ORIGINAL ARTICLE

Incidence of epilepsy and cognitive impairment following traumatic brain injury: a hospital based cross-sectional study

Rajasekhar Reballi, [1] MD, **Siva Prasad Kasimahanti,** [2], MD

[1]Consultant Psychiatrist, Nizamabad, [2]I/c Professor of Psychiatry, Institute of Mental Health, Department of Psychiatry, Osmania Medical College; Hyderabad; India

ABSTRACT

Background: Traumatic Brain Injury (TBI) is a risk factor for epilepsy. Several studies have been conducted to estimate the incidence of epilepsy after TBI. Similarly cognitive impairment is a common consequence of TBI and a substantial source of disability.

Aims: To study the incidence of epilepsy and cognitive impairment following TBI and correlate the findings with radiological abnormalities.

Method: The study was conducted on 50 consecutive patients with TBI based on the assessment of clinical history for epilepsy and MMSE for cognitive impairment.

Results: The incidence of epilepsy after TBI was found to be 40% in our study. It was increased to 50% among the individuals with radiological abnormality on CT scan brain following TBI. Cognitive impairment was found to be highest in individuals with frontal lobe injury (mean MMSE score – 24.13) followed by temporal lobe injury (mean MMSE score – 25.25) and parietal lobe injury (mean MMSE score 26.28). Individuals with no radiologically detectable injury had least cognitive impairment (mean MMSE score - 27.97) Moreover, cognitive impairment was more in individuals with higher number of days in hospital and greater psychological distress.

Conclusion: Severity of TBI and presence of radiological abnormality influence new onset epilepsy after TBI. Similarly, injury to frontal lobe and higher number of days in hospital influence cognitive impairment after TBI.

Key words: Traumatic brain injury; epilepsy; cognitive impairment; radiological findings

Date of first submission: *24/10/14* ***Date of initial decision:*** *30/10/14* ***Date of acceptance:*** *28/12/14*

INTRODUCTION

Traumatic brain injury (TBI) can be defined as any extracranial mechanical force to the brain that leads to any of the following. 1.Any period of loss of consciousness 2.Any loss of memory of the events immediately before or after the accident 3.Any alteration in the mental state at the time of accident 4.Focal neurological deficit(s) that may or may not be transient. [1] Traumatic brain injury (TBI) can be mild, moderate or severe. Glassgow coma scale (GCS), Loss of consciousness and Post traumatic amnesia can be used to define severity of head injury. It is now generally accepted that a GCS score of 13-15 defines mild TBI, 9-12 moderate brain injury, and 8 or less severe brain injury. [2]

Epilepsy after TBI

TBI is a risk factor for epilepsy has been known since ages. Several studies have been conducted to estimate the incidence of epilepsy after TBI. A review by D'ambrosia and Perucca, [3] noted that incidence of epilepsy after TBI ranges from 1.9 to over 30% depending on the severity of trauma. In general population the overall risk has been estimated at 2-5%, increasing to 7-39% for sub groups with cortical injury and neurological sequelae.

Annegers et al, [4] conducted a population based study of seizures after TBI. 4541 children and adults with TBI were studied. The overall standardized incidence ratio was 3.1 (95 percent confidence interval, 2.5 to 3.8). The standardized incidence ratio was 1.5 (95 percent confidence interval, 1.0 to 2.2) after mild injuries (loss of consciousness or amnesia lasting less than 30 minutes.), 2.9 (95 percent confidence interval, 1.9 to 4.1) after moderate injuries (loss of consciousness for 30 minutes to 24 hrs or a skull fracture), and 17.0 (95 percent confidence interval, 12.3 to 23.6) after severe injuries (loss of consciousness or amnesia for more than 24 hrs, subdural hematoma or brain contusion). In the multivariate analysis, significant risk factors for later seizures were brain contusion with subdural hematoma, skull fracture, loss of consciousness or amnesia for more than one day, and an age of 65 years or older. Those with evacuation of a subdural hematoma; surgery for an intracerebral hematoma; Glasgow Coma Scale in the severe range of 3 to 8; early seizures, especially delayed early seizures; time to following commands of a week or more; depressed skull fracture that was not surgically elevated; dural penetration by injury; at least one nonreactive pupil; and parietal lesions on CT scan have significantly elevated risk of post traumatic epilepsy. [5]

Address for correspondence: Dr.Rajashekar Reballi
Address: H. No. 1-51/26/1, Bank Colony, Boregaon (P.O), Nizamabad-503230. Telangana, India
Phone number: +919703094412
Email: rrkar1386@gmail.com

How to cite this article: Reballi R, Kasimahanti SP. Incidence of epilepsy and cognitive impairment following traumatic brain injury: a hospital based cross-sectional study. AP J Psychol Med 2014; 15(2):240-4.

After closed head injury temporal lobe epilepsy was the commonest form and was the type most frequently incriminated in leading to psychiatric disturbance. [6] Epilepsy occurred in 45% patients with penetrating injuries in ensuing 5 years and there was a highly significant relationship between its development and the degree of overall psychiatric morbidity. [7]

Cognitive Impairment after TBI:

Cognitive impairment is a common consequence of traumatic brain injury (TBI) and a substantial source of disability. Across all levels of TBI severity, attention, processing speed, episodic memory, and executive function were most commonly affected. [8] Disturbances of attention, memory, and executive functioning were the most common neurocognitive consequences of TBI at all levels of severity. Disturbances of attention and memory were particularly problematic, as disruption of these relatively basic cognitive functions may cause or exacerbate additional disturbances in executive function, communication, and other relatively more complex cognitive functions. [9]

Dikman, et al, [10, 11] conducted a systematic review of published peer reviewed literature on studies that examined cognitive impairment by using performance measures for adults who were at least 6 months post-TBI and reported that there was a clear evidence of an association between penetrating brain injury and impaired cognitive function. Factors that modified this association included pre-injury intelligence, volume of brain tissue lost, and brain region injured. There was also suggestive evidence that penetrating brain injury may exacerbate the cognitive effects of normal aging. A review by Piercy, [12] reported that damage to dominant hemisphere affects cognitive functioning more severely than damage to non dominant hemisphere.

Aims and objectives:

The aims and objectives of the study were 1. To study the incidence of epilepsy in individuals with TBI.2. To study the cognitive functioning in individuals with TBI 3. To correlate the epilepsy with radiological findings. 4. To correlate cognitive functioning of patients with radiological findings.5. To study the factors influencing the cognitive functioning in individuals with TBI.

MATERIALS AND METHODS:

Sample:

A group of 50 consecutive patients coming for follow up after discharge following treatment for TBI in neurosurgery department of Osmania General Hospital, Hyderabad were recruited into the study after obtaining informed consent. These patients were in the age group of 18 and 55, both sexes and who suffered a mild, moderate or severe head injury and admitted to the Neurosurgery Department. Patients with major medical illness like stroke, myocardial infarction etc, those with complicated diabetes mellitus, hypertension, Endocrine abnormalities like hypo or hyperthyroidism, cushings disease, addisons disease, and dementia etc were excluded. Those with history of seizure disorder and personality disorder prior to the injury also were excluded.

Tools:

Semi structured intake proforma. Epilepsy was diagnosed based on clinical history and EEG wherever necessary.

Mini mental status examination (MMSE): Mini Mental State Examination (MMSE) is a sensitive, valid and reliable 30 point questionnaire that is used extensively in clinical and research settings to measure cognitive impairment. [13]

General health questionnaire (GHQ-12): General Health Questionnaire (GHQ-12) is the most extensively used screening instrument for common mental disorders, in addition to being a more general measure of psychiatric well-being. [14]

Statistical analysis was done using SPSS17.0 version. Descriptive statistics were done for all continuous demographic and clinical variables; frequencies (percentages) were used for all categorical parameters. Mean, median were used as measures of central tendency. Chi square tests and T tests were used as tests for significance. ANOVA was used for comparing multiple groups. Spearman's rho correlation test was used to assess correlation between different variables.

RESULTS

Table 1 and 2 show epilepsy after TBI along with radiological changes. In this study 40% individuals with TBI developed epilepsy.

Table 2 shows, among12 individuals with no radiological abnormality, only 1(8.3%) developed epilepsy. Among 21 patients with right sided brain injury, 9(42.9%) developed epilepsy, and among 17 with left sided brain injury, 10(58.8%) developed epilepsy after head trauma. There was significant increase in incidence of epilepsy, if there was any radiological abnormality.

Table1: Epilepsy after head trauma

		N Y
Epilepsy after head injury	yes	20(40%)
	no	30(60%)
Total		50

Table 3 describes among 8 individuals with injury to frontal lobe, 5(62.5%) developed epilepsy. Among 13 with temporal lobe injury, 7(53.8%) developed epilepsy and among 18 with parietal lobe injury, 7(38.9%) developed epilepsy. There was significant increase in the incidence of epilepsy if there is injury to any of the lobes of the brain compared to those with no injury (P<0.001)

Table 4 shows, among 26 individuals with mild head trauma (GCS 13-15), 5(19.2%) developed epilepsy. In those with head trauma of moderate severity, 10(52.6%) of 19 developed epilepsy and 100% of 5 patients with severe head trauma (GCS 0-8) developed epilepsy. The incidence of epilepsy in those with mild head trauma was significantly less than those with moderate and severe head trauma is significant (P<0.001).

Table 5 represents the variables such as age, duration of hospital stay in weeks, MMSE scores, and GHQ – 12 scores of the total samples with mean and standard deviation for each variable.

Table 6 reveals correlations between, Glasgow coma scale, number of days in hospital, GHQ 12 scores and MMSE scores. It was seen that GHQ 12 scores were negatively correlated with Glasgow coma scale at the time of admission and MMSE scores at the time of interview and positively correlated with number of days of hospital admission. The correlation of GHQ 12 scores was significant with number of days of hospital admission (p=0.002) and MMSE scores at the time of interview (p=0.009). Though GHQ 12 scores were negatively correlated with Glasgow coma scale at the time of admission, the correlation was not significant (p=0.119).

MMSE scores at the time of interview were positively correlated with Glasgow coma scale at the time of admission, though the correlation was not at significant level (p=0.513), MMSE scores were negatively correlated with number of days of hospital admission and GHQ 12 scores at the time of interview and the correlation was significant with the number of days of hospital admission (p<0.001) as well as GHQ 12 scores (p=0.09).

Table 7 shows mean MMSE scores in individuals with injuries to different lobes of the brain. The mean MMSE score was least in the individuals with frontal lobe injury (mean=24.13) followed by temporal (mean=25.25) and parietal (mean=26.28). Individuals with no radiologically detectable brain injury had higher MMSE scores (mean=27.97) than those with injury to any of the lobes of brain.

Table 2: Incidence of epilepsy after head trauma with radiological findings

		Radiological findings			
		No abnormality N(%)	**Right sided brain injury N(%)**	**Left sided brain injury N(%)**	**Total N(%)**
Epilepsy after head trauma	yes	1(8.3)	9(42.9)	10(58.8)	20(40)
	no	11(91.7)	12(57.1)	7(41.2)	30(60)
Total		12	21	17	50

Chi square value=36.393, P<0.001

Table 3: Incidence of epilepsy in injuries to different lobes of brain

		Lobe of the brain that is injured				Total
		Frontal	**Temporal**	**Parietal**	**No abnormality**	
Epilepsy after head injury	yes	5(62.5%)	7(53.8%)	7(38.9%)	1(8.3)	20(40%)
	no	3(37.5%)	6(46.2%)	11(61.1%)	11(91.7)	30(60%)
Total		8	13	18	12	50

Chi square value=35.205, p<0.001

Table 4: Incidence of epilepsy with severity of head trauma

		Glasgow coma scale at the time of admission			
		13-15	**9-12**	**0-8**	**Total**
Epilepsy after head injury	yes	5(19.2)	10(52.6%)	5(100)	20(40%)
	no	21(80.8)	9(47.4%)	0	30(60%)
Total		26	19	5	50

Chi square value = 45.15, p < 0.001

Table 5: Age, Number of days in hospital, MMSE scores and General Health Questionnaire - 12 scores in individuals with 4head injury

Variable	N	Mean	Std. Deviation
Age	50	30.28	7.861
Duration of hospital stay in weeks	50	1.52	0.677
MMSE scores	50	26.08	3.498
General Health Questionnaire-12 scores	50	16.42	5.372

Table 6: Correlations among different variables in Head trauma group

		Glasgow coma Scale scores on admission	Duration of hospital stay (weeks)	GHQ12 scores	MMSE scores
Glassgow coma scale at the time of admission	Pearson Correlation	1	0.09	-0.16	0.07
	Sig. (2-tailed)		0.34	0.12	0.51
	N	100	100	100	100
Duration of hospital stay in weeks	Pearson Correlation	0.09	1	0.31**	-0.49**
	Sig. (2-tailed)	0.34		0.00	0.00
	N	100	100	100	100
GHQ12 scores	Pearson Correlation	-0.16	0.31**	1	-0.26**
	Sig. (2-tailed)	0.12	0.00		0.01
	N	100	100	100	100
MMSE scores	Pearson Correlation	0.07	-0.49**	-0.26**	1
	Sig. (2-tailed)	0.51	0.00	0.01	
	N	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7: Means of MMSE scores among lobes injured

Variable	Lobe of the brain injured	N	Mean	Standard deviation	95% CI for mean Lower bound	95% CI for mean Upper bound	Minimum	Maximum
MMSE scores	Frontal	8	24.13	4.912	20.02	28.23	14	29
	Temporal	13	25.15	4.079	22.69	27.62	14	29
	Parietal	18	26.28	2.718	24.93	27.63	21	30
	No abnormality	11	27.97	1.402	27.60	28.33	22	30
	Total	50	26.98	2.832	26.41	27.54	14	30

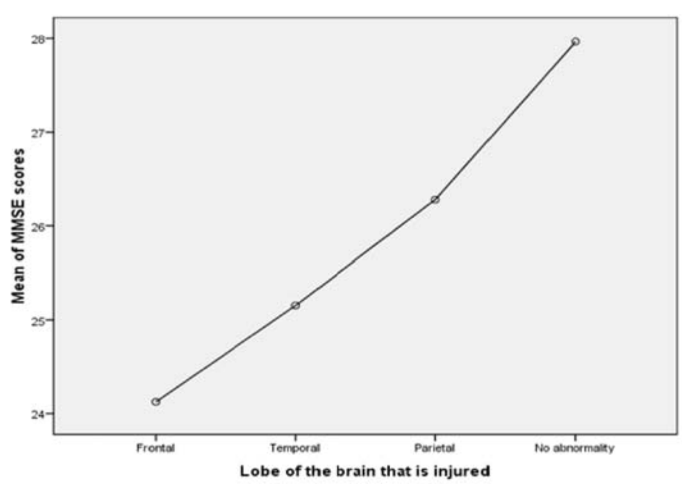

Figure 1 Mini Mental Status Examination (MMSE) scores on X axis and lobe of the brain injured on Y axis

Figure 1 shows the lobes of brain on x axis and mean MMSE scores for each lobe on Y axis. This depicts that frontal lobe injury had the lowest mean MMSE score, indicating the most severe cognitive impairment and parietal lobe injury showing the highest mean MMSE score indicating the least cognitive impairment.

DISCUSSION:

New onset epilepsy after TBI:

The incidence of new onset epilepsy after head trauma in our study was 40%. This was similar to previous studies by Ambrosio and Peruccal (7-39%), [3] and Lishman (45%). [7] Those with any abnormality in CT scan brain had significantly higher chances of epilepsy after head trauma. This was also in accordance with previous studies by Annegers et al, [4] and Temkin et al. [5] Those with moderate (GCS 9-12) and severe head injury with (GCS<8) had significantly higher incidence of epilepsy than those with mild head injury (GCS 12-15). This was also in agreement with the above study.

Cognitive functioning:

In our study cognitive functioning of the individuals was measured by MMSE scores. Among individuals with head trauma, MMSE scores were significantly negatively correlated with number of days of hospital admission and GHQ 12 scores. Although the MMSE scores were positively correlated with Glasgow coma scale, it was not statistically significant. So higher the number of days in hospital and greater the psychological distress, more was the cognitive impairment. Individuals with left sided brain injury have lower MMSE scores compared to right sided brain injury individuals. This finding shows that damage to dominant hemisphere could lead to more cognitive impairment. Injury to frontal lobe was associated with the lowest scores in MMSE, followed by injury to temporal and parietal lobe. This was also in agreement with previous studies by Arciniegas et al, [9] Wortzel et al, [8] which reported that cognitive impairment increased with severity of head trauma. Our study also was in agreement with the review by Piercy et al, [12] which reported that cognitive impairment was more in damage to dominant hemisphere.

Summary:

This cross sectional study was conducted with the aim of studying the incidence of epilepsy and cognitive impairment among individuals with traumatic brain injury. The salient findings of the study were i) presence of any radiological abnormality on CT scan brain significantly increased the incidence of epilepsy after head trauma ii) MMSE scores were significantly lower in individuals with any radiological abnormality on CT scan brain than those with normal brain scans iii)MMSE scores were negatively correlated with the number of days of hospitalization, and GHQ 12 scores and Glasgow coma scores.

Limitations of the study:

Our study has certain limitations. The sample size was small. It was a cross sectional study which assessed epilepsy only at that point of time. The study was conducted at tertiary care hospital where only more severe cases were referred. The study was done only on individuals coming for follow up, which cannot be generalized for all the individuals with head trauma.

Previously published work based on same data (related articles): Reballi R, Kasimahanti SP. Neuro-psychiatric complications of traumatic brain injury and orthopaedic injury: a comparative study. AP J Psychol Med 2014; 15(2): 228-34. The same data has been used in this study with different aims of research.

Acknowledgements: Nil

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Conflict of interest: None declared **Source(s) of support:** Nil