International Journal of Research in Medical Sciences
*Arfat M et al. Int J Res Med Sci. 2019 Jun;7(6):2356-2361*
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20192527

**Original Research Article**

# Emerging trends of traumatic brain injury in Western Uttar Pradesh, India: diagnosis and rehabilitation

**Mohd. Arfat[1]*, A. P. Verma[2], Arvind Shukla[3], Kailash K. Mittal[4]**

[1]Department of Radiology, UPUMS, Saifai, Etawah, Uttar Pradesh, India
[2]Department of Radiology, Nims University Jaipur, Rajasthan, India
[3]Department of Radiology, K.D. Medical College, Hospital and Research Center, Mathura, Uttar Pradesh, India
[4]Department of Radiotherapy, Uttar Pradesh University of Medica Sciences, Saifai, Etawah-India

**Received:** 03 April 2019
**Accepted:** 04 May 2019

***Correspondence:**
Mr. Mohd. Arfat,
E-mail: arfat.radiology@gmail.com



## ABSTRACT

**Background:** To study the various advance technology for the diagnosis of Traumatic Brain Injury (TBI) and find out Emerging trends occur in TBI (Traumatic Brain Injury) patients.
**Methods:** The present study was conducted with 500 patients, age between 02 year to 70 years mean age (36 Years) presenting to emergency department of Uttar Pradesh University of Medical Sciences, Saifai, Etawah, with a history of acute head trauma from January 2016 to December 2018. All patients were examined using 64 slices MDCT and 1.5T MRI Scanner also.
**Results:** Traumatic brain injury caused by various reasons like 62.1% road traffic accidents (RTA) and 25.1% fall from height (FFH) being and 11.83% Assault/hit by hard object and 0.88% are gunshot injury. Loss of consciousness was the most common complaint of the 59.1% TBI patients followed by 17.75% Vomiting and headache, 11.83% facial injury and 11.24% scalp injury. All TBI patients were diagnosed by MDCT 64 Slices Somatom Sensation Scanner who was observed 41.42% skull fractures, 29.28% extra dural hematoma, 27.21% sub dural hematoma, 23.96% sub archnoid haemorrhage, 13% intra cerebral hematoma, 30.17% brain contusions and 24.26% diffuse cerebral edema.
**Conclusions:** Road traffic accidents remain the leading cause of trauma in our country. MRI and MDCT are well recognized method to know the extent and various types of hemorrhages and skull fractures in TBI patients. The present study data is indicated 62.1% majority of TBI patients are suffered by Road traffic accidents mainly young males with alcoholism.

**Keywords:** Emerging trends, Rehabilitation, Extra-dural hematoma, Diffuse axonal injury, Sub dural hematoma, Traumatic brain injury, UPUMS

## INTRODUCTION

Traumatic brain injury (TBI) is a critical public health and socio-economic problem throughout the world. It is a major cause of death, especially among young adults and lifelong disability is common in those who survive.[1] Traumatic Brain Injury (TBI) has varied morbidity in surviving patients. The primary causes of TBI vary according to age of the people, fall from height is the leading cause of Traumatic Brain Injury in children up to 4 years of age and persons more than 70 years or above. Traffic and vehicle injury is very common young and up to 50 yrs of age, the cause behind is frequent and fast mobility for education and purpose of job and business. It is estimated that in the USA, around 5.3 million people are living with a TBI related disability.[2] Report shows one TBI every 15 seconds in the USA. TBI is the leading killer and disabler of young adults under the age of 35. In

India 1.5 to 2 million people were injured every year. The Lancet reports that TBI projected become the third largest cause of disease burden in 2020.

Head injury requires immediate and quick diagnosis for the early management to show the incidence of mortality and morbidity can be minimized. CT Scan is the primary most important diagnostic modality for head trauma, it is superior to MRI for the diagnosis of bone injury and acute haemorrhage.[3] It has got limitation (i) Beam hardening effect there by not suitable for the posterior fossa of brain. (ii) The age of the haemorrhage cannot be evaluated by the CTScan. (iii) The follow-up and complications are not visualized. (iv) Due to radiation effect can not be utilized in pregnant women.

MRI has got some advantage (i) No radiation hazard. (ii) Age of the hematoma can be better evaluated.(iii) It is better modality of choice compare to CT scan to see the post TBI complications and follow up.(iv) Absence of beam hardening effect, multiplanar imaging make it better modality for posterior fossa pathology. MRI is better than CT Scan in the detection of Non-hemorrhagic contusions and Diffuse Axonal Injury (DAI). A T2* Gradient Refocussed Echo (GRE) sequence is used to detect acute and chronic bleed. In this type of Sequence bleed appear black.

## METHODS

In the present study was done by diagnosis of 500 patients of acute head trauma and positive findings on head MDCT and MRI scanning between January 2016 and December 2018.

### *Inclusion criteria*

- Patients of all ages, sexes and occupations were included.
- Only patients with positive findings on brain MDCT and MRI scanning were included.
- Taking complete history of all trauma patients.
- General examination of the patients was done by the emergency department of U.P.UMS, Saifai, Etawah.
- CT scan of head using MDCT scanner and MRI 1.5 T scanner without using intravenous contrast media.

### *Exclusion criteria*

- Patients with non-traumatic intracranial bleed.
- Patients with age group <2 year.
- Pregnant females with history of head trauma.

### *Study area*

*The study will be carried out in the*

- Department of Radiology, Uttar Pradesh University of Medical Sciences, Saifai, Etawah.
- Emergency Department, Uttar Pradesh University of Medical Sciences, Saifai, Etawah.

### *Statistical analysis*

Data analysis will be planned based on the objectives of the study. It will be done to reduce, organize and give meaning to the data by using descriptive and inferential statistics with the use of Chi-square method and Wilcox signed-rank test. With the help of Chi-square method most of the cases were RTA which are highly significant cause of Traumatic Brain Injury in this study.

### *Multidetector computed tomogramphy technique*

The diagnosis of TBI was performed using a 64 row Multi detector computed tomography scanner, Siemens somatom sensation. Axial section images (1.25 to 5 mm slice thickness and image interval of 5 mm), with a high standard frequency reconstruction algorithm. On 64 slice siemens somatom sensation scanner, CT head data sets were performed in the supine position. For adequate Multi planar reconstruction, scanning was performed to cover the area from orbito-meatal line to the vertex of head. Then makes the thin slice of whole data we acquired and load to MMWP work station, where MPR images were obtained in axial, coronal and sagittal planes whenever need. 3D technique including shaded surface display (SSD), volume rendering technique (VRT) are used to obtained three dimensional image according to the findings from the original image.

### *Magnetic resonance imaging techniques*

The experimental data has been generated by using PHILIPS 1.5T Achieva Nova machine. Fast spin echo (FSE) T1 and T2 weighted sequence are used in the evaluation of head trauma.

FLAIR (Fluid Attenuated Inversion Recovery) and FSE T2 weighted sequence are sensitive in the detection of non-hemorrhagic lesions such as contusions and Diffuse Axonal Injury (DAI) because of the sensitivity of these sequences to the presence of extracellular free water content. A T2 gradient-refocussed echo (GRE) sequence with sensitivity to magnetic susceptibility effects will allow the detection of acute and chronic hemorrhagic lesions that may not be well visualized on FSE T2 weighted sequence. Acute hemorrhagic lesions are poorly seen on T1-weighted images because they are isointense or slightly hypointense. Diffusion -weighted image (DWI) sequences are also helpful in the evaluation of acute trauma. DWI has proven capable of detecting Diffuse Axonal Injury (DAI) that may not be seen on FLAIR and T2 GRE sequences. The multiplanar imaging capability and superior contrast resolution of MRI are advantages over CT Scan, allowing more accurate localization and characterization of intracranial injuries.

Image parameters for T1- weighted images -Repetition time (TR) = 500 msec, echo time (TE) = 20msec, number of excitations (NEX)= 2

For FLAIR images- TR=9000 msec, TE=155 msec, inversion time (TI)=2200, NEX=1

For FSE T2-weighted images- TR=2000 msec, TE= 80 msec, NEX=1

For T2 GRE- TR=500msec, flip angle -20 degrees

For DWI- TR=10,000 msec, TE=95 msec and NEX=1.

## RESULTS

In the present study, total 500 traumatic brain injury patients were diagnosed in which 285 males and 215 female patients. Their age ranges from 02 year to 70 year, with a mean age of 36 years. The peak age was the Fourth decades including 180 patients with average of 36.04% from the total no. of patients (Table 1).

**Table 1: Age and sex distribution among the studied 500 patients with acute traumatic brain injury.**

| Age in years | Male | Female | Total [N (%)] |
|---|---|---|---|
| 0 to 10 | 35 | 32 | 67 (13.49) |
| 10 to 20 | 33 | 27 | 60 (12.2) |
| 20 to 30 | 80 | 45 | 125 (25.17) |
| 30 to 40 | 105 | 75 | 180 (36.04) |
| 40 to 50 | 20 | 25 | 45 (9) |
| 50 to 60 | 09 | 08 | 17 (3.45) |
| 60 to 70 | 03 | 03 | 06 (1.18) |
| Total | 285(57) | 215 (43) | 500 (100) |

**Table 2: Causes of traumatic brain injury among the study population (500 patients).**

| Causes of TBI | Number of patients (%) |
|---|---|
| Road traffic accidents | 310 (62.1) |
| Fall from height | 125 (25.1) |
| Hit by hard object/ assault | 59 (11.83) |
| Gun shot | 06 (1.2) |

The majority of the 500 patients studied, who have traumatic brain injury caused by Road traffic accidents (RTA) 62.1%, and fall from height (FFH) 25.1%, being hit by assault/hard object 11.83% and gun shot 1.2% Chi-square value 84.56 P value <0.001 (statistically significant) (Table 2).

The total no. of patients presented with different clinical presentation. 59.17% of TBI patients were complained Loss of consciousness, 18% Vomiting/headache, 11.8% facial injury and 11.24 % suffered with scalp injury (Table 3).

**Table 3: Clinical representations among the studied (500 patients) with acute TBI.**

| Clinical presentation | No. of patients (%) |
|---|---|
| Loss of consciousness | 296 (59.17%) |
| Vomiting/Headache | 90 (18%) |
| Facial injury | 59 (11.8%) |
| Scalp injury | 56 (11.24%) |

**Table 4: MDCT findings among the 500 studied patients with acute traumatic brain injury.**

| MDCT findings | No. of patients (%) |
|---|---|
| Skull fractures | 207 (41.42%) |
| Extra dural hematoma | 146 (29.2%) |
| Sub dural hematoma | 136 (27.21%) |
| Sub archnoid haemorrhage | 119 (23.80%) |
| Intra cerebral hematoma | 65 (13%) |
| Brain contusions | 150 (30%) |
| Diffuse cerebral oedema | 121 (24.2%) |

Most of the examined patients showed more than one lesion. 207 (41.42%) of the 500 patients reported skull fractures. 146 patients had extra dural hematoma (29.2%), 136 patients had Sub dural hematoma (27.21%), 119 patients had Sub archnoid hemorrhage (23.96%), 65 patients had Intra cerebellar hematoma (13%), 150 patients had brain contusions (30%) and 121 patients had diffuse cerebral oedema (24.2%) (Table 4).

## DISCUSSION

Injuries have been reported to be a neglected epidemic in developing countries and accounting for more than five million deaths per year, roughly equal to the number of deaths from HIV/AIDS, malaria, and tuberculosis combined.[4,5] MDCT scanning is frequently used to diagnosis of all Traumatic Brain Injury patents those are admitted in hospital or their treatment. MDCT scanning is imaging technique used well assessment of the seriousness of injury and their image can be obtained by using multidetector high resolution scanners. The images could be observed using brain to bone contrast windows where data can be obtained into 3D CT sets to indicated bony and intracranial injuries.[6]

Axial CT scanning is used for evaluation of neurological injury in head trauma but it is limited in evaluation of the posterior fossa, the middle cranial fossa, and the inferior frontal lobes. Coronal and Sagittal CT reconstruction provide more informative of these areas.[7]

Previously in study of acute traumatic brain injuries conducted earlier these are direct relation between the severities of clinical symptom and demonstration of abnormalities.

Youmans et al, has been reported acute traumatic brain injuries are conducted on behalf of direct relation

between the severities of clinical manifestation and relation with their abnormalities.[8] Whereas present study has seen intracranial sequelae on MDCT scanning.

Ashikaga et al, reported use of MRI in skull fracture of TBI patients.[9] MDCT imaging was used for detecting fractures and depending on their location and type prompt surgical intervention can be done to prevent CSF leakage, infection, haemorrhage in which 41.42% of acute traumatic brain patient were suffered by open skull fractures and their pathological manifestation like depressed, crashes and abnormal thickened in skull bones in present studies of TBI patients. These results also supported to Ashikaga et al, (Figure 1).

**Figure 1: Skull fragment fracture.**

Mittl et al, has been well demonstrated Extra Dural hematoma in mild head injury and normal head CT finding.[10] In present study TBI patient cases were observed under MDCT imaging. 29.2% Extra Dural hematoma showed as biconvex hyper dense elliptical collection with sharp edge of acute traumatic brain patient. It was developed between the skull and dura associated with skull fracture (75-90 %). It may be due to injured middle meningeal artery (Figure 2).

**Figure 2: Dural hematoma.**

Sub dural hematoma was found 27.21% case of present study of TBI patients. It was evaluated by using subdural CT window. It was showed as hyperdense and concave in shape on CT scan. Singh et al, also reported in an unusual case of a compound depressed skull fracture.[11]

Subarachnoid hemorrhage was found 23.80% of acute traumatic brain injury patients (Figure 3). CT was showed more accurate in detecting acute sub arachnoid hematoma than routine MRI sequences. It may be due to the blood in acute sub arachnoid hematoma has a low deoxyhemoglobin and was appeared black. The present finding also supported to Bradley et al, and Holme et al, studies about MR Appearance of hemorrhage in the brain.[12,13]

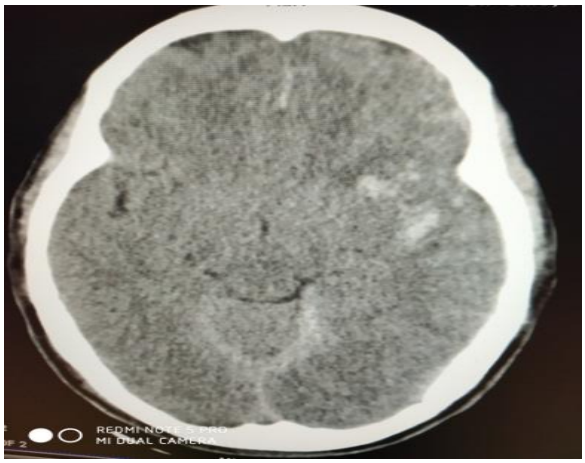

**Figure 3: Sub-archnoid hemorrhage.**

In the present study, it is revealed that 30% TBI patients suffered by brain contusions and 13% intra cerebral hematoma. The finding was confirmed due to scattered areas of bleeding seen at cortico- medullary junction or cortex of brain parenchyma and appeared as salt and pepper appearance. It could be hemorrhagic and non hemorrhagic. It was due to blunt head injury patients and in acceleration and deceleration trauma (Figure 4).

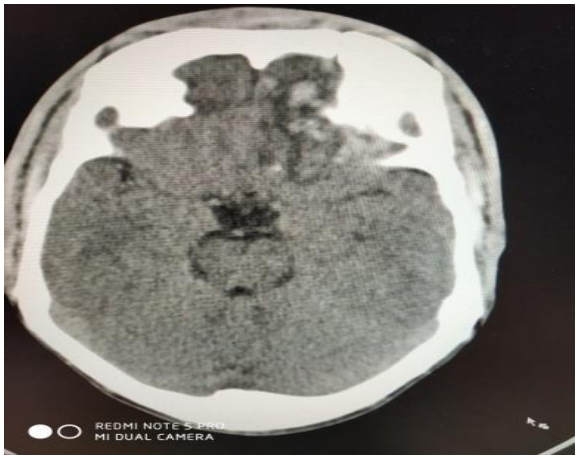

**Figure 4: Multiple brain contusions.**

It was observed that the clot signal was similar to the brain parenchyma in MRI in acute stage of head trauma. It was observed that MDCT was more sensitive in detecting clots within 24 hours of injury than MRI. The present study of MDCT was well documented by Gutman et al, intra cerebral hematoma was observed on CT.[14] It was well defined hyper dense area. ICH cause ruptured of blood vessels in Traumatic Brain Injury (TBI) patients. In previous studies of both ICH and contusions simultaneously present in same case.[15]

In the present study, it is revealed that 24.2% Diffuse cerebral oedema of acute traumatic brain patients. Diffuse cerebral oedema was made by loss of cerebral auto regulation due to significant increased blood flow and blood volume increased pressure on CSF leading to mildly increased density of white matter. The present finding was also well studied in various TBI patients.[16-18]

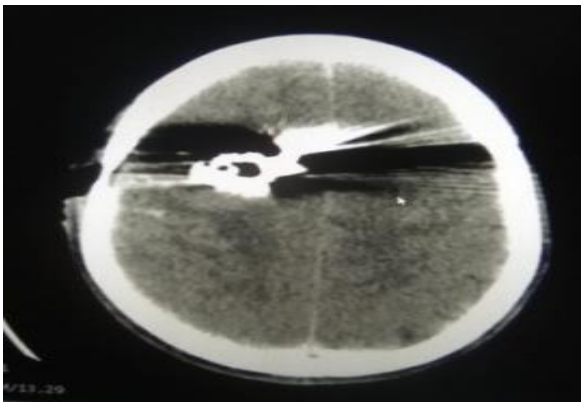

**Figure 5: Bullet inside the brain.**

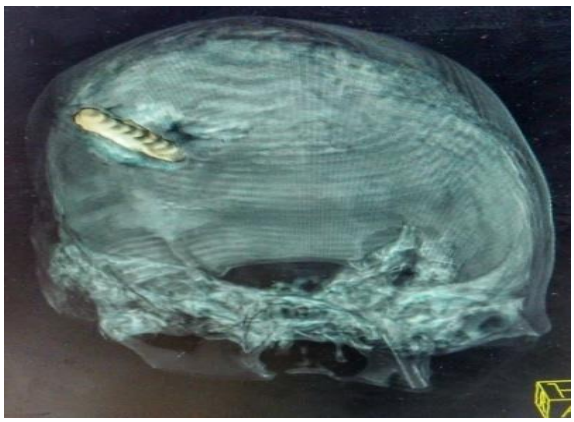

**Figure 6: 3D (VRT) shows bullet site.**

In the present study, it is revealed that 1.2% patients of traumatic brain injury due to gun shot. MDCT is very useful in detection of exact location of bullet with the help of Multi Planar Technique (MPR) and 3D reconstruction technique (VRT) (Figure 5 and 6).

Magnetic Resonance Imaging (MRI) is playing an increasingly important role in the evaluation of Traumatic Brain Injury. MRI is more sensitive than CT Scan in the detection of Non-hemorrhagic contusions, Diffuse Axonal Injury (DAI). MRI is the modality of choice in assessment of age (time duration) of trauma. Development of MRI Compatible life support equipment such as Non-ferromagnetic ventilators, allows the severely injured comatose traumatic patients to be evaluated with MRI Scanner. FLAIR and FSE T2 weighted sequence are used in detection of non-hemorrhagic lesions such as -contusions, Diffuse Axonal Injury (DAI) (Figure 7A ,7B). The Multiplanar Imaging capability and superior contrast resolution of MRI are the key advantage over CT scan.

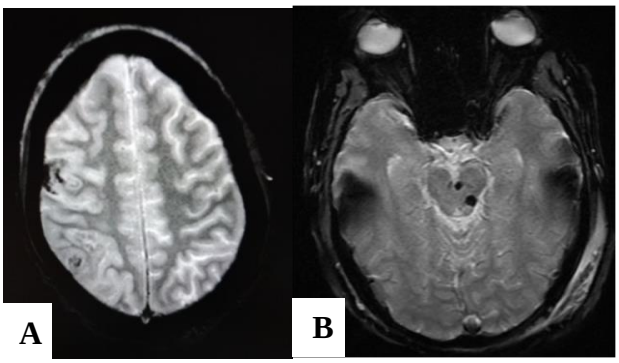


**Figure 7: (A) and (B): MRI shows small foci of bleed suggests Diffuse Axonal Injury (DAI).**

## CONCLUSION

Traumatic Brain Injury causes more deaths and disability than any other neurologic condition before the age of 40 years. Road Traffic Accidents (RTA) remains the leading cause of brain trauma, which is the leading cause of death more in men compare to females. The Lancet reports that in 2020 Traumatic Brain Injury projected become the 3rd largest cause of disease burden. 1.5 to 2 million persons injured every year in India due to Traumatic Brain Injury (TBI). The present study indicated that 62.1% patients suffered with TBI by Road Traffic Accidents (RTA). Scalp swelling was common findings among all the cases of Traumatic Brain injury (TBI). Different types of Skull fractures (depressed, fragment, basilar etc.) were noted in majority of the cases. In the diagnosis of skull fractures Multiplanar reconstruction (MPR) and 3D techniques of CT scan are very useful and effective to find out degree of displacement. Coronal images are very useful in detection of lesion especially in posterior fossa area where more bones are found. 3D techniques (VRT, SSD) are also very useful in detection of exact location of bullet in case of Gunshot patient. CT examination with Spiral technique increase patient comfort by reducing the scan time.MRI also plays a very important role in case of Traumatic Brain Injury patients. Susceptibility weighted imaging (SWI) is a very new and effective technique to find of Diffuse Axonal Injury (DAI). FLAIR and FSE T2 weighted sequence are used in detection of non-hemorrhagic lesions such as -contusions, Diffuse Axonal

Injury. The Multiplanar Imaging capability and superior contrast resolution of MRI are the key advantage over CT scan.The main cause of RTA occurs due to Alcoholism, lack of road side and driving precautionary majors. Aside from this CT scan of brain is a very effective radiological method of choice in emergency condition to explain the position of Traumatic Brain Injury (TBI) patients and MRI is very useful to diagnose the other type of head injury like Diffuse Axonal Injury (DAI).

## ACKNOWLEDGEMENTS

Authors would like to thank Vice Chancellor of UPUMS, who supported well in this study and also emergency room doctors of UPUMS Saifai, Etawah, Uttar Pradesh, India.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Maas AI, Stocchetti N., Bullock R. Moderate and severe traumatic brain injury in adults. Lancet Neurol. 2008;7:728-41.
2. Langlois JA, Sattin RW. Traumatic brain injury in the United States: research and programs of the Centers for Disease Control and Prevention (CDC). J Head Trauma Rehabil. 2005;20:187-8.
3. Ogbeide E, Isara AR. Cranial computed tomography utilization in head trauma in a Southern Nigerian tertiary hospital. Sahel Med J 2015:18(1):27-30.
4. Gosselin RA, Spiegel DA, Coughlin R, Zirkle LG. Injuries: The neglected burden in developing countries. Bull World Health Organ. 2009;87:246.
5. Debas HT, Gosselin RA, McCord C, Thind A. Disease Control Priorities in Developing Countries. 2nd ed. New York: Oxford University Press; 2006.
6. Coles JP. Imaging after brain injury. Br J Anaesth 2007;99:49-60.
7. Zacharia TT, Nguyen DT. Subtle pathology detection with multidetector row coronal and sagittal CT reformations in acute head trauma. Emerg Radiol. 2010;17:97-102.
8. Youmans, JR. Neurological surgery. Saunders, Philadelphia. 1982.
9. Ashikaga R, Araki Y, Ishida O. MRI of head injury using FLAIR. Neuroradiol. 1997;39:239-42.
10. Mittl RL, Grossman RI, Hiehle JF, Hurst RW, Kauder DR, Gennarelli TA. et al, Prevalence of MR evidence of diffuse axonal injury in patients with mild head injury and normal head CT findings. Am J Neuroradiol. 1994;15:1583-9.
11. Singh, Suryapratap An unusual case of a compound depressed skull fracture. PaK J Med Sci. 2009;14:184-6.
12. Bradley WG. MR. Appearance of hemorrhage in the brain. Radiol. 1993;189:15-26.
13. Holmes EJ, Forrest-Hay AC, Rakesh RM. Fundamentals of CT imaging. In: Holmes, EJ, Forrest- Hay AC, Misra, RR. eds. Interpretation of Emer- gency Head CT: A Practical Handbook. Cambridge Uni- versity Press, Cambridge, 2008;3-9.
14. Gutman MB, Moulton RJ, Sullivan I, Hotz G, Tucker, WS, Muller PJ. Risk factors predicting operable intracranial hematomas in head injury. J Neurosurg. 1992;77: 9-14.
15. Suryapratap ST, Bhargava A, Reddy N. Significance of computed tomography scans in head injury. OJCD. 2013;3:109-14.
16. Hydel ML, Preston CA, Mills TJ, Luber S, Blaudean E, Deblielux MC. Indications for computerized tomography in patients with minor head injury. N Engl J Med. 2000;343:100-5.
17. Sosin DM, Sniezek JE, Thurman DJ. Incidence of mild and moderate brain injury in the United States. Brain Inj.1996;10:47-54.
18. Missouri Okla- homa, and Utah, Traumatic Brain Injury Colorado, 1990-1993. Morb and Mortal W Repor .1997;46:8-11.

**Cite this article as:** Arfat M, Verma AP, Shukla A, Mittal KK. Emerging trends of traumatic brain injury in Western Uttar Pradesh, India: diagnosis and rehabilitation. Int J Res Med Sci 2019;7:2356-61.