Clinico-radiological and Demographic Profile of Diffuse Axonal Injury Cases in Tertiary Care Hospital in Gwalior Region

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ABSTRACT

Introduction: Diffuse axonal injury refers to head trauma which is associated with loss of consciousness for more than 6 hours, but is not due to space occupying lesions or ischemic insults and is not associated with a lucid interval. Aim of present study is to find out the clinico-radiological and demographic profile of Diffuse Axonal Injury cases in tertiary care hospital.

Material and methods: This study was carried out on 35 cases of diffuse axonal injury in Neurosurgery department of Medical College Hospital, Gwalior from July 2006 to March 2008. A subgroup of patients with moderate and severe head injury and discrepancy between the apparently normal CT scan findings and their neurologic status were studied with MRI.

Results: In present study, maximum cases of DAI were recorded in age group of 20-40 years. The commonest mode of injury was road traffic accident followed by fall from height. Most of the DAI victims belonged to severe head injury group (GCS<8). Majority (54.29%) of CT presentation of DAI cases was apparently normal scan. Most common associated findings in DAI were SAH and forniceal injury.

Conclusions: Even normal CT scans have reported in 50-80% cases of DAI. MRI has been found to be much more sensitive in detection and classification of lesions of DAI.

Keywords: Diffuse Axonal Injury, Clinico-radiological, Demographic, CT Scan, MRI.

INTRODUCTION

Diffuse axonal injury (DAI) is considered major cause of unconsciousness, profound neurologic deficits and persistent vegetative state after head injury.[1] DAI causes significant medical problems because of the high morbidity of the patient, thereby causing considerable stress to patient's family members when patient is in a persistent vegetative state, resulting in financial burden to the patient's family and to the society.

Unlike brain trauma that occurs due to direct impact and deformation of brain, DAI is the result of traumatic shearing forces that occurs when the head is rapidly accelerated or decelerated, as occur in vehicle accidents, falls and assaults.[2] It usually results from twisting of rotational forces rather than forward and back impacts linear momentum.[3,4] DAI is a frequent cause of persistent vegetative state in head injury patients.

Patient typically has several focal white matter lesions of variable size (1-15 mm) in a characteristic distribution. Areas most vulnerable to injury are the frontal and temporal lobes.[5] These areas may be more easily damaged because of the difference in density between them and the rest of the brain.[6]

The classic CT appearance of DAI consists of small focal punctuate tissue tear haemorrhage in cerebral white matter, basal ganglion, corpus callosum and dorsal part of brain stem. These CT appearances do not explain the neurological condition of patient clearly. Even normal CT scans have reported in 50-80% cases of DAI. MRI has been found to be much more sensitive in detection and classification of lesions of DAI. Present study was carried out to meet the objective of, analyzing the clinic-radiological spectrum of diffuse axonal injury, in our department admitted over a period of about 2 years.

MATERIAL AND METHODS

This study was carried out on 35 cases of diffuse axonal injury in Neurosurgery department of Medical College Hospital, Gwalior from July 2006 to March 2008. A subgroup of patients with moderate and severe head injury and discrepancy between the apparently normal CT scan findings and their neurologic status were studied with MRI. Inclusion criteria for the study were closed traumatic brain injury, GCS score<12 and CT scan criterias for DAI. Exclusion criteria were penetrating TBI, Prolonged hypotension, hypoxia etc.

Detailed history, particulars of patients (name, age, sex, date of admission & time of injury), details of mode of injury were recorded. History of unconsciousness, vomiting, ENT bleed, seizures, weakness etc were taken. General physical and neurological examination was done. Patient was also examined for scalp injury, black eye, bleeding for nose and CSF leak.

The management of all of these patients with head injuries was performed according to the standardized protocol and

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How to cite this article: Gupta R, Singh AK, Bansal MK, Priyatma. Clinico-radiological and demographic profile of diffuse axonal injury cases in tertiary care hospital in Gwalior Region. International Journal of Contemporary Medical Research 2021;8(4):D1-D4.

DOI: http://dx.doi.org/10.21276/ijcmr.2021.8.4.16

CT scan was done. Any discrepancy between the apparently normal CT scan findings and their neurologic statuses were studied with MRI. The outcomes were evaluated at third month of injury by using Glasgow Outcome Scale (GOS).

RESULTS

In present study, 2/3rd of patients belonged to reproductive age group of 20-40 years. About one third of patients were of pediatric and adolescent age group (0-20 years). DIA is infrequently seen above 40 years of age in present study. Mean age was 25 years and range was 7-42 years. Male preponderance is clearly evident from above table with male: female ratio being 6:1. (Table 1)

Variables	No. of cases	Percentage of cases
Age group (In Years):		
0-10	04	11.44%
11-20	08	22.85%
21-30	12	34.27%
31-40	10	28.58%
>40	01	2.86%
Gender:		
Male	30	85.71%
Female	05	14.29%

Table-1: Demographic Profile of Cases with Diffuse Axonal Injury

Table 2 shows that most common mode of Diffuse Axonal Injury (DAI) was road traffic accident (77.14%) followed by fall from height (20%). Most of the DAI patients were of severe head injury with GCS score<8. Most of the patients admitted were of GCS score 7 & 6. Mean GCS score was 6.14. There were only 2 patients of moderate head injury (GCS score= 9-12).

In present study, most of the patients (54.29%) showed normal CT scan followed by Petechial haemorrhage at grey-white matter junction (25.71%) presentation on CT scan. Small number of patients presented with peri-ventricular

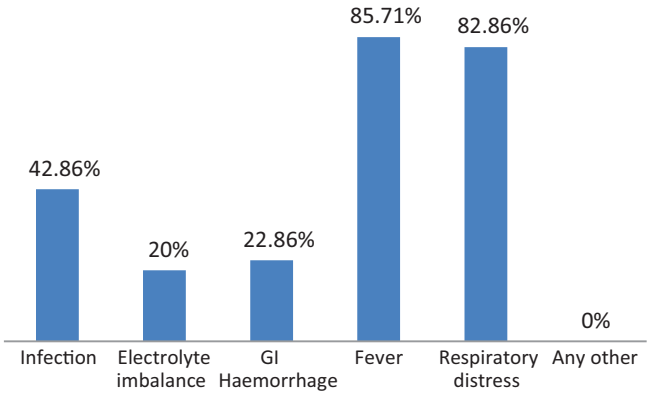

Figure-1: Complication in Diffuse Axonal Injury Cases

Variables	No. of Patients	%
Mode of injury		
Road Traffic Accident	27	77.14%
Fall from height	07	20%
Assault	01	2.86%
Neurological status at time of admission (GCS Score)		
>9	02	5.71%
8	03	8.57%
7	10	28.57%
6	12	34.29%
5	02	5.71%
4	06	17.42%
CT Scan findings:		
Petechial haemorrhage at grey-white matter junction	09	25.71%
Peri-ventricular haemorrhage	02	5.71%
Brainstem haemorrhage	02	5.71%
Intra-ventricular haemorrhage	03	8.58%
Normal Scan	19	54.29%
MRI Findings:		
Petechial haemorrhage at grey-white matter junction (Grade-I)	04	11.43%
Petechial haemorrhage at grey-white matter junction + Corpus Callosum (Grade-II)	17	48.57%
Petechial haemorrhage at grey-white matter junction+ Corpus callosum+ Brain stem (Grade-III)	14	40%

Table-2: Clinico-radiological Profiles of Patients with Diffuse Axonal Injury

Associated Findings	No. of Patients	Percentage
Fracture of skull bone	01	2.86%
Extradural haematoma	00	0%
Subdural haematoma	02	5.72%
Subarachnoid haemorrhage	09	25.71%
Diffuse cerebral oedema	01	2.86%
Forniceal haemorrhage	11	31%

Table-3: Associated findings in Patients with Diffuse Axonal Injury

haemorrhage, brainstem haemorrhage and intra-ventricular haemorrhage. On MRI scan, most common finding was of grade II (48.57%) followed by grade III (40%). Small number of DAI patients were of grade-I. In patients having corpus callosum petechial haemorrhage, maximum (93.1%) was present in splenium.

Table 3 shows that in present study, 11 patients (31%) had forniceal haemorrhage followed by 9 patients (25.71%) had subarachnoid haemorrhage as associated finding to diffuse axonal injury. One patient had skull bone fracture and diffuse cerebral oedema.

Figure 1 shows that fever (85.71%) and respiratory distress (82.86%) were the most common complication in DAI patients. Infection (42.86%) was the second most common complication in DAI patients.

DISCUSSION

The present study analyses 35 cases of diffuse axonal injury patients admitted in department of Neurosurgery, G.R. Medical College& J.A. group of Hospitals, Gwalior from July 2006 to March 2008. Special emphasis was made to assess various factors affecting clinical profile and outcome in diffuse axonal injury patients.

Maximum number of patients of DAI in present study belonged to 21-40 years age group with mean age of patients was 25 year. The experiences of other authors (Giugni et al.[7], Legeres et al[8], Lobato et al.[9] and Mustafa et al.[10]) are similar. The high incidence in this age group is quite understandable owing to the fact that this age group is most active requiring outdoor activities and thus more susceptible to injury. DAI may occur in utero if a pregnant woman is subjected to sufficient force (Yamamoto et al.[11])

The present study shows clear cut male preponderance in DAI patients with male: female ratio of 6:1. Studies done by various authors (Patarakis et al.[12], Rainer et al.[13], Legaras et al.[8] and Giugni et al.[7]) also show male preponderance similar to present study. This generally reflects the life style where males are more active in outdoor activities and thus are more susceptible to injuries.

In present study, RTA was the commonest cause of DAI followed by fall from height. In various studies (Pamela et al.[15], Barbara et al.[14], Legaras et al.[8] and Rainer et al[13]), most common cause of DAI was road traffic accident. Road traffic accidents are increasing everyday because of heavy increase in vehicular traffic, poor implementation of rules, regulations and safety measures.

DAI occurs due to shaking effect of the brain within skull caused by acceleration-deceleration effects of the mechanical input to the head. Determination of its severity is based on the direction, magnitude and speed of head motion during the injury sequence. This results in shearing or stretching of nerve fibers with consequent axonal damage which forms the substrate of diffuse brain injury. (Kim et al.[16])

DAI type lesion had been produced in experimental animal subjected to relatively long duration angular acceleration injury to the head. (Genneralli et al[17]) The presence of DAI depends on the mechanism of the trauma, being more frequent in high energy trauma especially in traffic accidents. (Lageras et al.[8]) DAI occurs most commonly in patients injured with road traffic accident and rarely in association with simple falls. (Adams et al.[18])

In present study, most of the patients (94.23%) were of severe head injury with GCS score being below 8. Mean GCS score was 6.14. Severe head injury group (GCS score<8) is most commonly reported with DAI in most series (Levi et al.[19], Sung et al.[20], Paterakas et al.[12] and Legares et al[8].). In study conducted by Levi et al., GCS score was less than or equal to 8 in 83% of cases while half of these cases had GCS score equal to 4 or less than 4.

Diffuse axonal injury is due to the shearing injury to the axons. These axons shears, which are directly related to the extent of the trauma, can be scattered widely throughout the peripheral white matter of the cerebral hemisphere or in more severe cases, can be present in deeper brain structures such as upper brain stem as well. The amount of axonal shears that ensues is parallel to the duration of coma, neurological status and outcome. (Gennarali et al.[21])

In present study, mean GCS score of patients who had only white matter haemorrhage was 7.75. Mean GCS score of patient who showed white matter haemorrhage and corpus callosum haemorrhage was 6.11 and of patients who displaced brainstem haemorrhage was 5.76. Most of patients (31/35) in present study had petechial haemorrhage at white-grey matter junction, in corpus callosum & brainstem. Hence, generally presented with GCS score <8 (Severe head injury). Another reason for low GCS score in DAI is that majority of DAI cases are suspected following severe head injuries, with near normal CT scan although mild and moderate head injury can also result in DAI. (Mittl et al.[22]) Autopsy studies find an 80% to 100% incidence of DAI associated with fatal head injury. (Generrali et al[17])

In present study, most of the patients (54.29%) showed normal CT scan followed by Petechial haemorrhage at grey-white matter junction (25.71%) presentation on CT scan. Small number of patients presented with peri-ventricular haemorrhage, brainstem haemorrhage and intra-ventricular haemorrhage. In study done by Mustafa et al., 13 out of 33 patients had petechial haemorrhage, 7 patients had normal scan and 12 patients had intra-ventricular haemorrhage.

Cranial CT has been the most widely used evaluation modality for patient suffering from head trauma. However it has been found to have low sensitivity for the identification of DAI and posterior fossa lesion by majority of authors (Lagares et al[8] and Peterakis et al.[12])

CT scan findings suggestive of DAI includes petechial haemorrhage often in the peri-ventricular white matter, corpus callosum and brain stem, traumatic SAH and IVH as well as tissue tear haemorrhage or even no abnormality (Lobato et al.[9])

Normal CT scan in severe head injury patients can be due to prolonged hypotension and hypoxia. But such cases were excluded from this study. To exclude focal cortical contusions, the extensive foci (>2 cm) and foci in contact with the brain surfaces were excluded from study done by

Rainer et al.[13]

In present study, most of the patients (88.58%) of DAI belong to stage-II & stage-III on MRI findings. In a study done by Paterakis et al.[12], 79.18% patients showed stage-II & stage III MRI findings, 50% of the patients displaced stage-II and III MR findings in study of Lee at al. and 30.3% patients had stage-II & III MR findings in Rainer et al. The increased number of patients suffering from stage-II and stage-III is explained by the fact that patients were selected for the MRI because of the incompatibility between CT scan findings and neurologic conditions. (Paterakis et al.[12])

CONCLUSION

In present study, maximum cases of DAI were recorded in age group of 20-40 years. The commonest mode of injury was road traffic accident followed by fall from height. Most of the DAI victims belonged to severe head injury group (GCS<8). Majority (54.29%) of CT presentation of DAI cases was apparently normal scan. Most common associated findings in DAI was SAH and forniceal injury.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 11-02-2021; **Accepted:** 04-03-2021; **Published:** 28-04-2021