

Original Research Article

Correlation of Glasgow Coma Scale with Non-Contrast Computed Tomography findings in immediate post traumatic brain injury

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ABSTRACT

Background: This study was undertaken to correlate Glasgow Coma Scale (GCS) score with Non-Contrast Computed Tomography (NCCT) findings in patients with acute traumatic brain injury (TBI) attending tertiary care Shree Narayana Hospital, Raipur, Chhattisgarh, India.

Methods: A cross-sectional study was performed among 100 patients of acute traumatic head injury (those presenting to hospital within 24 hours of injury) over a period of six months. The patient's GCS score was determined and NCCT Brain scan was performed in each case immediately (within 30 minutes) after presenting to casualty of the hospital. A 16 slice siemens Somatom CT scan was utilized and 5mm and 10mm sections were obtained for infratentorial and supratentorial parts respectively.

Results: The age range of the patients was 0 to 76 years and male: female ratio was 2.85:1. Younger age group was more commonly involved, with 61% of cases seen in 11-40 years of age group. The most common causes of head injury were road traffic accident (RTA) (65%) and fall from height (25%). The distribution of patients in accordance with GCS was found to be 55% with mild TBI (GCS 12 to 14), 25% with moderate TBI (GCS 11 to 8) and 20% with severe TBI (GCS 7 or less).

Conclusions: The presence of multiple lesions and midline shift on CT scan were accompanied with lower GCS, whereas patients having single lesion had more GCS level. There was significant correlation between GCS and NCCT findings in immediate post TBI.

Keywords: GCS, NCCT findings, Traumatic brain injury

INTRODUCTION

Traumatic brain injury (TBI) is one of the leading causes of death in the younger age group (below 40 years) and constitutes one of major health problem. Road traffic accidents (RTA) are the leading cause of head injury followed by fall from height, physical assaults, firearm wounds and others.¹⁻³ Incidence of traumatic brain injury is high and having increasing trend worldwide, with high mortality among adolescents and young adults.

The invention of CT in 1973, revolutionized the management of patients with acute cranio-cerebral trauma.^{4,5} The primary goal of imaging the trauma patient is to identify treatable lesions by surgery before secondary injury to the brain occurs. CT is ideally suited to evaluate patients immediately after trauma due to its wide availability, rapid scan time, and allowing close monitoring of unstable patients. NCCT is highly sensitive in detecting acute hematomas (EDH, SDH, SAH, IVH, Brain contusions etc.) and depressed fractures that require emergency surgery. All patients with TBI are initially

assessed by GCS, data regarding the accident and NCCT wherever required. Clinically significant information includes determining the cause of trauma, the impact intensity, vitals, presence of neurological symptoms, loss of consciousness, time elapsed between the accident and the examination, vomits and seizures.^{6,7} Traumatic brain injuries are classified as mild, moderate or severe according to GCS. Initially described by Teasdale and Jennet in 1974, GCS is currently the most widely used parameter for assessment of consciousness level, as it comprises a set of very simple and easy to perform physical examinations.⁸ 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 all of them reporting approximately the same variation: the more severe the TBI is, more numerous and severe are the findings in CT.^{9,10} Lower GCS and special CT scan findings including SAH, midline shift of more than 3 mm, and multiple hemorrhagic contusions are poor prognostic indicators after closed head injury.¹¹ This study was oriented to evaluate the relation between CT scan findings in acute traumatic brain injury and GCS.

METHODS

A cross-sectional study conducted in the Department of Radiology and Imaging, Shree Narayana Hospital, Raipur, Chhattisgarh, India. All cases that were referred for CT scan with acute head injury amongst the admitted patients from June to November 2018 were studied.

Exclusion criteria

- Known hypertensive and diabetic patients receiving anti-coagulant drugs, patients with known bleeding disorder and those with history of previous cerebrovascular accident were excluded.

The patients were scanned using Siemens somatom 16 slice helical CT scan machine. It is sixth generation CT scanner with parameters of matrix size-512, and slice thickness-10 mm, 5 mm, 3 mm, 2 mm and 1mm, having KV of 80 to 130 and m as 50 to 340. A complete clinical history of the patients was taken. The type of trauma was classified into road traffic accident, fall from height, physical assaults, and others (pedestrian injury). This was followed by general physical examination and detailed examination of the central nervous system. Injuries involving 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:

- Mild- 12 to15,
- Moderate- 8to11,
- Severe- 7 or less.

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.

Statistical analysis

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

Traumatic brain injury was found to be much more common in males in this study with 74% cases involving males as compared to 26% in females, as described in (Table 1).

Table 1: Age and sex distribution of cases.

Age (years)	Male	Male (%)	Female	Female (%)	Total	Total (%)
0-10	6	6	2	2	8	8
11-20	12	12	3	3	15	15
21-30	21	21	7	7	28	28
31-40	13	13	5	5	18	18
41-50	9	9	3	3	12	12
51-60	6	6	3	3	09	09
61-70	5	5	2	2	07	07
Above 70	2	2	1	1	03	03
Total	74	74	26	26	100	100

Younger age groups were comparatively more affected in this study, with almost 28% cases in 21-30 years age

group, followed by 18% in 31-40 years and 15% in 11-20 years age group. There was decrease in number of cases

with increasing age in all age group above 40 years of age (Table 1). In present study, the most common mode of injury was RTA in 65% cases, followed by falls from height in 25%, physical assaults in 8% and others (pedestrian injury) in 2% (Table 2).

Table 2: Incidence of different modes of injury.

Type of injury	Number of cases	Percentage
RTA (Road traffic accident)	65	65
Fall from height	25	25
Physical assault	8	8
Others	02	2
Total	100	100

According to GCS, (immediately recorded after presenting to casualty of hospital) 55% cases were mild TBI, 25% were moderate TBI and 20% cases were severe TBI (Table 3).

Table 3: Grading of head injury based on GCS score.

Type of head injury	GCS	No. of cases	Percentage
Mild	12-15	55	55
Moderate	08-11	25	25
Severe	Less than 8	20	20
Total	-	100	100

Finally, GCS score was correlated with CT findings and was found to have significant P value of less than 0.001 in each case (Table 4) and thus clearly suggesting that higher the GCS score, lesser the number of lesions in NCCT and lesser or absent midline shift.

Table 4: Grading of type of lesions based on GCS.

CT findings	N	Mean GCS±SD	P value
Single lesion	55	13.2±1.41	Less than 0.001*
Multiple lesions	25	10.3±1.85	Less than 0.001*
Single or multiple lesion with midline shift	20	5.9±1.78	Less than 0.001*

*Highly significant at 95%CI

Lower GCS score (7 or less) was strongly correlated with multiple NCCT brain lesions and midline shift of more than 5mm. Multiple brain lesions included EDH, SDH, SAH, intraventricular hemorrhage, hemorrhagic contusion, diffuse cerebral edema, depressed fracture, brain herniation, diffuse cerebral edema etc.

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. GCS (Glasgow Coma Scale score) from Scottish Intercollegiate Guideline Network (SIGN) 2000 was found to have a predictive factor of outcome following statistical analysis.¹² Mortality correlates with the severity of injury based on the GCS score.^{13,14} GCS score has been found to be a good indicator of outcome in many other studies including a local study by Selladurai BM et al, which showed that over 95% of patients with a score of 4 or less are likely to have a poor outcome compared with those with a score of 8 or a more.¹⁵

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.³ Male predominance was also seen in the present study where Male: Female ratio was 2.85:1. 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%.³ In the present study also the incidence of cranio-cerebral trauma was highest in the age group 11-40 which was 61%. But in the present study it was found that the incidence of RTA was high i.e. 65%. 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.

The Marshall CT score was published in 1992 and proved to correlate the presence of intracranial abnormalities on CT with intracranial pressure (ICP) and outcome.¹⁶ The Rotterdam score is a more recent classification system which allows single CT abnormalities to be scored separately and includes two additional parameters: traumatic subarachnoid haemorrhage and intraventricular haemorrhage.¹⁷ Another classification scheme is the Helsinki CT score, which considers bleeding type and size, intraventricular haemorrhage and suprasellar cisterns.¹⁸ CT scan findings and their correlation with GCS scores is especially important in treatable lesions like EDH, cerebral edema, mass effects, midline shift, brain herniation etc. The secondary lesions can cause significant morbidity and mortality. Kido et al, also showed a significant relationship existed between lesion size and GCS, the larger lesion correlating with lower GCS scores (p = 0.02).¹⁹ In the present study, low GCS scores were considered as a severity risk factor in association with a greater number of CT findings. Lobato et al, study pointed out that the type of lesion is an important factor in determining the outcome as the severity of injury assessed by GCS.²⁰ Patients with severe 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. Yamaura et al, noted a higher mortality when SDH was associated with the presence of parenchyma lesion.²¹ Patients having multiple brain lesions and midline shift had low GCS score than the patients having single lesion. Mild head injury patients have 12 to 15 GCS score, moderate head injury patients 8 to 11 and severe head injury patients less than 8. So, authors conclude lower the Glasgow Coma Scale, more severe were the TBI and more brain lesions were found in NCCT.

CONCLUSION

The presence of multiple lesions and midline shift in NCCT was significantly related to lesser GCS. More severe the head injury, lesser the GCS score. Multiple brain lesions in NCCT included EDH, SDH, SAH, intraventricular hemorrhage, hemorrhagic contusions, diffuse cerebral edema, depressed fracture, brain herniation, diffuse cerebral edema etc. The present study concluded that there was significant correlation between GCS and NCCT findings in immediate post TBI.

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