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Original Article

Neurocognitive Assessment of the Mild Traumatic Brain Injury Patients using Montreal Cognitive Assessment Score: Six Months' Follow-up Study

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Abstract

Objective: To explore the cognitive patterns in mild traumatic brain injury (mTBI) patients using Montreal Cognitive Assessment (MoCA) score over a period of 6 months and association with different brain lesions.

Material and Methods: This study is a hospital-based, observational, prospective longitudinal study undertaken at tertiary trauma center, SMS Medical College and Hospitals, Jaipur, Rajasthan, India from January 2019 to June 2020, on mild TBI patient total 169 mTBI patients aged between 15 and 65 were included in this study. All the patients evaluated were awake, comfortable and co-operative accompanied with one family member. MoCA (Hindi version 7.01) scale was used and same version was also used during their follow-up visits at 6 months, in the outpatient department clinic. A cutoff score of <26 on the MoCA indicated cognitive impairment (an additional score of 1 was added to the total score for patients with <12 years of education), as recommended in the literature. Computer software (SPSS trial version 23 and primer) was used for the statistical analysis. First, demographic characteristics of the mTBI patients were analyzed. Then, cognition with respect to TBI severity and lesion sites was measured. Finally, a multiple linear regression model was constructed based on the least square method. This model was used to analyze the significance of demographic variables, lesion site, and TBI severity (measured by the Glasgow Coma Scale [GCS] score) in predicting cognitive outcome in mTBI patients, specifically, with age, years of education, GCS score as a continuous variables and the gender and lesion site as nominal variables.

Results: Results show mean MoCA score of 20.82 ± 5.265 during their admission period and mean score of 25.14 ± 3.11 at 6 months with significance improvement in cognitive score. This improvement was significant in all subsets of MoCA on follow-up ($P < 0.001$). Sex, education status, and GCS were significant; age and brain lesions were non-significant factors to determine cognitive functions. Comparison of MoCA scores with brain lesions shows occipital injury with highest MoCA score (24.0 ± 4.1) and mixed injury group with lowest score (19.19 ± 5.46). At 6 months' follow-up, 51.66% of patient continues to show cognitive impairment (MoCA score <26/30).

Conclusions: MoCA scale reliably detects cognitive impairment in mild TBI patients. Compare to 6 months score, there are significant improvement in function of executive/visuospatial functions, memory, abstract thinking, attention, language, and orientation. As there are still residual deficit, these patient may require detailed neuropsychological and neurocognitive evaluation, so that rehabilitation can be planned to improve their cognitive ability, and thus improve the quality of life.

Key words: Cognitive impairment, Cognitive rehabilitation, Follow-up study, Mild traumatic brain injury, Montreal Cognitive Assessment

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INTRODUCTION

According to the World Health Organization (WHO), traumatic brain injury (TBI) is a public health issue, resulting in high rates of morbidity and mortality.[1] Traumatic brain injuries are the seventh leading cause of mortality in India and 78% of these deaths are due to

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road traffic accident (RTA) alone.[1] Even after survival, the morbidity leads to a significant burden on health system worldwide.[1] Patients suffer from loss of physical and cognitive functions in varying degrees which causes significant deterioration in not only functional ability, social skills, and economic productivity but overall quality of life. With the advancement in modern medicine and availability of newer technique of treatment, survival rate of TBI patient has increased and so as people living with cognitive impairment.[2-5]

Recovery after mild TBI (mTBI) may have different patterns as shown by study where most cognitive deficits post-trauma usually disappear beyond 1 month.[6] Other reviews show that the recovery of cognitive functions does not occur in a steady manner. It is usually faster in first 90 days and then it tends to slow down. Frencham *et al.* have suggested that almost all the cognitive domains follow similar recovery pattern after mild TBI except for working memory, which may see significant impairment for up to 93 days.[7] According to one meta-analysis, cognitive functions which are affected most between 48 h and 1 month after mild TBI are verbal learning, concentration, and information processing.[8] Other studies have shown that in about 5–10% of patients some atypical cognitive impairment may persist up to 1 year.[9]

Since a significant percentage of patients of mild TBI have a risk of developing debilitating and persistent cognitive deficits for longer periods of time, it becomes extremely important to assess the cognitive functions in every patient of mild TBI and recognize the impairments associated with mTBI early.[10] It is essential that with the help of an assessment tool, screening of all patients for cognitive deficit and a prediction of the possible late outcome be made so that a quick and efficient planning of rehabilitation can be done for these patients after the initial management. Moreover, the nature of TBI is such that the effects on cognition are of varying degrees and duration which makes it difficult to assess their prognosis.[10] Therefore, various factors must be taken into account including impairment in cognition in the acute phase of injury.[11]

In recent update of ontario neurotrauma foundation 3rd Edition have suggested use of various screening tools to assess the cognitive functions in TBI patients.[12] MoCA is one such tool, which can be used to evaluate the cognitive impairment in TBI population. Montreal cognitive assessment (MoCA) is a brief standardized tool, use to assess mild cognitive impairment[13] and has been used widely in various population group including TBI patient.[14,15]

In general, 80–85% of mTBI patients with normal computed tomography (CT) findings show complete cognitive recovery but there is always some percentage of patients, who continue to show persistent cognitive deficit and data analysing their etiology and further prognosis of the patient remains insufficient.[16] Furthermore, there is no sufficient data to show various demographical and accident-related factor effect the cognitive performance on the MoCA scale in our geographical setup, Western part of India. Therefore, the first aim of our study was to assess the cognitive pattern in mild TBI patients over a period of time using MoCA as a cognitive assessment tool. The second objective was to explore the effect of various demographic variable, TBI severity and different lesion site have over the cognitive profile of TBI patient. Finally, how different lesion site of brain affect the various substrate of global cognitive function over the period of time. We hypothesized that generalized improvement in global cognitive functions (improve MoCA score) over a time period in most of mild TBI patients. We expect that different demographic and others factors such as age, education, and TBI severity has effect on cognitive functions. We also expect improvement in different cognitive function (different MoCA subscales) associated with different brain lesions site.

MATERIALS AND METHODS

Study Design

This study is a hospital-based, observational, prospective longitudinal study undertaken at tertiary trauma center, SMS Medical College and Hospitals, Jaipur, Rajasthan, India from January 2019 to June 2020, on mild TBI patient. Ethical committee clearance was taken from our institute before commencement of this study. Hindi edition of MoCA version 7.01 was used for assessment.

Participants

Patient admitted between ages of 15–65 years in a trauma center of Department of neurosurgery for TBI, were enrolled for the study. Informed consent was taken from the patient or a close relative about the study. The patients were later followed up after discharge from ward, in outpatient clinic of our neurosurgery department after a period of 6 months. Criteria for mTBI were selected according to Glasgow Coma Scale score of 13–15.[17] Other than above classification, definition of mild TBI given by Brain Injury Committee on head injury was used.[18] mTBI is defined as "a person who has had a traumatically induced physiological disruption of brain function, as manifested by one or more of the following:

1. Loss of consciousness for 30 min or less.
2. Memory loss for events before or after the accident up to 24 h.

3. Change in mental state like confusion, disorientation after the time of the accident.
4. Transient or non-transient focal neurological deficits.

Following patients was excluded from our study: previous history of head injury or neurological deficit, substance abuse, known patient of mental retardation or Alzheimer disease, or Parkinson disease or any other degenerative brain disease. Patients who could not complete the cognition test were also excluded.

Baseline data, including demographic information, educational qualification, mode of injury, GCS score, and intracranial finding of CT scan as reported by radiologist blinded from study were also taken into account. All these details were recorded in a self-designed pro forma. All the patients admitted in neurosurgery ward, initially underwent stabilization of their vitals, complete history taking, general and neurological examination was done. Management for head injury was given according to the treatment protocol followed at our institute and no cognitive intervention was done during their hospital stay.

Evaluation Methods

All the patients evaluated were awake, comfortable and co-operative accompanied with one family member. MoCA (Hindi version 7.01) Scale was used and same version was also used during their follow-up visits at 6 months, in the outpatient department clinic. A cutoff score of < 26 on the MoCA indicated cognitive impairment (an additional score of 1 was added to the total score for patients with <12 years of education), as recommended in literature.

MoCA

The MoCA is a cognitive assessment tool used as a screening test, initially developed to evaluate mild cognitive decline in degenerative diseases of CNS.[13] Since the invention of test multiple versions has been developed in different languages worldwide,[19-23] this scale is now freely available for use by health-care professional. Various studies in the past have found MoCA as an assessment tool to be effective in many diseases.[24] MoCA is a single-page test with a maximum score of 30 points, which can be completed in about 10 min. It has become one of the most common choices for quick cognitive assessment these days.

12 subsets of MoCA Scale assess seven cognitive functions, includes:

1. Visuospatial or executive function includes: score of 1 for trail making test, 2 for cube copying, and 3 for clock drawing. Total score is 6 for this function.
2. Attention and concentration function includes: 2 for digit span testing, 3 for serial subtraction, and 1 for tapping. Total score is 6.
3. Language function includes: 3 for naming, 2 for repetition, and 1 for fluency. Total score is 6.
4. Memory function include: 5 score for delayed short term memory recall test after approx 5 min, two learning trials of five nouns are given at the initial of testing. Total score is 5.
5. Abstraction function: 2-item verbal abstraction test. Total score is 2.
6. Orientation function: testing for orientation to time and place. Total score is 6.
7. Naming function: 3-item confrontation test. Total score is 3.

The MoCA detect 90% of mild cognitive impairment subjects with high sensitivity and specificity using a cutoff score of 26.[13,25,26] Similarly, Saleh *et al.*, 2018 observed in their study that a MoCA score of 26/30 or above is presumed normal.[27] Thus, a MoCA score of <26 indicates the participants are more likely to have cognitive impairment.[26,27]

RESULTS AND STATISTICAL METHODS

Computer software (SPSS trial version 23 and primer) was used for the statistical analysis. First, demographic characteristics of the mTBI patients were analyzed. Then, cognition with respect to TBI severity and lesion sites was measured. Finally, a multiple linear regression model was constructed based on the least square method. This model was used to analyze the significance of demographic variables, lesion site, and TBI severity (measured by the GCS score) in predicting cognitive outcome in mTBI patients, specifically, with age, years of education, GCS score as a continuous variables, and the gender and lesion site as nominal variables. On the basis of years of education, patients were categorized into three groups: Less than 6 years, 6–12 years, and more than 12 years. GCS score more than or equal to 13 was considered.

Descriptive Statistics

A total of 169 participants were included in the study. The age range in our study was 15–63 years, with majority of patients presenting in the age group <40 years - 146 patients (86.39%). Peak incidence was seen in the third decade. There was male preponderance - 109 patients (64.49%). The patients were classified into three groups based on their education in years as <6 years, 6–12 years, and more than 12 years and had 53 (31.4%), 60 (35.5%), and 56 (33.1%) patients in each category, respectively. Most of the traumas were caused by motor vehicle crashes/RTA 139 patients (82.2%), followed by assaults 16 (9.5%) and falls 14 patients (8.3%). GCS score was obtained. Out of 169 patients, 72(42.6%) had a score of 15, 55 (32.5%) had

a score of 14, and 42 (24.9%) received a score of 13. The sociodemographic profile is presented in Table 1.

Distribution of MoCA Total Scores by the Lesion Site at Admission and at 6-Month Follow-up

Patients were classified into six groups on the basis of site of lesion(s): frontal lobe injury, occipital lobe, temporal lobe, parietal lobe injury, multiple lobe injury, and others injuries as confirmed by radiological imaging. In the present study, multiple lobe injury means injuries in more than one lobe of brain, such as in frontal lobe and temporal lobe, or in occipital lobe and parietal lobe or any other 2 or more lobe combinations. In our study, bilateral injury of same or different lobes was also considered in the category of multiple lobe injury. Other injuries included lesions which cannot be defined in earlier groups like inter-hemispheric bleeds, brainstem lesions, or basal cisterns bleeds, as confirmed by radiography. The statistical details for MoCA score according to the site of lesion are shown in Table 2. The average score of MoCA was highest for occipital lobe injury category (average score of MoCA = 24) and lowest for mixed injury category (mean MoCA score = 19.19). The average total MoCA score at the time of admission was 20.816 which are much less than the cut-off of 26 for cognitive impairment as suggested in earlier studies (Nasreddine *et al.*, 2005) thus suggesting higher chances of cognitive impairment in these patients.[13] Overall, 81.66% participants showed cognitive impairment as per the MoCA (score < 26/30).

Correlation of Cognitive Status with Various Factors in mTBI Patients

Using demographic characteristics, site of lesion, and GCS score as independent variables and MoCA score as a dependent variable, a multiple linear regression model constructed on basis of least square method was applied to analyze the effect and correlation of these variables on cognition and their role in predicting long-term cognitive outcome in TBI patients as measured by the MoCA total score. According to the results, gender, severity of injury, and education were significant factors, affecting cognitive function in patients with TBI (Table 3). It was found that education had a positive correlation with better preservation of cognitive functions in these patients; that is, longer the duration for which patient received education, the better they performed on MoCA test and the cognitive functions were less affected by TBI in such patients, and vice versa. Similarly, severity of injury measured by GCS score also showed positive association with MoCA score. TBI patients with a higher GCS score scored better on MoCA test (Table 4). Age and site of lesion did not show any association with the total MoCA score.

Table 1: Sociodemographic profile of the patient

Variables	Number of cases (%)
Age	
≤20	36 (21.3)
21–30	78 (46.2)
31–40	32 (18.9)
41–50	18 (10.7)
>50	5 (3)
Gender	
Male	109 (64.49)
Female	60 (35.51)
Education	
<6	53 (31.4)
6–12	60 (35.5)
>12	56 (33.1)
Mode of injury	
Assault	16 (9.5)
Falls	14 (8.3)
RTA	139 (82.2)
GCS (on admission)	
13	42 (24.9)
14	55 (32.5)
15	72 (42.6)
Total	169 (100)

RTA: Road traffic accident, GCS: Glasgow Coma Scale

Table 2: Distribution of total MoCA score by lesion site

Lobe	Number of patients	At admission	At 6 months	*P*
Frontal	52	20.88±5.09	25.5±3.17	<0.001
Parietal	8	23.25±1.58	27.25±2.05	<0.001
Temporal	32	22.06±5.09	25.56±2.78	<0.001
Occipital	6	24.0±4.1	26.67±2.88	0.025
Mixed	57	19.19±5.46	24.14±3.01	<0.001
Others	14	21.57±5.87	25±3.68	0.001
Total	169	20.81±5.26	25.14±3.11	0.001

MoCA: Montreal Cognitive Assessment

Table 3: Multiple linear regression coefficients of the MoCA total score

Variables	Coefficient	SE	*t*	*P*
Constant	15.292	1.749	8.741	0
Age	0.017	0.039	0.425	0.671
Sex	4.746	1.509	3.145	0.002
MOI	0.137	0.588	0.234	0.816
GCS total	2.968	0.447	6.644	0
EDU level	1.144	0.427	2.68	0.008
Lesion site	−0.067	0.199	−0.335	0.738

SE: Standard error, GCS: Glasgow Coma Scale, MoCA: Montreal Cognitive Assessment

Comparison of MoCA Subsets Score at Admission Time and Follow-up

Mean MoCA score obtained in our sample were 20.82 ± 5.265 at time of admission and 25.14 ± 3.11 at 6-month follow-up. Paired sample *t*-test was used to analyze MoCA scores of different subsets between the two groups (Table 5). Mean of each subset was calculated with standard

Table 4: MoCA score in relation to GCS score

GCS at admission	Total MoCA score at admission	Total MoCA score after 6 months
13	16.33 ± 4.91	22.57 ± 3.02
14	21.24 ± 4.12	25.45 ± 2.58
15	23.11 ± 4.62	26.39 ± 2.64

MoCA: Montreal Cognitive Assessment, GCS: Glasgow Coma Scale

Table 5: Mean MoCA subsets score at admission time and follow-up

Function	Timing	Mean±SD	*P*
Visuospatial	At admission	3.73±1.126	0.000
	At 6 months	4.38±0.689	0.000
Naming	At admission	2.66±0.544	0.000
	At 6 months	2.89±0.346	0.000
Attention	At admission	4.43±1.507	0.000
	At 6 months	5.00±0.886	0.000
Language	At admission	1.95±0.844	0.000
	At 6 months	2.34±0.588	0.000
Abstraction	At admission	0.81±0.824	0.000
	At 6 months	1.39±0.536	0.000
Memory	At admission	2.53±1.155	0.000
	At 6 months	3.67±0.760	0.000
Orientation	At admission	4.34±1.295	0.000
	At 6 months	5.09±0.826	0.000
Total score	At admission	20.82±5.265	0.000
	At 6 months	25.14±3.111	0.000

SD: Standard deviation, MoCA: Montreal Cognitive Assessment

deviation, and then, these values were compared with those at 6 months. All subsets showed low mean MoCA scores at admission as compared to follow-up scores. A statistically significant difference ($P < 0.05$) was observed at follow-up period in all subset of MoCA score. Difference for total MoCA score at follow-up period was also found to be statistically significant.

Association of MoCA Subsets Score with Brain Lesions at Admission Time and Follow-up

MoCA score was between 10 and 30 at the time of admission and 21–30 at 6 months follow-up in the present study. To compare the effect of lesion site over various subset of MoCA during 6 months period, patients were divided into six categories based on the lesion site (Table 6). A total of 52 patients had frontal lobe injury, 32 patients had temporal lobe injury, and parietal and occipital lobe injury was present in eight and six patients, respectively. 57 patients belonged to "Mixed" injury group and 14 patients were classified under "Others" group. Mean MoCA score of each lobe is shown in (Table 6) at admission and at 6 months. Each lobe injury shows significant difference ($P < 0.05$) at 6 months' follow-up. Different subsets of MoCA score were also compared at 6 month' follow-up. Most of functions had significant improvement. For frontal lobe and mixed injury group, all MoCA subsets showed significant increase in value at

Table 6: Comparison of MOCA SUBSET Score with brain lesions at admission time and follow up

Lobe	Visuo-spatial			Naming			Attention			Language			Abstraction			Memory			Orientation		
	ADM	6 M	p value	ADM	6 M	p value	ADM	6 M	p value	ADM	6 M	p value	ADM	6 M	p value	ADM	6 M	p value	ADM	6 M	p value
Frontal	3.65	4.42	0.000	2.73	2.96	0.000	4.35	5.04	0.000	2.15	2.5	0.000	0.85	1.42	0.000	2.65	3.77	0.000	4.27	5.15	0.000
Parietal	3.75	3.75	*	3	3	*	5.0	5.75	0.048	2.00	2.5	0.033	0.5	1.25	0.003	3.25	4.25	0.007	5.75	5.75	*
Temporal	3.75	4.38	0.000	2.75	2.94	0.012	4.88	5.06	0.245	1.94	2.19	0.018	1.00	1.44	0.000	2.5	3.75	0.000	4.63	5.19	0.000
Occipital	4.67	4.67	*	3	3	*	6	6	*	2.00	2.67	0.025	1.00	1.67	0.025	2.67	3.67	0.041	4.67	5.00	0.175
Mixed	3.74	4.28	0.000	2.46	2.79	0.000	4.02	4.75	0.000	1.72	2.25	0.000	0.58	1.25	0.000	2.30	3.46	0.000	3.95	4.93	0.000
Others	3.57	4.29	0.003	2.71	2.86	0.165	4.43	4.86	0.054	2.14	2.29	0.165	1.29	1.71	0.008	2.57	3.71	0.003	4.57	5.00	0.054

(* denotes no change in score), ADM=at admission time and 6m denotes 6 month follow up

follow-up ($P < 0.05$). In temporal lobe group, all subsets showed significant increase except "attention" function, which show no significant increase ($P = 0.245$). In parietal lobe group, attention, language, abstract thinking, and memory function showed significant increase in score, whereas visuospatial/executive function, naming, and orientation showed no change in score. Similarly, occipital lobe group showed significant increase in language, abstract thinking, and memory function score, but score for orientation function had non-significant increase while visuospatial/executive, naming, and attention function showed no increase in value. For "Other" injury group, only abstract thinking, and memory function showed significant increase in score with other function showing improvement which was statistically not significant.

DISCUSSION

This study was planned with a objective to explore the cognitive patterns in mTBI patients using MoCA score over a period of 6 months. We performed MoCA on 169 patients with mTBI and evaluated them and followed them over a period of 6 months.

The results of our study showed that 81.66% of patients had cognitive impairment, at the time of their first assessment during their hospital stay. MoCA score <26 is taken as a set point in our study to consider for cognitive decline. Various past studies using different population group of TBI have also reported such high incidence of cognitive impairment (Nasreddine and Patel, 2016; Panwar *et al.*, 2018, Saleh *et al.*, 2018),[25-27] where cognitive deficit was present in 79.2% of patients. This high incidence could be explained by admission criteria followed at trauma center and likely that these admitted patients were more severely injured than those who did not need admission after sustaining mild TBI.

This group of patient was followed up in our outpatient clinic during their post TBI acute recovery period. At 6 months of follow-up, cognitive deficit was seen only in 51.66% of patient (MoCA score <26) with significant improvement in cognitive function in all the patients. Dikmen *et al.* studied 20 patients and noted that some cognitive impairment was present in cases of mTBI compared controls at 1-month post-injury which became insignificant one year and both the cases and controls showed similar performance on MoCA.[28] Ponsford *et al.* conducted a study on 84 patients and followed them up to 3 months.[29] They observed complete resolution of any cognitive impairment which was seen at 1 week. This improvement in function can be explained by the resolution of acute disruption of cerebral function after both direct physical and secondary neuro-pathological events in the brain. As brain physiology re-organizes and some degree of neurological stability is re-attained, cognitive function is tends to normalize.

In our study, level of education and TBI severity were statistically significant factors that affected cognitive functions. Patients who received education for more than 12 years performed significantly better compared to those who received it for <12 years ($P < 0.008$). These results are similar to many previous studies (de Guise *et al.*, 2014, Fretter *et al.*, 2012 and Rosetti *et al.*, 2011).[14,15,28] TBI severity at the time of admission also shows positive co-relation with MoCA score ($P < 0.05$). These results are similar to West *et al.*, 2011 and de Guise *et al.*, 2014.[14,30]

Gender turned out to be a statistically significant factor in our study ($P = 0.008$). This can be attributed to higher number of male participants compared to females in our study and greater exposure of males to RTA since males go out for field work more than females in India. Puvanchandra *et al.*, in his study has suggested that such gender difference is seen with TBI in the Indian Subcontinent.[5] Age was not statistically significant as majority of our study population were of age group <40 years. Leitgeb *et al.* conducted prospective study with 863 patients in 2012 found that age of the patients, GCS score and TBI severity were the main factors affecting the cognitive outcome post TBI.[31] Other authors also reached similar results in their respective studies (West *et al.*, 2011; de Guise *et al.*, 2014).[14,30] However, in a 2007 review by Mathias and Wheaton who did a meta-analysis of 41 studies, it was concluded that age and education were not significant factors causing cognitive deficits in TBI patients.[32] It is seen that age shows negative correlation with MoCA score and younger age group perform better at cognitive scales. This is explained by faster capacity of brain to recover from acute mechanical trauma and better brain plasticity.

A qualitative analysis of cognitive domains of MoCA demonstrated that all the MoCA subset had lower score at the time of admission as compared to at 6 months post injury with statistically significant difference in their score. This indicates global improvement in cognitive function over the period of time as brain recovers from acute injury. In this study, at 6 months, all subsets of MoCA still showed some deficit from their maximum score. Similar results were found in a study by Heitger *et al.* where they observed that cognitive impairment in mild group persisted up to 6 months post TBI.[33] Kemp *et al.* also reported early presentation of the cognitive deficit which persisted for longer time up to 8 months.[34]

Our last objective was to evaluate the effect of site of brain lesions on cognition over a period of 6 months. All the 6 categories of brain injury were compared with all the subset of MoCA at the time of admission and at follow up and their statistical significance was calculated. Results showed mixed injury had lowest mean MoCA score and occipital lobe injury had highest MoCA score. Mixed injuries have diffuse impairment in all the functions/subsets of cognition, due to extensive damage to neural pathway of cognitive function. Occipital lobe has less of cognitive pathway, so better performance in MoCA scale. When this above correlation was followed at 6 months period, all the cognitive subset showed increase in their mean value with most of them showing significant increments ($P < 0.05$). Several references of previous studies can be found in literature in which the relationship between lesion site and cognitive impairment in patients of TBI has been explored. Lehtonen *et al*., 2005 studied patients with TBI lesions in frontal and temporal lobe and the neuropsychological outcome of such injuries in comparison to patients having non-frontal or no lesions.[35] Patients with frontal and fronto-temporal lesions performed better in constructional ability but worse in executive functioning. However, no difference was found in neuropsychological and community reintegration parameters on follow-up at one year. Similarly, a study by Panwar *et al*. found that bilateral and diffuse lesions were more common in patients with moderate TBI, while patients in mild TBI group showed a greater number of unilateral lesions particularly in right frontal location.[26,36,37]

Limitations

There were a few limitations to our study. The study was conducted on mTBI patients at a tertiary care trauma center; hence, the data collected may be too homogenous to be generalized in other population groups. Results may differ between participants in other regions or countries with different population characteristics. Since present study only includes mild cases of TBI, excluding moderate and severe cases, therefore results cannot be generalized for overall TBI population. Furthermore, time period of follow-up was only 6 months so there may be chance that change in pattern of cognition beyond this period could not be detected and also any long-term deficit in cognition may not be known.

CONCLUSIONS

In conclusion, the present study demonstrated that cognitive assessment in every case of TBI is of utmost importance since even cases of mild TBI show impairment in cognitive functions which can last for weeks to months, causing significant morbidity and distress to the patients and their caregivers. MoCA is one such quick and easily implementable cognitive assessment tool which can identify the cognitive damage with fairly high sensitivity. All the main domains of cognition such as executive functions, memory, abstract thinking, attention, language, and orientation show significant improvement over 6 months' period. Even though patient continue to show recover to their cognitive function, they still need to be kept under follow-up and those with continued deficit should undergo further evaluation using detailed neuropsychological and neurocognitive tools. Future studies are still needed to evaluate the association between different domains of the global cognitive function and different brain lesions over course of time. This is the time, we focus on post-TBI rehabilitation programs even for patients with mild TBI who otherwise are not offered rehabilitation most of the time and are forced to endure the social, psychological and economic implications which may take months to recover.

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