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Memory Functioning in 'Good Recovery' Stroke

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Abstract

Objective: The primary aim of this study was to assess memory functioning in patients after a first symptomatic stroke without previous cognitive decline and with a good motor, linguistic, and functional recovery (i.e. 'good recovery').

Methodology: The study was cross-sectional. Subjects were three months or more post stroke patients (both ischemic and hemorrhagic) having 'good recovery,' taken from out-patient services of Dept. of Neurology, King George's Medical University, Lucknow. PGI Memory Scale by Pershad, et al. was used to assess memory functioning. Hindi Mental Status Examination (HMSE) and Modified Barthel Index (MBI) were used to screen for dementia and functional independence respectively. All data were analysed using chi square test and Kruskal Wallis H test. Fisher's exact value was used where cell value was small.

Result: The sample consisted of 30 subjects, 22 (73.3%) males and 08 (26.7%) females. Differences in memory functioning were seen in terms of age, gender and duration since stroke. On average, 63% of the sample had significant memory deficits in several areas of memory functioning. Some of these differences were found to be significant in terms of gender and duration since stroke but not for age.

Conclusion: The study found that the patients being considered as asymptomatic were, infact, exhibiting a multidomain memory impairment that could impact return to life as before stroke. The study throws light on the importance and necessity of regular monitoring and management of cognitive dysfunction in such patients.

Keywords: Memory functioning; Stroke; Cognitive decline; Deficits; Neuropsychology; Cross sectional

Abbreviations: HMSE: Hindi Mental Status Examination; MBI: Modified Barthel Index; MINI: Mini International Neuropsychiatric Interview.

Introduction

Cerebrovascular disorders or stroke are a major cause of the total functional disability in the elderly population. Disablement that occurs due to stroke is usually a mixture of both neurological and psychiatric problems. The psychiatric aftermath may be caused either due to the resultant brain damage or an individual's reaction to the resulting handicaps from stroke.

The psychiatric sequelae and neurological disability have to be addressed in parallel for successful rehabilitation [1].

Stroke has been reported to be one of the major causes of reduction in quality of life because of physical disabilities; second major contributory factor for cognitive deficits and dementia in elderly with frequency ranging from 16-32%; and the third largest cause of mortality, overall, after heart disease and cancer [2]. On an average, it has been found that

a quarter of patients die approximately within a month of having suffered first ever stroke. There is a wide variation in the range of mortality rates across studies, ranging from 18-50%. This may be attributable to the difference in age and health status of the populations being studied. With respect to impairment, estimates show that at 6 months post stroke, about 50% of the patients continue to have either partial or complete motor loss, one quarter are not oriented and about 15% have aphasia. As a result, more than 20% of the patients are atleast moderately dependent. In a study by Pohjasvaara, et al. 286 survivors of stroke were studied at 3 months and 15 months. The study reported that depression and declining cognition were correlated with increased dependence at 15 months. During the first three to four months after stroke, the recovery is usually most rapid. However, some stroke survivors continue to recover well at first and second year after stroke.

In the event of a stroke, patient's personality and life situation have a profound effect on the way he makes adjustment with the disability. Also, the psychiatric components in the picture, especially cognitive functioning, play a vital role in determining the level of success achieved in rehabilitation, and in the overall prognosis too. In a study by Lee, et al. several parameters of stroke recover during the period from pre-treatment to 6 months follow-up, covering both the acute and the sub-acute phases. Recovery was found to be relatively fast during the first four weeks after treatment and then gradually slowed between a periods of three to six months after the stroke had occurred. This study confirmed the importance of first three months after stroke for recovery because it is during this period that most of the recovery, ranging from 48-91% occurs. Therefore, an early and intensive treatment program, focusing on the motor and sensory functions of the individual, may prove to be of utmost importance in recovery from neurological impairments and functionality. These patients who recover significantly well at three to six months post stroke may be suggested to have 'good recovery,' i.e., those patients having no sensory-motor, language or neglect deficits.

However, the cognitive outcomes of patients with 'good recovery' stroke, remains understudied [3,4].

Cognition in Stroke

Cerebrovascular disease is an important risk factor for impairment of cognitive functioning and cognitive deficits are among the more serious consequences of stroke, making attempts at rehabilitation difficult. Also, cognitive deficits are less obvious than physical handicap in the clinical picture, yet often are significant factors which are responsible for failure of recovery. The cognitive impairment that takes place after stroke is typically of a focal nature. However, for some time initially, global confusion and disorientation may be in the picture if extensive damage has taken place. The true extent of cognitive dysfunction is revealed once the situation improves. The longer the duration of clouding of consciousness, the more severe the cognitive deficits are likely to be (Fleminger) [1]. Patients with good recovery, i.e., not exhibiting any evident sensory-motor or language deficits are considered healed and expected to return to their family, social and professional lives like they were prior to stroke. Traditionally, clinical outcomes in studies related to stroke have been evaluated only in terms of physical recovery or focal cortical syndromes such as aphasia or neglect. The wide spectrum of cognitive changes remains overlooked.

Only a few prospective follow-up studies have reported the long term functional impact of multi-domain cognitive impairments. Some of the major domains usually affected due to cognitive impairment are attention, processing speed, executive functions, learning and memory. When stroke occurs, attention and executive functions are most severely impaired, however, memory deficits have also been reported. Results of a study on five-year progression of vascular cognitive impairment have been reported to include memory deficits. In older people, the presence of subcortical infarcts has been found to be associated with lower episodic, semantic, and working memory performance [5]. Approximately 30% of stroke patients suffer from dementia within a year of being diagnosed with stroke. Earlier studies have reported 3-months post stroke memory deficits prevalence varying from 23%-55%, ending with a decline to11% to 31%, 1-year post stroke [2]. Identifying the extent of compromise made to memory functioning after stroke is not easy. Gradually memory deficit may lead to slowed cognitive flexibility, perceptual disorder and impairment of information retrieval [3]. When memory deficits occur, they have a different etiopathogenesis to that seen in Alzheimer patients.

Recognition memory, testing retention of information without effortful search and retrieval, may be less affected as compared to non-cued recall after stroke [6]. Thus, memory deficits may occur for one or more memory types depending upon the stroke location and severity [7].

Even though cognitive impairment is a common feature after stroke, the long term significance and prevalence of the myriad neuropsychological deficits on functional outcome are still not well known. In the recent years, an emerging interest in studying the cognitive functioning of good recovery stroke is seen. The present study was planned to assess memory functioning in patients who show successful physical recovery post stroke, i.e. 'good recovery stroke'.

Methods

The present study was a cross sectional study using purposive sampling method aimed at assessing memory functioning in patients post-stroke (3 months or more) with 'good recovery.' The sample was collected from out-patient services of Department of Neurology, King George's Medical University, Lucknow on specified days. The study was approved by the Institutional Ethics Committee.

Sample

A total of 30 participants were included in the study. The eligibility criteria for participation were (1) Adults between the ages 18 years-60 years (2) >3 months after first ever stroke (3) with 'good recovery' (4) able to read and write Hindi (5) willing to give written informed consent. Those with a comorbid neurological or psychiatric disorder or having any medical illness requiring immediate attention were excluded. Also, those with abnormal blood parameters (LFT, KFT, Blood sugar, T3/T4/TSH, B12, Homocysteine) were excluded as that might hamper appropriate interpretation of results, given that chronic medical illnesses can be associated with cognitive impairment [1,8].

Procedure

A total of 36 patients were screened out of which 30 formed the sample for the present study. Patient selection was done in consultation with Neurologist, especially in order to ensure absence of neurological deficit and normality of blood parameters. Patients with "good recovery" and normal blood parameters, who met selection criteria, taken up for study related assessments.

Measures

Semi structured proforma for socio-demographic and clinical details: Specifically designed semi structured proforma was used to record the sociodemographic data like name, age, gender, education, marital status, monthly income; and clinical details like age at onset of stroke, duration since stroke, type of stroke, family history of stroke and blood parameters of the patient. Mini International Neuropsychiatric Interview (MINI) Version 6.0.0. was applied to rule out the presence of any comorbid psychiatric disorder. Hindi Mental Status Examination (HMSE), Hindi version of the Mini mental status examination, a 30 point measure was applied to screen for the presence of gross cognitive disturbances, if any. A cut off score of ≥23 indicating preserved cognition was taken. Modified Barthel Index (MBI) is an ordinal scale applied to measure performance in activities of daily living. The scale was applied to check for functional independence. A cut off score of ≥12, indicating preserved functioning was used.

PGI Memory Scale [9] was used to assess memory functioning. It includes both verbal and non-verbal items and has ten subtests- Recent Memory, Remote Memory, Mental Balance, Attention & Concentration, Delayed Recall, Immediate Recall, Verbal retention for similar pairs, Verbal retention for dissimilar pairs, Visual retention &Recognition. Its test-retest reliability over a period of one week ranges from .69-.95 for ten subtests and for the total test about .90 (test-retest and split-half). Correlation of PGIMS with Boston's Memory Scale and Wechsler's Memory Scale were found to be 0.71 and 0.85 respectively. Separate norms have been provided for three education levels, i.e., „0-5," „6-9," and "10 and above" years of schooling.

Statistical Analysis

Data was summarized as frequencies, percentages, mean and standard deviation. The statistical analysis of the gathered data was done with respect to three aspects- age, gender and time duration since stroke. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as frequencies and percentage. Chi-square test and Kruskal Wallis H test were used to compare the different groups. Fisher's exact value was used where the cell value was small instead of Pearson Chi-square value to determine the level of significance. All analyses were two tailed and p values <0.05 were regarded being significant.

Results

A total of 36 patients having suffered a stroke were screened for inclusion into the study over a period of 3.5 months. Out of the six patients excluded, two refused to give consent and four had comorbid psychiatric disorder. Two of the patients had depression, one had bipolar disorder and one had psychosis (Table 1). depicts the socio-demographic profile of the study sample. The mean age of the sample was 46.56±9.12) years. The sample was divided in three age groups as shown. 10% of the sample belonged to 18-30 years age group, 33.3% of the sample belonged to 31-45 years age group and majority of the sample, i.e., 56.67% belonged to 46 -60 years age group. A majority of patients in the study were male (73.3%). For education, the study sample was divided into two categories. 76.7% of the sample was 'school educated' (those with upto 10 years of education) and 23.3% of the sample was 'college educated' (those with more than 10 years of education). With regards to occupation, 86.7% of the sample was employed and 13.3% of the subjects in the sample were housewives.

Socio demographic profile		No. of Cases (N=30)	Percentage	Mean ± SD
Age	18-30 years	3	10%	46.56 ±9.12
	31-45 years	10	33.33%	
	46-60 years	17	56.67%	
Gender	Male	22	73.30%	
	Female	8	26.70%	
Education*	School Educated	23	76.70%	
	College Educated	7	23.30%	
Occupation	Employed	26	86.70%	
	Housewife	4	13.30%	
Socio- economic status**	<5000	0	0%	
	5000-1000	6	20%	
	>10000	24	80%	
*- as per NIMHANS Neuropsychological Battery				
** Categories as per Socio-economic and Caste Census of India, 2011.				

Table 1: Socio-demographic profile of the study subjects (N=30).

With respect to the clinical characteristics of the sample, the mean age at onset for the study sample was 46.13 (±9.02) years. Time duration since stroke was divided into three categories, a large part of the sample belonged to 6-9 months duration (43.3%) followed by 3-6 months (40%) and then 9-12 months (16.7%) of the sample. Most of the patients (83.3%) suffered ischemic type stroke (Table 2). Only 16.7 % patients suffered from hemorrhagic type of stroke. Family history of stroke was found to be present in only 20% of the sample.

Clinical profile		No. of Cases (N=30)	Percentage	Mean ± SD
Age at Onset	18-30 years			46.13 ± 9.02
	31-45 years			
	46 -60 years			
Duration since stroke	3-6 months	12	40%	
	6-9 months	13	43.30%	
	9-12 months	5	16.70%	
Type of stroke	Ischemic	25	83.30%	
	Haemorrhagic	5	16.7	
Family History of stroke	Yes	6	20%	
	No	24	80%	

Table 2: Clinical characteristics of the study sample (N=30).

The mean scores for the study sample on Hindi Mental Status Examination (HMSE) and Modified Barthel Index (MBI) were calculated. The cut off score for HMSE was 23 or more and the mean score was 26.63 (± 1.09) indicating that based on the HMSE scores, the sample had no gross cognitive disturbances. For MBI, the cut off score was 12 or more and the mean score was 17.83 (± 0.91) indicating that the sample was functionally independent. The results obtained for HMSE and MBI were subjected to further statistical analysis, in order to find out the presence of any significant differences that may be present on the basis of age, gender and duration since stroke. None of the differences were found to be statistically significant.

With respect to memory assessment, presence and absence of dysfunction in various sub-domains was assessed on the basis of norms for the PGI Memory Scale. Table 3 shows the results found on various sub-domains of the PGI Memory Scale in terms of dysfunction present or absent. Overall, 63% of the sample had deficits on atleast one subtest as measured by the scale.

Name of the subtest	Dysfunction	
	Present n (%)	Present n (%)
Remote Memory	18 (60)	12 (40)
Recent Memory	05 (16.7)	25 (83.3)
Mental Balance	21 (70)	09 (30)
Attention & Concentration	25 (83.3)	05 (16.7)
Delayed Recall	24 (80)	06 (20)
Immediate Recall	26 (86.7)	04 (13.3)
Verbal Retention for Similar Pairs	21 (70)	09 (30)
Verbal Retention for Dissimilar Pairs	22 (73.3)	08 (26.7)
Visual Retention	25 (83.3)	05 (16.7)
Recognition	26 (86.7)	04 (13.3)

Table 3: Results of PGI Memory Scale.

Age and gender have been shown by previous studies to play a role in occurrence of stroke and have also been cited as predictors of outcome post stroke. Differences in memory functioning on the basis of age groups (18-30, 31-45&46-60 years) and gender were analysed. Results show that the three age groups did not differ significantly with regards to memory functioning. However, with regards to gender, significant differences were found on the subtests of mental balance, delayed recall, verbal retention for similar pairs and verbal retention for dissimilar pairs, on PGI Memory Scale. Further, time duration since stroke is also a significant variable as it has been shown to be an important predictor of recovery post stroke by previous studies. Thus, differences in memory functioning on the basis of time duration since stroke were also assessed.

In Table 4, significant differences in memory functioning in terms of age, gender and duration since stroke is shown. The sample was divided into three groups on the basis of duration (3-6 months, 6-9 months & 9-12 months). Significant differences were found in the area of mental balance, delayed recall, visual retention for similar pairs and visual retention for dissimilar pairs in terms of gender. In terms of duration since stroke, differences were found in the area of remote memory. No differences were found to be significant in terms of age, however.

Name of the test X^2 value (df=2)		Age		Gender		Duration since stroke	
		p value	Fisher's exact value (df= 1)	p value	X2 value (df= 2)	p value	
Memory	Remote Memory	0.368	0.832	0.455	0.678	**8.360***	0.015
	Recent Memory	1.899	0.387	0.136	1	1.615	0.446
	Mental Balance	5.763	0.056	**5.487***	0.032	2.869	0.238
	Attention & Concentration	1.582	0.453	0.545	0.589	4.302	0.116
	Delayed Recall	2.207	0.332	**6.136***	0.029	1.963	0.375
	Immediate Recall	1.407	0.495	1.285	0.284	3.107	0.212
	Visual Retention for Similar Pairs	2.44	0.295	**5.487***	0.032	1.697	0.428
	Visual Retention for Dissimilar Pairs	1.5	0.472	**7.163***	0.016	1.18	0.554
	Visual Retention	1.582	0.453	0.545	0.589	4.302	0.116
	Recognition	1.407	0.495	1.285	0.284	3.107	0.212
* p<0.05							

Table 4: Differences in memory functioning in terms of age, gender and duration since stroke (N=30).

Discussion

Research in the recent years has highlighted the fact that post stroke cognitive phenomenology is still poorly understood. Moreover, only in the last six years has the importance of assessing cognitive impairments and their impact on functional outcome in 'good recovery' stroke has been stressed upon, with the first study published in 2012 by Plantom, et al. Stroke is a disabling condition with a significant negative impact on the quality of life. While cognitive deficits are poor predictors of a good outcome post stroke, the cognitive profile of stroke patients, especially those with 'good recovery' still remains understudied. In view of this, the present study was designed to assess the memory functioning in patients with 'good recovery' at three months (or more), post stroke.

In the present study, approximately 63% of the sample had deficits in the area of memory as measured by the PGI Memory Scale. The findings of this study are in line with earlier studies on good recovery stroke. In the study conducted by Jokinen, et al. [4], overall 83% of the sample was found to be deficient in atleast one cognitive domain wherein most common impairments were found in memory, executive functions and visuo-constructional abilities. These findings are similar to the present study.

In yet another study by Plantom, et al. [3] on cognitive impairments in 'good recovery' stroke, thirteen cognitive functions were tested and performance was compared to healthy controls. Statistically significant differences were found between the performance of the patients tested and the healthy controls. Further, additional analyses done using Cohen's d indicated a large effect size for seven of the thirteen cognitive functions assessed- categorization, mental speed, initiation, free recall, verbal working memory, continuous attention and visual working memory. For other domains, i.e., motor speed, errors of continuous attention, flexibility, inhibition, recognition and cued recall, medium effect sizes were found.

Cognitive impairment can occur immediately after stroke. However, it often becomes apparent only after some time has passed [4]. It is still not clear whether stroke has an independent effect on resulting cognitive decline or it merely speeds-up a pre-existing process. It has also been suggested that because of underlying subclinical cerebrovascular diseases such as symptom free infarcts, white matter lesions or microbleeds, cognitive decline may be a predictor for stroke. In a meta-analysis conducted by Pendelbury, et al. (2009), the pooled prevalence of pre-stroke dementia was higher (14.4%) in hospital based studies than in population based studies (9.1%). In yet another meta-analysis, each standard deviation of low performance in tests for cognition was associated with a 15% higher risk of stroke [10]. Furthermore, people showing a more pronounced cognitive decline over time have a greater risk for developing stroke, although cognitive impairments are most frequent within the first 3 months after a stroke [11].

Recent studies have demonstrated that residual cognitive impairments can persist as long as 75 months after a stroke and perhaps longer [13].

'Good recovery' stroke, as defined earlier is characterized by the presence of "successful clinical recovery" [4] or by the absence of any evident sensory-motor, language or neglect deficits [3]. In this study, 'good recovery' was characterized as lack of any evident sensory-motor, language deficits as indicated by score of 12 or more on Modified Barthel Index, indicating that the patient was functionally independent. Even though cognitive impairment is common after stroke and is a major determinant of poor long term outcome, the prevalence and long-term significance of the diverse neuropsychological deficits even after successful clinical recovery are still not well known [3,4]. Post-stroke cognitive impairment is not a unitary syndrome in and of itself. It includes several types of deficits in multiple domains such as attention, executive functions, memory, language and visuo-perceptual abilities.

Earlier studies assessing the cognitive impairment symptomatology in stroke patients have also found that impairment in memory functioning is one of the biggest sequelae post stroke. In a study by Hochstenbach, et al. [14] the most frequent cognitive complaints were forgetfulness (60%), mental slowness (56%), poor concentration (55%), and inability to do two things simultaneously (53%). Pohjasvaara, et al. [15] examined 486 consecutively admitted ischemic stroke patients between 55 and 85 years of age (mean 71.2 years), and found that cognitive impairment of any kind was present in 61.7% of the subjects 3 months post-stroke. The functions most frequently affected were memory functions (23%-34%), orientation (23%) and attention (22%). Cognitive changes as assessed by neuropsychological tests are also confirmed by 50% or more of the patients and their next of kin in interviews 3-9 months post-stroke.

The findings of all the above studies discussed support the findings of the present study where impairments in memory functioning were found even in patients with good functional outcome.

With regards to differences in memory functioning in terms of age, no significant differences were found in the present study. Thus, it cannot be commented upon as to which age group had more deficiencies in memory functioning. In the study conducted by Jokinen, et al. in 2015 [4], memory

impairment was not found to be significantly associated with age. However, the post stroke prevalence ratio of cognitive impairment increased with older age as revealed by multivariate analyses as revealed by the South London Stroke Register [16]. This study also reported that with each year increase in age, the prevalence of cognitive deficits increases by 2% in patients with stroke. Increasing age has been found to be a significant risk factor for occurrence of stroke and several studies have supported this view [17,18]. Maybe when the study is repeated on a larger sample, age differences may be found.

Gender has been shown by previous studies to play a role as a risk factor for the occurrence of stroke. Significant differences in memory functioning were found in terms of gender in the present study. On PGI memory scale, differences were found on the subtests of mental balance [$\chi 2$ 5.487, $p<0.05$]; delayed recall [$\chi 2$ 6.136, $p<0.05$]; verbal retention for similar pairs [$\chi 2$ 5.487, $p<0.05$] and verbal retention for dissimilar pairs [$\chi 2$ 7.163, $p<0.01$]. However, on the basis of the results of present study, it cannot be commented as to whose performance was more impaired when compared in terms of gender. Also, presence of gender differences in stroke is a controversial issue with some studies reporting male gender to be at higher risk of stroke [17,18] and some reporting women to be at a higher risk (Reis et al., 2008; Nys et al, 2007). In the study by Renjen, et al. [18] conducted in India, the male female ratio of stroke was found to be 2:1. Similar findings were reported earlier in a study conducted in Bangalore city where a greater preponderance of stroke was found among males (67%) and the male female ratio was found to be 2:1 [19]. Sex differences in the distribution of cognitive dysfunction after stroke might be attributable to differences in stroke mechanisms between men and women.

Time duration since stroke is a significant variable as the results of neuropsychological assessment vary depending upon testing time. A period of three months or more has been described as the optimal period of recovery and studies have revealed that traditionally, recovery reaches a plateau after a time period of 90 days has passed [3,4,20]. Thus, differences in neuropsychological performance on the basis of time duration since stroke were looked for. The sample was divided into three groups on the basis of duration (3-6 months, 6-9 months & 9-12 months). Results show that in terms of duration since stroke, significant differences in memory functioning were found in the area of remote memory [$\chi 2$ 8.360, $p<0.05$]. Even though it cannot be commented upon as to which group had the lowest scores, it may follow from these findings that even after a considerable duration has passed, cognitive impairment still remains present. Earlier studies have reported that memory decline becomes apparent gradually. Also, mostly, long-term episodic memory has been found to be impaired significantly after some time has passed post stroke [4]. Thus, it may follow logically that there are significant differences in memory functioning in terms of duration since stroke in the sample.

Overall, the findings of this study are in accordance with earlier studies where neuropsychological testing has been done at various intervals and results have revealed the presence of cognitive deficits in different ranges on the basis of duration. However, estimating the prevalence of cognitive impairment is difficult because of the so many different cognitive tests and cut-offs used in various studies. Depending on the criterion used and on the type of stroke, 17%-92% patients have been diagnosed with cognitive impairment at three months post stroke [21-23].

Limitations

This study has certain limitations. The first limitation was a small sample size due to a constraint of time as this study was conducted within a period of 3.5 months. Also, there is a lack of control group matched for age, gender and education. The assessments were cross sectional in nature, limiting longitudinal and possibly dynamic understanding of cognitive impairment phenomenology in the sample. Also, not all possible areas and determinants of cognitive functioning have been assessed. The analysis of results has been done only in terms of age, gender and duration since stroke. Relationship with other variables like education, site of lesion, family history of stroke, lifestyle related factors, etc. has not been assessed in the present study. Post hoc analysis can also be done for more specific results.

Strengths

To the author's best knowledge, this is probably one of the first Indian studies to assess the memory functioning of patients with 'good recovery' stroke. Another major strength of the study is that memory functioning has been compared with respect to age, gender and duration by dividing these variables into separate groups. This division allowed for a better understanding and a more precise picture of neuropsychological functioning in the study sample. The study made use of standardized tools and most importantly Indian normative data was available. This lends to the generalizability of the study findings in the Indian population.

Future studies can look for functioning in terms of site of lesions and the area impaired accordingly. Associations with more determinants can be looked for. Also, study can be planned using a larger sample.

Conclusion

The impairment in memory functioning is high. More than half of the sample (63.3%) reported deficits on atleast

one subtest of memory functioning. Differences in terms of gender and duration since stroke were found to be significant [24-28].

The findings of this study have important implications for clinical practice, the core message being that cognitive functions must be carefully and periodically assessed in patients with stroke, including those with apparently good physical and functional recovery. Cognitive impairment early post stroke may serve as a risk marker for any functional impairment taking place in future. Very often, such patients are not aware of their cognitive impairments and are discharged without proper rehabilitation services provided for their assistance. The findings of the study might emphasize the requirement of a multidisciplinary team approach in the assessment of cognitive and emotional impairments in such patients. In lieu of this, the role of clinical psychologists becomes very important.

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