ORIGINAL ARTICLE

Visuospatial Working Memory Deficits in Patient with Schizophrenia

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ABSTRACT

Background: Review of Literature suggests that cognitive deficits of patients with schizophrenia can be attributed to an inherent deficit of working memory. Hence, present study was conducted to assess the spatial working memory in schizophrenic patients, to compare it with normal control and to find out clinical and socio-demographic correlates of spatial working memory deficit.

Material & Method: The sample consisted of 25 schizophrenic patients (diagnosed according to DCR of ICD-10) and 25 normal participants. Psychopathology was rated on Brief Psychiatric Rating Scale. Normal participants were screened using General Health Questionnaire-12. The Rey–Osterrieth Complex Figure Test was used to assess visuo-spatial working memory.

Result: Result shows that schizophrenic patient performed poorly on all the trials of ROCFT than normal control. Increased severity of psychopathology was correlated with poor visuo-spatial working memory.

Conclusion: Since severity of psychopathology was correlated with poor immediate recall trial and delayed recall trial, longitudinal studies will be important to know whether these deficits improve with improvement in psychopathology. Findings will help in framing cognitive rehabilitation strategies for management of the schizophrenic patients.

Key Words: visuospatial working memory, schizophrenia

Schizophrenia is associated with a broad array of cognitive impairments, including impaired attention/ information processing, reasoning and problem-solving, social cognition, processing speed, verbal and visual learning and memory, and working memory functions. Attention, language, memory, and processing speed impairments are critically important and account for much of the variance in poor social and occupational functional outcomes. On a theoretical level, attention, working memory, and, possibly, verbal memory impairments may be liability and vulnerability markers and may be used to define schizophrenia phenotypes. A number of investigations have demonstrated that many of the cognitive deficits of schizophrenic patients can be attributed to an inherent deficit of working memory, and at least some of the cognitive deficits of schizophrenic patients can be attributed to a dysfunction of the pre-frontal cortex[1]. Spatial working memory (SWM), the temporary storage and manipulation of spatial information in the service of "higher" cognitive processing, has been proposed as a potential locus of dysfunction in the pathophysiology of schizophrenia. Cognitive processes that involve spatial working memory are compromised by a number of mental illnesses; symptoms (absence of

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normal traits) include affective and motivational deficits, emotional and social withdrawal, disorganized speech and anhedonia.

Many studies indicate that schizophrenia patients show working memory deficits, transcending differences in specific paradigms or tasks employed[2-8]. There is partial evidence for the trait-marker hypothesis of working memory deficit. In the current study, we examined one component of the working memory system i.e., spatial working memory. Park et al. (1992, 1995)[2, 9] reported SWM deficits in the non affected first degree relatives of schizophrenic patients as well as schizophrenic patient. Schizophrenic patients exhibit impaired performance in spatial working memory tasks (spatial oculomotor tracking tasks) that involve eye or manual movements toward the remembered direction of a visual target presented a few seconds earlier or that require them to keep track of the locations of visual stimuli presented or sampled in sequence. They also concluded that schizophrenia is causally associated with an inherent (genetic) impairment of spatial working memory that is probably associated with dysfunctions of the pre- frontal cortex [10].

Schizophrenic patients are similarly impaired in antisaccade tasks which are a measure of spatial working memory, requiring an eye movement in the direction opposite to a visual target, and to smooth-pursuit eye movements, tracking a moving visual stimulus[11,12]. Impairment of spatial working memory performance has been observed in patients with both negative and positive symptoms of schizophrenia, including those with psychosis, those who are medicated and unmediated, those in the acute phase of illness or in relapse, and even in undiagnosed relatives of schizophrenic patients[6, 9, 13, 14] and it may be at the root of the cognitive fragmentation associated with a propensity towards psychotic symptoms[15]. Joyce *et al* (2002)[16] found significant deficits in spatial working memory, short-term spatial memory and long-term episodic memory in 136 patients with schizophreniform disorder (with less than 12 weeks' medication) compared with 81 healthy controls. Some studies done on schizophrenic to know neuropsychological profile also found that schizophrenic patients performed worst on Ray-Osterrieth Complex Figure test[17-22].

Review of literature shows that there is lack of study on spatial working memory in Indian context. The purpose of the present study was to assess the spatial working memory in schizophrenic patient, to compare it with normal control and to find out clinical and socio-demographic correlates of spatial working memory deficit.

MATERIALS AND METHOD:

SAMPLE:

This is a hospital-based cross sectional study done at Central Institute of Psychiatry, Ranchi. The sample comprised of 25 patients of schizophrenia and 25 normal participants. These individuals fulfilled the criteria for schizophrenia according to DCR of ICD-10 (WHO, 1992)[23]. Patients with any co-morbid psychiatric disorder and any significant neurological disorder, head injury, epilepsy, major physical illness, and using any substance were excluded from the study. The mean age was 29.32 ± 5.49 years for patient group and 26.68 ± 5.44 years for patient group. Minimum education of all participants was 10 years. Majority of participants of both groups were Hindu and belonged to rural background.

TOOLS:

Socio-demographic and Clinical Data Sheet:

A socio-demographic and clinical data sheet was specially designed for this study. It contained information about socio-demographic and clinical variables.

Brief Psychiatric Rating Scale (Overall & Gorham, 1988[24]):

The Brief psychiatric rating scale (BPRS) is a widely used scale that measures major psychotic and non-psychotic symptoms in individuals with a major psychiatric disorder, particularly schizophrenia. This scale contains 18 items and it is rated on 7 point scale.

General Health Questionnaire-12 (Goldberg & Williams 1988[25]):

It consists of 12 items and is used to screen probable psychiatric morbidity.

The Rey–Osterrieth Complex Figure Test (ROCF; Rey, 1941[26]):

It was developed by Rey in 1941 and standardized by Osterrieth in 1944, is a widely used neuropsychological test. The ROCF consists of three test conditions: Copy,

Immediate Recall and Delayed Recall and measures visuo-spatial, constructional functions, and nonverbal memory.

PROCEDURE:

After screening participants were selected. Socio-demographic data sheet was filled up. BPRS was administered on patient group and GHQ-12 was administered on normal group. Rey–Osterrieth Complex Figure Test (ROCF) was administered on all participants individually.

STATISTICAL ANALYSIS:

To compare the performance of patient and control groups t-test was used. Correlation between ROCFT variables and socio-demographic and clinical variables was computed using Pearson's r and point biserial correlation. Statistical Package for Social Sciences (SPSS), version 13.0 was used for the analysis of the data.

RESULTS

The performance of schizophrenic patients and normal control was compared on Ray Osterrieth Complex Figure Test (ROCFT) copy trial, immediate recall, Delayed recall, recognition total correct. Normal control scored higher on all the trials of ROCFT than schizophrenic patients (Table 1). Statistically significant difference ($p < .01$) was found which indicates that schizophrenic patient performed poorly on all the trials of ROCFT than normal control.

Table 1: Performance of patient and normal group on ROCFT

Variable	Schizophrenic patients Mean ±SD (N=25)	Normal control Mean ±SD (N=25)	t (df=48)
ROCFT copy trial	33.52 ±3.58	36.00± 0.00	03.46**
ROCFT immediate recall	12.80 ±5.70	28.14 ±4.19	0.84**
ROCFT Delayed recall	12.52 ±5.50	28.18 ±4.46	11.06**
ROCFT recognition total correct	17.32 ±2.70	19.96 ±2.05	03.89**

Significant at ** p<0.01

To find out socio-demographic correlates of the performance correlation was computed. Significant positive correlation has been found between education of schizophrenic patient and copy trial of ROCFT ($p < .05$), residence of schizophrenic patients and recognition trial of ROCFT ($p < .05$), and family income and all the trials of ROCFT (Table 2). In clinical variables, BPRS Score was significantly negatively correlated with immediate recall trial and delayed recall trial of ROCFT ($p < .01$) suggesting that increased severity of psychopathology was correlated with visuo-spatial working memory (Table 3).

Table 2: Correlation between socio-demographic variables and performance on ROCFT

Variable	ROCFT copy trial	ROCFT Immediate recall	ROCFT Delayed recall	ROCFT Recognition trial
Age	- 0.12	-0.02	0.03	-0.27
Education	0.41*	0.33	0.34	0.26
Total no of family members	-0.23	0.15	0.16	0.28
Marital status	.27	.06	0.03	.26
Sex	-.09	.21	.17	.21
Occupation	-.12	.12	.11	-.23
Residence	-.33	-.27	-.28	-.40*
Family income	.39**	.32*	.32*	.29*
Religion	.12	.06	-.05	.03

Significant at *p<0.05

Table 3:Correlation between clinical variables and performance on ROCFT

Variable	ROCFT copy trial	ROCFT Immediate recall	ROCFT Delayed recall	ROCFT Recognition trial
Duration of treatment	0.15	0.03	0.03	0.18
BPRS Score	-.17	-.66**	-.66**	-.14
Family history	.21	.17	.20	.01
Course of illness	.15	.14	.16	.20
Progress of illness	.25	.37	.32	.30

Significant at ** p<0.01

DISCUSSION:

The aim of the present study was to see visuo-spatial working memory deficit in schizophrenic patients. Visuo-spatial working memory was assessed by Ray Osterrieth Complex Figure Test (ROCFT) copy trial, immediate recall, delayed recall, and recognition trial. Schizophrenic patients showed significantly poor performance on ROCFT than normal control suggesting significant deficit in visuo-spatial working memory of schizophrenic patients. Present results are consistent with the findings of previous studies. Bozikas et al. (2006)[17] found significant difference (p value<0.01) between normal control and schizophrenic patients on immediate, delayed and recognition trial of ROCFT. White et al. (2006)[18] also reported that normal control scored high on copy trial, and immediate and delayed recall of ROCFT than schizophrenic patients. Deficit in visuo-spatial working memory of schizophrenic patients have been reported by Snitz et al. (1999)[19], Hoff et al. (1999)[20], Krishnadas et al. (2007)[21] and Brodeur et al. (2010)[22].

Correlation between BPRS score and ROCFT suggests that increase severity of psychopathology was correlated with poor immediate recall trial and delayed recall trial. Clinical correlates of ROCFT performance is less studied area. Krishnadas et al. (2007)[21] found that there was no significant meaningful correlation between the scores on the tests of ROCFT and the scores on SANS, BPRS and HRSD, however, it is important to note that most of these patients were in remission phase.

In order to generalize present findings study should be replicated on a large sample. Since severity of psychopathology was correlated with poor immediate recall trial and delayed recall trial, longitudinal studies will be important to know whether these deficits improve with improvement in psychopathology. Findings will help in framing cognitive rehabilitation strategies for management of the schizophrenic patients.

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