Association of the Presenting Glasgow Coma Scale in patients who requires ICU admission or operative intervention following traumatic brain injury with the Marshall computed tomography (CT) classification of traumatic brain injury

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ABSTRACT

BACKGROUND Glasgow coma scale (GCS) and Marshall computed tomography classification of traumatic brain injury can predict the severity of the brain injury in patients following trauma. This study aims to analyse the association between two, in patients who required ICU admission or neurosurgical intervention following trauma.

METHODOLOGY Retrospective study of 64 patients who underwent ICU admission or neurosurgical intervention following traumatic brain injury from September 2017 to December 2020 in Nepal Mediciti Hospital. Majority of the mild head injury where CT scan was not performed, discharged from the emergency or did not need ICU admission or admitted in ward for observation, severe polytrauma were excluded from the study. Glasgow coma Scale was categorized into mild (13-15), moderate (9-12) and severe (<8).The Marshall CT scan Grade was dichotomized into (1-3) and (4-6).

RESULTS Out 64 patients, majority were male 48 (84.4%), mean age 42.33 (SD±16.16).In admitted patients, 48.4 %(GCS< 8), 39.1% (GCS 9-12), 12.5% (GCS 13-15).The higher marshal grade (4-6) was present in 93.54 %(<8), 48% (9-12), 25% (13-15). There was significant association of the GCS with the Marshall Ctsacn grade (p=0.00).

CONCLUSION

There is significant association between the presenting GCS and Marshall CT Scan grade following TBI .The more severe patients with decreasing GCS have higher Marshall CT Scan grade in CTscan of the brain .

Key words: Marshall Grade, Glasgow coma scale, correlation

BACKGROUND

Glasgow coma scale (GCS) is commonly used to calculate patient's level of consciousness using triple scoring system with giving total score 3-15 and is invaluable in clinical assessment though greater training needed to ensure reliability. [1, 2, 3] It is not always possible to elicit GCS in TBI patient as may be intoxicated, sedated or intubated. [4- 6]Therefore, morphological classification based on CT scan could be alternative in this kind of patients and gold standard, though MRI Brain may be more sensitive for detecting small white matter lesion in later phase. [7, 8] The Marshall classification of traumatic brain injury grading system based on CT scan findings uses important prognostic independent variables; including the state of the cisterna ambiens, midline shift and the presence of local lesions, to categorize patients into six different groups which can predict outcome. [9]Different studies have shown correlation of the CT scan grade with the Glasgow Coma Scale (GCS) in the patients presenting with head injury. [10, 11] This study aims to analyse the association between the presenting Glasgow Coma Scale (GCS) of the patients with the Marshall computed tomography (CT) classification of traumatic brain injury in patients who presented in emergency with head injury and either admitted in ICU or underwent neurosurgical intervention.

METHODOLOGY

This was a retrospective analysis of 64 patients who presented in the emergency department with the history of head injury in Nepal Mediciti Hospital from 2017 sept to December 2020. Majority of the mild head injury where CT scan was not performed, discharged from the emergency or did not need ICU admission or admitted in

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ward for observation, severe polytrauma were excluded from the study. The data was collected from the medical records and entered in proforma after authorization from the institutional review committee (IRC). The Marshall computed tomography (CT) classification of traumatic brain injury (Table.1) was dichotomized into two groups (1-3) and (4-6).The GCS in the patients were categorized as mild head injury (13-15), moderate (9-12) and severe (<8). The association between the variables of Marshall CT grade and GCS will be analysed (Table.2).

Statistical analysis was done by SPSS (25) for windows using chi-square .The type 1 error was set as p=0.05

RESULTS

Patient's characteristics

There were total 64 patients included for the study, Male 48 (75%), Female 16 (25%) with mean age 42.33 (SD±16.16), 37 (57.8%) were < 45 years of age.

RTA 54 (84.4%), Fall 7 (10.9%) and Physical assault 3 (4.7%).

Type of head injury

Out of 64 patients, 31 (48.4%) had Severe head injury, 25 (39.1%) had moderate head injury and 8 (12.5%) had mild head injury, presented in (Bar diagram.1).

CT scan Grades (Marshall computed tomography (CT) classification of traumatic brain injury)

Out of 64 patients, 21(32.81%) had Marshall Grade of (1-3) and 43(67.18%) patients had Marshall Grade (4-6)

Outcome

The majority of the patients 48.4% admitted had severe head injury with GCS <8,39.1% (GCS 9-12) and 12.5%(GCS13-15).The higher Marshal grade in CT scan were present in (93.54%) patients with severe head injury (<8),48% (9-12) and 25%(13-15).

There was significant association of the Presenting GCS of the patient presenting with head injury with the Marshall computed tomography (CT) classification of traumatic brain injury (p=0.00).

DISCUSSION

TBI is a major cause of death in young adults and majority of the patients suffer physical and psychological disabilities following head injury. [12] Around 80% of the patient following TBI have mild head injury, 10% moderate and only 10% of the patients suffer severe head injury.[13] However, majority of the patients requiring hospital admission or neurosurgical intervention are severe head injury ,moderate head injury and sometimes the patients with mild head injury may require hospital admission . The majority of the patients in our series had TBI following RTA 54 (84.4%), fall from height 7 (10.9%) and physical assault 3(4.7%).Head injury is usually more common in young productive age and male group. There were 48 (75%) male in our series with 37 (57.8%) below the age of 45.There were 31 (48.4%) patients with severe head injury, 25(39.1%) moderate head injury and 8 (12.5%) mild head injury patients who required ICU admission or surgery following head trauma.

The GCS provides a clinically based comprehensive framework to assess verbal, visual and motor response which may help to predict the extent of neural impairment and severity of injury. [14, 15] Though GCS is valid tool to assess the patient clinically following TBI, it is not always possible to evaluate the patients following trauma as they may be intoxicated, in shock, require early sedation, intubation .This may have individual variation, much experience and knowledge is must.

Therefore radiological diagnosis always adds adjunct to the clinical findings especially in case of TBI which can describe the morphological severity of the TBI. The radiological diagnosis besides the therapeutic implications in the further management of the patients helps to predict severity and prognosis. The CT scan of brain has always been a radiological investigation of choice following trauma in patients presenting with suspected TBI. [16]However, MRI may be more preferable for further diagnosis later in the course of treatment. According to the Canadian CT Head Rule (CCHR) the high risk groups with GCS score <15 at 2 hours after injury, suspected open or depressed skull fracture, sign of basal skull fracture, vomiting > 2episoded, age> 65years have to evaluated. [17]The patients with mild head injury with abnormal CT scan with contusions, extra-dural hematoma and subdural hematoma may have neurological deterioration, progression of existing lesion or appearance of new lesion in repeat CT scan. [19]Therefore may need ICU admission for further observation and management. The Marshall computed tomography (CT) classification of traumatic brain injury is valid tool to assess the grade of severity. The patients with higher grades are more severe and at higher risk of morbidity and mortality.

GCS of the patients may correlate with the extent of head injury evident on CT scan of the brain .Usually the patients with decreasing GCS may have higher Marshall grades in CT scan of the brain. [10,11] There was significant association of the GCS with Marshall grades of CT scan in our series(p=0.00).Out of 31 patients with severe head injury (GCS <8) ,29 (93.54%) patients had marshall grade (4-6) and only 2 patient had Marshall grade (1-2).Out of 25 patients with moderate head injury (GCS 9-12) ,12 (48%)patients had Marshall Grade (4-6) and 13 had Marshall grade (1-2).Out of 8 patients with mild head injury (GCS 13-15) only

2(25%) Patients had Marshall Grade (4-6) and 6 patients had Marshall grade (1-3).The patients with decreasing GCS had higher Marshall grades in the CT scan .The severity of the injury assessed clinically with GCS was correlated with grades of the radiological grading in CT scan of the brain following the trauma who needed ICU admission or neurosurgical intervention . This association of the GCS with marshall CT scan grade for traumatic brain injury is very important tool for all neurosurgeon as traumatic brain injury is very common in every part of the world. This may help early detection of the high risk cases, prognosticate, early diagnosis and intervention in TBI cases.

Limitation of the study

This was the retrospective study , single centered, GCS was evaluated by the trained personnel ,however individual variation could exist .Therefore ,multi centered ,RCT may be needed to stablish the findings.

CONCLUSION

Clinical grade GCS correlates with the Marshall computed tomography (CT) classification of traumatic brain injury in patients presenting with trauma and requiring ICU admission or neurosurgical intervention. Higher Marshall CT Scan grade (4-6) is observed in more severe injury with with deceasing GCS,whereas Lower Marshall CT Scan grades(1-3) is observed more in patients with more higher GCS.

Table .1 The Marshall computed tomography (CT) classification of traumatic brain injury

Category	Defination
Diffuse injury I	No visible intracranial pathology seen on CT scan
Diffuse injury II	Cisterns present with midline shift of 0 – 5 mm and/or lesion densities present; no high or mixed density lesion > 25 cm3; may include bone fragments and foreign bodies
Diffuse injury III (swelling)	Cisterns compressed or absent with midline shift of 0 – 5 mm; no high or mixed density lesion > 25 cm3
Diffuse injury IV (shift)	Midline shift > 5 mm; no high or mixed density lesion > 25 cm3
Evacuated mass lesion (V)	Any lesion surgically evacuated
Non-evacuated mass lesion (VI)	High or mixed density lesion > 25 cm3 not surgically evacuated

Table .2 Correlation of presenting GCS with Marshall Grade

GCS	Marshall Grade	Total	P Value
	1-3	4-6	
<8 (severe head injury)	2	29	31
9-12 (moderate Head injury)	13	12	25
13-15 (mild head injury)	6	2	8
Total	21	43	64

0.000

Disclosure statement

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