

GCS score and MRI grading does not predicts the outcome in dai patients - a prospective study

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Abstract: Diffuse axonal injury (DAI) is a type of brain injury due to extensive lesions in white matter tract occurring over a wide area. It is one of the most common and devastating types of traumatic brain injury and major cause of unconsciousness and persistent vegetative state after head trauma. DAI occurs in about half of all cases of severe head trauma. The study was undertaken to correlate the GCS at time of admission and Grade of DAI with the outcome. *Aim:* - To correlate GCS Score and MRI grading with the outcome in DAI patients. *Setting and Design:* - A 3 months prospective study was conducted in Department of Neurosurgery. *Material and Method:* - Sources of Data: - Patients admitted with clinical diagnosis of Diffuse Axonal Injury under Department of Neurosurgery. Sample size: - 50 cases of Diffuse Axonal Injury. Inclusion Criteria: - All traumatic DAI Patients requiring ICU care. Exclusion Criteria: - Head injury patients requiring Surgery. Patients other findings on imaging as contusion, EDH, SDH, IVH. Patients with Sepsis. Patients with other co morbid Illness as DM, Hypertension. Patients who were haemodynamically unstable at the time of admission. Patients with other systemic injuries. *Statistical Analysis.* Data so collected was analysed using IBM SPSS Statistics Windows, version 20.0 (Armonk, NY: IBM Corp) for the generation of descriptive and inferential statistics. The statistical significant difference among age groups was determined by Chi square test and one way analyses of variance. The level of significance was set at $p < 0.05$. *Results:* Distribution of patients according to Gender and MRI Grading shown in Table 1. Total 50 patients were evaluated out of which 38 (76%) were male and 12 (24%) were female. Number of patients according to Grading [Table 2 and Fig. 1] Out of 50 patients admitted 10% (5) constitutes Grade 1 DAI, 28% (14) grade II, and 62% (31) Grade III. Grades of DAI according to age of patients [Table 3]. Mean age in Grade I patients was

20.83±3.63, Grade II 23.36±7.089 and in Grade III 22.32±11.38. Comparisons of Mean ICU stay Mean Hospital stay and Mortality in Different GCS Groups [Table 4]. In patients with GCS 3-8 the mean ICU stay was 18.48±14.53, mean hospital stay was 37.24±12.31 and Mortality was 15.21%, in patients with GCS 9-12, mean ICU stay was 10.5±4.12, Hospital stay 19.4±5.79 and mortality was 25%. Comparison of Mean ICU stay, and Ventilator stay in different MRI Grade [Table 5]. In patients with Grade I DAI Mean ICU stay was 17.13±14.65 and Mean Ventilator stay was 6.24±2.57, In Grade II DAI mean ICU stay was 20.57±15.45 and Ventilator stay was 12.01±3.82 and in Grade III mean ICU stay was 23.4±15.41 and mean Ventilator stay was 10.89±2.58. Mortality of patients in different Grades and GCS groups [Table 6 and Fig 2] In patients with GCS 9-12 and Grade III only 1 patient died, while in patients with GCS 3-8 total 7 died, 2 in Grade I, 2 in Grade II and 3 in Grade III. Complications [Table 7] Out of 5 patients in Grade I, electrolyte imbalance was seen in 1 patient in the form of hypernatraemia, 1 patient developed seizure, and septicaemia was seen in 1 and 1 patient developed shock. In patients with Grade II DAI out of 14 patients 1 had ventilator associated pneumonia, hypernatraemia was seen in 1, 1 patient developed bed sore, seizures seen in 3, 2 had septicaemia & shock was seen in 2, and in 1 drug reaction occurred. Out of 31 patients with Grade III DAI 2 developed ventilator associated pneumonia, hypernatraemia and hyponatraemia was seen in 2 & 1 patient respectively, 2 developed bed sore, seizure in 1 and septicaemia and shock was seen in 3-3 patients. *Conclusion*:-Diffuse axonal injury is a very common finding in traumatic head injury patients. Magnetic resonance imaging and GCS scoring does not have appropriate prognostic value in pure DAI patients and a better survival rate can be achieved with dedicated neurocritical care and neurosurgical management

Key words: DAI, ICU Stay, GCS, MRI.

Introduction

Head injury includes injury to brain and other parts of head as scalp, skull and can be of open or closed types. Closed head injuries causes two major types of traumatic brain injury – Focal brain injury and Diffuse axonal injury. In focal brain injury, Orbitofrontal cortex, ventromedial prefrontal cortex and temporal pole are frequently damage because of shape of skull base. [1] DAI is one of the

most common pathology of traumatic brain injury, occurring in both mild and severe cases and is one of the major causes of traumatic brain injury leading to coma. [2] It occurs most often in RTA, fall or assaults in which strong inertial force causes axons to loose their normal elasticity and become brittle. [3] DAI occurs in 40-50% of traumatic brain Injury. [4]

In DAI, subcortical neuronal damage results from stretching and shearing of axons as brain moves inside skull. Histopathologically DAI is characterized by Wallerian type axonal degeneration in parasagittal white matter, corpus callosum and dorsal upper brainstem due to shearing forces by acceleration, deceleration or rotation of brain. [5] In DAI brain damage was thought to occur diffusely in white matter [6] while the effect on Grey matter or whole brain is poorly understood. Diffuse degeneration of cerebral white matter was first defined by Strich in a study of patients with severe post- traumatic dementia in 1956. [7] The time course of pathological changes were established by Adams et al. [8] Diffuse axonal injury can be diagnosed using clinical signs and radiological evidence. Brain Magnetic Resonance Imaging (MRI) is the most sensitive method to diagnose diffuse axonal injury, especially in gradient echo image. [9, 10, 11]

Method of Collection of data

After taking detailed history all patients were examined and investigated. Severity of head injury was assessed via modified Glasgow Coma Score and MRI brain. According to GCS head injury is classified as mild having GCS 14-15, moderate 9-13, and severe with GCS less than 8. We divided patients into three groups according to grade of MRI finding according to classification proposed by Adams.

Grade 1. Involves grey-white matter interface, most commonly parasagittal regions of frontal lobes, periventricular temporal lobes, less commonly: parietal and occipital lobes, internal and external capsules and cerebellum.

Grade 2. Involves corpus callosum in addition to stage 1 locations, most commonly: posterior body and splenium but does advance anteriorly with increasing severity of injury

Grade 3. Involves brainstem in addition to stage 1 and 2 locations most commonly: rostral midbrain, superior cerebellar peduncles, medial lemniscus, and corticospinal tracts.

Table 1

MRI grading	Male	Female	Chi square	P-Value
Grade 1	5(10%)	-		
Grade 2	11(22%)	3(6%)	0.57	0.751
Grade 3	22(44%)	9(18%)		

Table 2

Grade I	10% (5 patients)
Grade II	28% (14 Patients)
Grade III	62% (31 Patients)

Table 3

MRI Grading	Age Group (Mean +SD)	Anova test	P-Value
Grade I	20.83±3.63		
Grade II	23.36±7.089	0.1317	0.8769
Grade III	22.32±11.38		

Table 4

GCS Groups	ICU stay	Hospital stay	Mortality
3-8	18.48±14.53	37.24±12.31	7(15.21%)
9-12	10.5±4.12	19.4±5.79	1(25%)
Anova, P-Value	1.17,0.283	8.12,0.006	

Table 5

MRI Grading	ICU stay(mean±SD)	Ventilator stay(Mean ±SD)
Grade I	17.13±14.65	6.24±2.57
Grade II	20.57±15.45	12.01±3.82
Grade III	23.4±15.41	10.89±2.58
Anova test,P-Value	0.4408,0.6461	<0.01

Table 6

MRI grading	GCS	Mortality	GCS	Mortality
Grade I	9-12	-	3-8(5)	2
Grade II	9-12(2)	-	3-8(12)	2
Grade III	9-12(2)	1	3-8(29)	3

Table 7

MRI Grading	VAP	Hypernatremia	Hyponatremia	Bedsore	Seizure	Septicemia	Shock	Drug Reaction
I	-	1	-	1	1	1	1	-
II	1	1	-	1	3	2	2	1
III	2	2	1	2	1	3	3	-

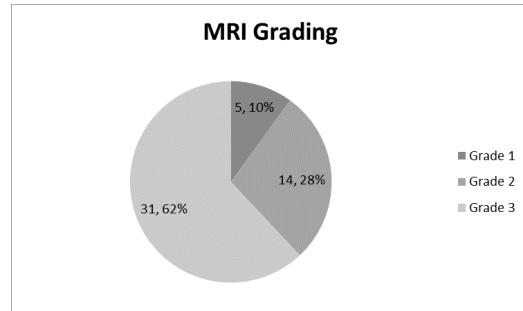


Figure 1

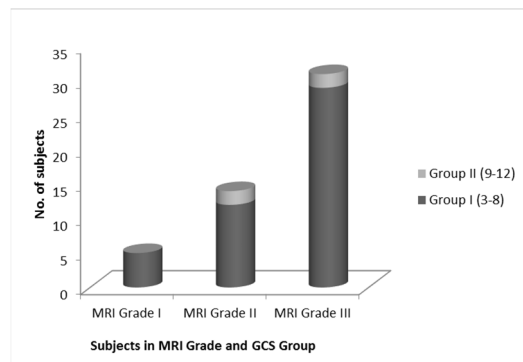
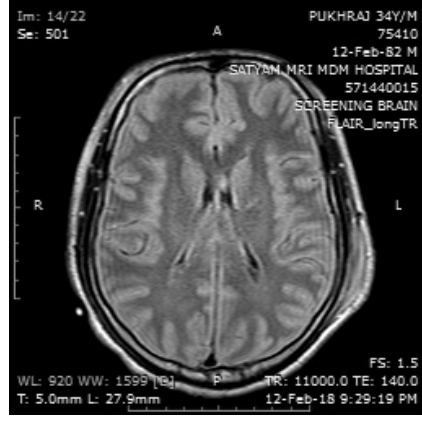
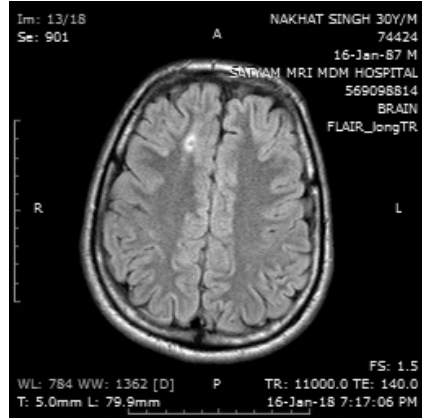
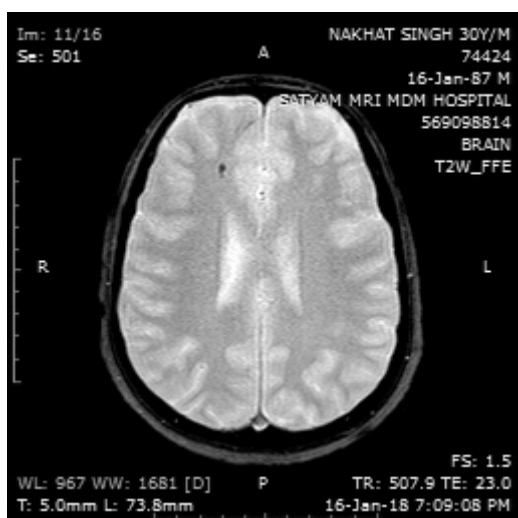
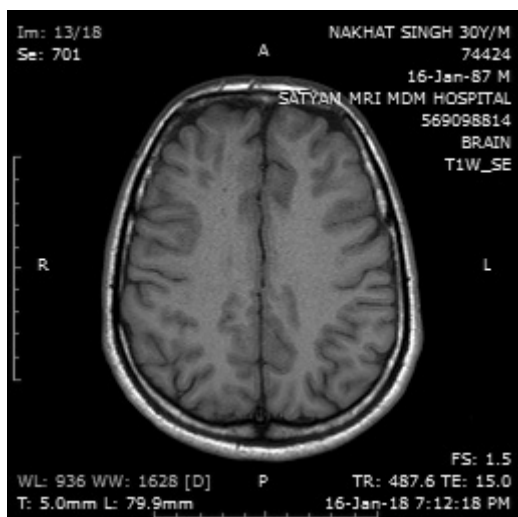


Figure 2





Discussion

Diffuse axonal injury (i.e., widespread damage to axons in white matter of brain) is well recognized severe posttraumatic head injury. [12] It is defined as prolonged post traumatic coma following injury without demonstrable intracranial mass lesion. [13, 14, 15] In 1956, Strich [7] defined the “diffuse

degeneration of cerebral white matter” in a series of patients with severe post-traumatic dementia diffuse axonal injury is caused by acceleration-deceleration effects of mechanical input to head on shaking of brain within skull.[14,15] This results in shearing or stretching of nerve fibres with consequential axonal damage. Mostly, this injury mechanism is caused by traffic accidents producing comparatively prolonged acceleration and is dependent on Direction, Magnitude and speed of head motion during injury. Diffuse axonal injury readily occurs in coronal acceleration of head and occasionally in sagittal or oblique direction. [16] In mild head injury lesions are localized to fronto-temporal cerebral white matter and stronger rotatory acceleration causes additional lesions in corpus callosum and brain stem. Gannarelli et al [16] reported severe head injury has a tendency to cause deeper lesions. Adam et al established pathological changes in due time course [8].In humans, instantaneous injury occurs to numerous axons in white matter of brain manifested by axonal retraction balls visible on microscopic examination. Gross lesion associated with severe diffuse axonal injury in humans consist of haemorrhagic tears in corpus callosum and dorsolateral quadrant or rostral brain stem. Several days later, microglial clusters appear and axonal retraction balls start to disappear. Months later bulk of white matter is reduced and long tract degeneration is seen. [16]

Diffuse axonal injury can be diagnosed clinically (level of consciousness and neurological deficits) and radiological findings. Zimmerman[17] reported first study

of radiological diagnosis of diffuse axonal injury that includes small hemorrhagic lesion on corpus callosum, upper brainstem, corticomedullary junction, parasagittal area and basal Ganglia. Brain computed Tomography findings lack accuracy in prediction of patients outcome and do not correspond well to patient's GCS score or neurological state[10,18].

Brain MRI gradient echo imaging is far more sensitive than spin echo imaging on paramagnetic lesion such as hemorrhage or calcification for a long time, and is considered most sensitive for conforming presence of small hemorrhagic lesion in white matter, corpus callosum, and brain stem in diffuse axonal injury.[9,10,11]

As the studies done by Gannarelli.T.A et al, R.kalff et al, and Levati et al shows that patients presenting with low GCS have poorer outcome but in our study in patients with GCS less than 8 the mortality was only 15% (7 out of 46) and in patients with GCS more than 8 the mortality was 25% (1 out of 4).

Oh.et.al and Kim et al reported worse outcome in patients with Grade II and III DAI, but in our study in patients with Grade I DAI mortality was 40% (2 out of 5) in Grade II DAI mortality was 14.21% (2 out of 14) and in patients with Grade III DAI mortality was 12.9% (4 out of 31) Better outcome seen our study can be due to early referral of patients, better neurocritical care, early tracheostomy, early recognition of complications and its management.

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