worldwide, currently with a high and increasing incidence, representing an important cause of mortality among adolescents and young adults.

The invention of CT in 1973, revolutionized the management of patients with acute cranio-cerebral trauma.<sup>4,5</sup> The primary goal of imaging the trauma patient is to quickly and accurately identify treatable lesions before secondary injury to the brain occurs. CT is ideally suited to evaluate patients immediately after trauma. It is widely available, and rapid, permits close monitoring of unstable patients. It is very sensitive in detecting acute hematomas and depressed fractures that require emergency surgery.

The initial assessment of a patient with TBI includes the GCS, data regarding the accident and CT. It is essential to determine the cause of the trauma, the impact intensity, presence of neurological symptoms, convulsion, and particularly document any reports on loss of consciousness,<sup>6</sup> time elapsed between the accident and the examination, vomits and seizures.<sup>7</sup>

According to the GCS, traumatic brain injuries are classified as mild, moderate or severe. The GCS was initially described by Teasdale & Jennet in 1974, and is currently the most widely used parameter for assessment of consciousness level, as amongst its advantages, it comprises a set of very simple and easy-to-perform physical examinations.<sup>8</sup>

CT findings in TBI vary according to the trauma severity, that is, in accordance with the GCS score.

The relationship among types of brain lesions demonstrated in CT, type of TBI (severity of the lesion) and prognosis are described by several authors in the literature<sup>9,10</sup> all of them reporting approximately the same variation: the more severe the TBI is, more numerous and severe are the findings in CT.

Lower GCS and special CT scan findings including SAH, midline shift of more than 3 mm, and mass lesions are poor prognostic indicators after closed head injury.<sup>11</sup> This study was oriented to determine the mechanisms, severity, and CT scan findings of head trauma and to evaluate the relation between CT scan findings and level of consciousness.

## MATERIALS AND METHODS

It is a cross-sectional study conducted in the department of Radiology and Imaging, Chitwan Medical College (CMC) and Teaching Hospital, Bharatpur, Nepal. All cases that were referred for CT scan with acute cranio-cerebral trauma amongst the admitted patients at CMC from March to June, 2012 were studied. Known hypertensive and diabetic patients receiving anti-coagulant drugs, patients with known bleeding disorder and those with history of previous cerebro-vascular accident were excluded.

## STUDY METHOD

The patients were scanned using GE BRIGHT SPEED helical CT machine. It is sixth generation CT scanner, matrix size-512, and slice thickness-10 mm, 5mm, 3mm, 2mm and 1mm, having KV of 80 to 130 and mAs 50 to 340.

A complete clinical history of the patients was taken. The type of trauma was classified into road traffic accident, falls, assaults, and pedestrian injury. This was

followed by general physical examination and detailed examination of the central nervous system. Injuries involving the other systems of the body were also noted. After initial resuscitation, severity of cranio-cerebral trauma was graded with the help of GCS as follows:

Grades	Score
Normal	15
Mild head injury	12-14
Moderate head injury	8-11
Severe head injury	< 7

The patients were examined with CT scanner in the supine position having gantry tilt +/- 25 degree parallel to the scan plane to the orbito-meatal line. The scan range included base of skull to the vertex.

The data was analyzed by SPSS (Statistical Package for software analysis) version 17.0. The correlation between CT scan findings and the level of consciousness was evaluated using chi square test. Independent sample t test was used to study the number of lesions and presence of midline shift with mean GCS. P value <0.05 was regarded as significant.

## RESULTS

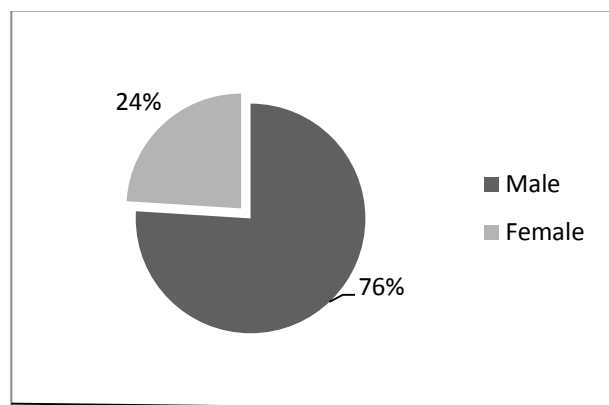


Fig. No. 1: Sex distribution of cases  
In the present study, as shown in figure 1, males were predominant comprising of

76 % cases and 24% females resulting male: female ratio of 3.1:1. The age and sex distribution of the cases is represented by table 2.

**TABLE 2: SEX AND AGE DISTRIBUTION OF CASES**

AGE (years)	MALE		FEMALE		TOTAL NO
	No	%	No	%	
0-10	5	13.16	4	33.34	9
11-20	5	13.16	0	00	5
21-30	3	7.89	1	8.33	4
31-40	9	23.69	1	8.33	10
41-50	10	26.32	3	25	13
51-60	2	5.26	0	00	2
61-70	2	5.26	2	16.67	4
> 70	2	5.26	1	8.33	3
TOTAL	38	100.00	12	100.00	50

**TABLE 3: INCIDENCE OF DIFFERENT MODES OF INJURY**

TYPE OF INJURY	NO.OF CASES	PERCENTAGE
RTA	30	60.00
Fall	10	20.00
Physical assault	06	12.00
Pedestrians	04	8.00
TOTAL	50	100.00

In our study, the commonest mode of injury was RTA in 60% cases, followed by falls in 20%, assaults in 12% and pedestrian injury in 8% (Table 3).

**Table No. 4: Grading of type of lesions based on GCS**

CT Findings	No	Mean GCS ±SD	P value
Single lesions	27	13.33 ±1.330	<0.001*
Multiple lesion	14	10.50 ± 1.990	<0.001*
Single lesion + Multiple lesion+ Midline Shift	9	6.22 ± 1.202	<0.001*

\* Highly significant at 95% CI

The mean GCS was compared with the cases with single and multiple lesions and, lesions with midline shift using independent samples t test. The mean GCS of the cases with single lesion was 13.33 ±1.330 and that of those with multiple lesions was 10.50 ± 1.990. Their mean GCS was statistically significant (p value <0.001).

The mean GCS of the cases with multiple lesions and those with multiple lesions with midline shift (mean ± SD of 6.22 ± 1.202) was also statistically significant (p value <0.001).

While analysing the type of lesion within association of GCS score, it was revealed that

- (a) Multiple lesions have lower GCS score than single lesion.
- (b) Midline shift + multiple lesions have lower GCS score than single lesion and multiple lesion.

**Table No. 5: Grading of head injury based on GCS score**

Type of head injury	GCS	No.of cases	Percentage
MILD	12-14	27	54%
MODERATE	8-11	14	28%
SEVERE	<7	9	18%
TOTAL		50	100%

According to the GCS grading, there were 54 % mild head injury cases, 28 % moderate cases and 18% severe cases (Table 6).

## DISCUSSION

Early and precise determination of cranio-cerebral lesions in acute head trauma is of great importance because of the high mortality caused by these lesions and the fact that early diagnosis and treatment will significantly reduce the complications. CT scan is now the primary modality for evaluation of patients with acute head trauma. An important factor in decision making about the initial treatment and long term complications is the initial GCS of patients.

It is universally noted that the cranio-cerebral trauma is more frequent in the males Male predominance varies from 81% in England, to as low as 59% in the United States as reported by Kalsbeek and associates.<sup>12</sup> Male predominance was also seen in the present study where Male: Female ratio was 3.1:1.

Head injuries are more frequent in the younger age group in the United States. The incidence of head injury in 0-20 age group was 30%, 20-40 years was 60% and above 40 years was 10%.<sup>12</sup> In the present study also the incidence of cranio-cerebral trauma was highest in the age group 41-50 which was 26% .

According to Lindell,<sup>1</sup> the incidence of RTA was 20-50%. But in the present study it was found that the incidence of RTA was high i.e.60%. This can be attributed to the reason that participants in this study live in close proximity to the National Highway and due to rapid urbanization in this area there is an increase in the number of vehicles and population leading to more movement of people.

CT scan findings and their correlation with GCS scores is especially important in treatable lesions like mass effects, brain herniation etc. These secondary lesions can cause significant morbidity and mortality.

In the present study, low GCS scores were considered as a severity risk factor in association with a greater number of tomographic findings. Patients with TBI and low GCS scores are affected by cerebral injuries with more devastating effects and present with a tendency for hemodynamic instability as observed in other studies.

Patients having mixed lesions and midline shift had low GCS score than the patients having single lesion. Mild head injury patients have 12 to 14 GCS score, moderate head injury patients 8 to 11 and severe head injury patients less than 7. So, we conclude that severe the head injury lowers the Glassgow Coma Scale.

## **CONCLUSION**

The presence of mixed lesions and midline shift regardless of the background lesions was significantly related to decrease in GCS score in patients. More severe the head injury lesser the GCS score.

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