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Research Paper

Cognitive profile during remission phase of bipolar mania

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ABSTRACT

Background – Normally, it is considered that as the severity of bipolar disorder decreased the patients improve their cognitive function. But recently, cognitive impairment in bipolar disorder is coming under increasing scrutiny because of some poor cognitive performance in bipolar patients despite the improvement in their severity of illness and mood. And some deficits have been shown to be more persistent. The time course of cognitive impairment in bipolar disorder is not well studied. ***Purpose*** - The present study aims to investigate cognitive functioning of bipolar mania especially in remission phase of the illness so that an insight could be developed regarding prognosis and overall social and occupational management as well as therapeutic plan. ***Methods*** – Cognitive impairment was assessed on PGI-Battery for Brain Dysfunction to all 40 male and 40 female adult patients suffering from bipolar affective disorder with the manic episode during their remission phase and mostly recovered or in mild level of severity, and compared to normal controls. They were limited to less than five years of total illness duration including two to three episodes of mania or mania and depression with onset of illness after 18 years of age. ***Result*** – Findings suggested impairment in all domains of cognitive function included in the study. On memory scale 86.3%, on intelligence scale 63.8% and on scale assessing visuospatial/perceptuomotor abilities 50% patients performed poorer to normal control. They significantly performed poorer on all sub domains of memory scale, intelligence scale and visuospatial/perceptuomotor scale to normal control except difference between PQ & VQ of intelligence scale. Further, As higher score shows higher dysfunction on PGI-BBD, total score was positively correlated to total duration of present episode, but significant negative correlation was found between retention for similar pair and age of onset, BGT and total duration after 1st episode, and immediate recall, retention of dissimilar pair, recognition and duration of the present episode. ***Conclusion*** – Undoubtedly, many bipolar patients do not reach to optimum level of their cognitive abilities during remission phase or normal stage of the illness. It needs to take into consideration while formulation therapeutic or management plan for them.

Keywords: *Memory, intellectual function, visuospatial abilities, perceptuomotor, Bipolar Affective Disorder, impairment.*

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Higher mental processes which make a person enable to acquire highest level of knowledge is known as cognition. It includes various processes such as perception, memory, thinking, intelligence and executive function as well.

Disturbances in any elements of the cognitive area may reflect as sign or symptoms in a person's behaviour varies from mildest to profound level depending on areas and level of disturbance. In various chronic psychiatric disorders or organic based psychiatric disorder, ample evidences reported of cognitive disturbances in earlier studies but still there is a dilemma taking such disturbances in bipolar affective disorder especially when the symptoms are functional in nature or in the condition where there is no significant evidence of organic injury. Apart from this, mostly bipolar patients show generally good outcome of treatment; however, a sub population of between 5% - 34% have constantly been described as having poor social outcome or poor response to treatment (Johnston et al., 1985; Harrow et al., 1990). It also has been observed that patient with bipolar disorder cannot think clearly. The reasons identified in studies are cognitive impairment and lack of awareness of illness.

The different set of research findings suggested that tasks that demand the most effort of speed are difficult for patients with bipolar disorder. Though, studies demonstrating cognitive impairment and memory deficits in the depressed patient are numerous, few such studies have been conducted in the euthymic period, deficits have been observed to persist despite improvement in clinical state (Savard et at., 1980; Sapin et al., 1987). To date, some converging evidence suggests that people with bipolar disorder exhibit persistent cognitive impairment across a range of tasks of attention, memory and even executive function during remission (Van Grop et al., 1998; Ferrier et al., 1999; Rubinsztein et al., 2000; Martinez-Aran et al., 2004). And all patients have shown dysfunction in several cognitive areas, such as attention, executive function, learning, memory and psychomotor speed (Martinz-Aran et al., 2000; Bearden et al., 2001; Quraishi et al., 2002). However, it remains unclear whether cognitive deficits are stable and independently of clinical state.

Most investigations have compared heterogeneous group without distinguishing between patients in different states of the illness. The controversy among authors regarding what kind of cognitive functions are impaired during the active periods of the illness and which of these deficits persist in clinical remission may probably be due, in part, to methodological limitations. Moreover, regarding intellectual functioning and visuospatial/perceptuomotor functioning of patients suffering from bipolar affective disorder very less study have been conducted; however results varied from one study to another and need further research to reach at a conclusion. Further, how do some other clinical factors such as number of episodes, duration of illness, and severity of illness influence the cognitive functions especially of the manic type need to elaborate.

On this background the present study aims to investigate cognitive functioning of bipolar mania especially in remission phase of the illness so that an insight could be developed regarding prognosis and overall social and occupational function.

MATERIALS AND METHODS

Sample characteristics

To conduct the present study a total of 80 inpatients and outdoor patients of bipolar affective disorder with current episode of mania during of their remission phase mostly recovered or mild level were selected including 40 male and 40 female diagnosed on DCR of ICD-10 from Ranchi Institute of Neuro-Psychiatry & Allied Sciences (RINPAS), Ranchi, Jharkhand.

The sample were not included any such patients having co-morbid psychiatric disorder, history of alcohol and substance abuse, family history of mental illness, significant head injury or other neurological problems, intellectual disability or poor eye sight. Further, the clinical sample were limited to less than five years of total illness of duration including two to three episodes of mania or mania and depression with onset of illness after 18 years of age. In the normal control group randomly selected 40 male and 40 females were included matched on age, gender, education, handedness, marital and socioeconomic status. The age range of the sample was 18 to 45 years.

Tools

To collect the relevant information for the study a self-design demographic and clinical data sheet were used apart from following screening and assessment tools for the assessment of cognitive domains.

1. ***Sidedness Bias Schedule (Mandal et al., 1992)*** **–** Hindi version of sidedness bias schedule was used to determine the handedness of the subjects,
2. ***Young Mania Rating Scale (Young et al., 1978)*** **–** This is well reliable and probably the most frequently worldwide utilized rating scale to assess core manic symptoms containing 11 items – elevated mood, increased motor activity-energy, sexual interest, sleep, irritability, speech (rate and account), language-thought disorder, content, disruptive-aggressive behaviour, appearance, and insight.
3. ***PGI-General Well Being Measure (Verma & Verma, 1989)*** **–** To screen the well being of the normal controls these screening tools was used which is based on USA developed general well being schedule and the Hindi version of this scale contains 20 items to measure general well being. It is a well reliable on KR-20 formula and found to be 0.98 and valid as well.
4. ***PGI- Battery of Brain Dysfunction (PGI-BBD) (Prasad & Verma, 1990)*** **-** It has been used in a number of diversified studies where theoretically cognitive dysfunction is assumed to occur. It measures basically memory, intelligence, and perceptuomotor functions. The following tests are in this battery.
    - ***a. Memory Scale:*** It defines memory as the ability to retain and reproduce impressions once perceived intentionally. It includes verbal and non-verbal material and measures remote, recent and immediate short term, very short term, immediate term and long-term memories. There are 10 subtests in this scale. Its test-retest reliability over a period of one-week ranges from .69 to .85 for 10 subtests and for the total test about .90 (test-retest and split half).
    - **b.** ***Battery of performance test of intelligence***: This is an adaptation of Bhatia's Intelligence Test Battery (Bhatia, 1955) short scale (Murthy, 1966) consisting of Koh's Block and Pass-a-long tests.
    - **c.** ***Verbal Adult Intelligence Scale (VAIS):*** This battery of verbal test of intelligence includes four sub–tests (i) Information (ii) Digit span (iii) Arithmetic and (iv) Comprehension. To develop the items for these subtests help was sought from the Weschsler's Adult Intelligence Scale. Test-retest reliability over a period of 1-2 weeks was found to be in the range of .87 to .98 and split-half reliability in the range of .59 to .85 for four subtests.
    - **d.** ***Nahor-Benson Test***: Nahor and Benson (1970) had developed a quick and simply screening test for organic brain pathology. It consists of 8 cards. Out of these five cards contain a design each and three cards contain the instructions to be followed (Nahor & Benson, 1970; Prasad & Verma, 1978).
    - **e.** ***Bender Visual Motor Gestalt Test (BVMGT):*** Based on Wertheimer's classical work in the field of perception, the Bender Visual Gestalt Test was introduced by

Bender in 1938, as a test of visuo-motor coordination. The test consists of nine figures characterized by their gestalt. It measures visual acuity and motor functioning.

Procedure

To select the sample many patients were visited at inwards and outwards level admitted or attended the hospital and finally 80 BAD patients currently mania was selected fulfilling the inclusion and exclusion criteria based on purposive sampling technique. They were clinically interviewed and screened by screening tools along with semi-structured socio-demographic and clinical data sheet. Only right-handed patients scoring <22 in Young Mania Rating Scale were included in the study. Further, 80 normal subjects were randomly selected for the study those who otherwise fulfil inclusion and exclusion criteria and scored below cut-off point on PGI-General wellbeing scale. Finally, PGI-Battery of Brain Dysfunction was administered to all samples as per direction and instruction given in the test manual and scored accordingly.

Statistical analysis

All the data were analyzed by SPSS for windows (Ver. 10.0). Descriptive statistics has been used to describe the data. Discriminant analysis has been used to assess the classification rate. For group comparison t-test was used for interval scale and Chi-square was used for category scale data. To find out the correlation Pearson's r and contingency coefficient were used for continuous variable and category variable respectively.

RESULT

The present study analyzed the data using appropriate statistics e.g., descriptive statistics, t-value, chi-square, Discriminant analysis and correlation as per requirement. The socio-demographic characteristics of the included participants are presented in table-1. It shows no significant difference between clinical group (Bipolar affective disorder-Mania, or BAD-M) and normal control group in their age, education, socio-economic status, and occupation except marital status and religion.

Table 1: Showing difference of socio-demographic characteristics between BAD-M and normal group.

Variable	Category	Group		Chi-square (df)
		Mania N (%)	Normal N (%)	
Age	18-25	42 (52.5)	43 (53.8)	3.998 (2)
	26-35	33 (41.3)	25 (31.3)	
	36-44	5 (6.3)	12 (15.0)	
Education	Up to 10	59 (73.8)	46 (57.5)	5.776 (2)
	Higher Sec.	4 (5.0)	11 (13.8)	
	Above	17 (21.3)	23 (28.8)	
Marital Status	Married	55 (68.8)	38 (47.5)	

	Unmarried	24 (30.0)	41 (51.3)	9.554* (3)
	Widow	0 (0.0)	1 (1.3)	
	Divorce	1 (1.3)	0 (0.0)	
Religion	Hindu	70 (87.5)	49 (61.3)	17.174* (3)
	Islam	6 (7.5)	13 (16.3)	
	Christian	2 (2.5)	2 (2.5)	
	Sarna	2 (2.5)	16 (20.0)	
SES	Lower	8 (10.0)	9 (11.3)	0.259 (2)
	Middle	69 (86.3)	69 (86.3)	
	Upper	3 (3.8)	2 (2.5)	
Occupation	Unemployed	7 (8.8)	15 (18.8)	7.545 (3)
	Service/Business	13 (16.3)	15 (18.8)	
	Farmer/Labour	19 (23.8)	8 (10.0)	
	Housewife/Others	41 (51.3)	42 (52.5)	

**** = p<0.05***

Descriptive statistics were applied to find out the range and mean of different clinical variables of BAD-Mania.

Table 2 shows that the range for age of onset was 18-37 years (mean 23.7250 ±5.2434). Total duration of illness after 1st episode range was 12-60 months. The mean score on YMRS was 11.0875, and mean episode was 2.4125.

Table 2: Showing mean and SD of clinical data (mania, N = 80)

Variable	Range	Mean	SD
Age of onset (in year)	18-37	23.72	5.24
Total duration after 1st episode (in month)	12-60	37.35	16.14
Duration of the present episode (in month)	1-11	2.66	1.68
Total score on YMRS	3-21	11.08	4.53
Episode	2-3	2.41	0.49

To find out the discriminating power of clinical variables – memory, intellectual functioning, visuospatial and perceptuomotor abilities under study in discriminating patient and control groups, discriminant analysis was done presented in table-3. Stepwise discriminant analysis shows a classification rate of 88.8% for total score on PGI-BBD. It shows 77.5% of BAD-M performed within impaired range. However, 22.5% of BAD-M performed on total score on PGI-BBD similar to performance of normal group. On PGI-BBD-Memory scale a classification rate of 92.5% were to be found. Out of ten subscales of

memory entered for analysis most discriminating variable were retention for similar pair followed by immediate recall, visual retention, recognition, and recent memory. Overall, in PGI-BBD-Memory scale 86.3% BAD-M patient performed within impaired range. Further on PGI-BBD-Intelligence scale a classification rate of 80% were found. Out of seven sub-scales of intelligence entered for analysis most discriminating variable were TQ on digit span followed by performance quotient and P/K x 100. Here, 63.8% BAD-M patient performed within impaired range on intelligence scale. While entered for discriminant analysis for visuospatial/perceptuomotor test, a classification rate were 73.1% and out of two sub-tests of visuospatial/perceptuomotor test entered for analysis most discriminating test was BGT (Bendor Gestalt Test).

Table 3 : Showing discriminant analysis of total score and different sub-scale of PGI-BBD

			Predicted group membership		Classification rate
			BAD-M N (%)	Normal N (%)	
Total Score	**Original group membership**	**BAD-M**	62 (77.5)	18 (22.5)	88.8%
		Normal	0 (0.0)	80 (100.0)	
Memory Scale	**Original group membership**	**BAD-M**	69 (86.3)	11 (13.8)	92.5%
		Normal	1 (1.3)	79 (98.8)	
Intelligence Scale	**Original group membership**	**BAD-M**	51 (63.8)	29 (36.3)	80.0%
		Normal	3 (3.8)	77 (96.3)	
Visuospatial/Perceptuomotor Tests	**Original group membership**	**BAD-M**	40 (50.0)	40 (50.0)	73.1%
		Normal	3 (3.8)	77 (96.3)	

A detail analysis of the profile of each subject was done. Findings are given in Table no. 4 that shows different dysfunction rating categories and Chi-square of different variables of both groups on PGI-BBD. It shows both groups (BAD-mania and normal) differ significantly in almost all variables of PGI-BBD i.e. memory, intelligence, and visuospatial and perceptuomotor coordination except difference between PQ & VQ. They significantly differ on remote memory (P<.001), recent memory (P<.001), mental balance (P<.001), attention and concentration (P<.001), delayed recall (P<.001), immediate recall (P<.001), retention for similar pair (P<.001), retention for dissimilar pair (P<.001), visual retention (P<.001), recognition (P<.001), $^{P}/_{K} \times 100$ (P<.001), performance quotient (P<.001), TQ on information (P<.05), TQ on digit span (P<.001), TQ on Arithmetic (P<.01), TQ on comprehension (P<.01), Nahor and Benson test (P<.01) and BGT (P<.001). On variables TQ on information (mania = 85%, normal = 97.5%) most of the subjects from both groups performed within average level performance. On few variables borderline dysfunction were showed more by patient group compare to normal i.e. recent memory (mania = 33.8%, normal = 6.3%), $^{P}/_{K} \times 100$ (mania = 26.3%, normal = 6.3%), performance quotient (mania =25%, normal = 1.3%), TQ on digit span (mania = 48.8%, normal = 2.5%), and TQ on arithmetic (mania = 28.8%, normal = 12.5%). In a number of variables of PGI-BBD patient

group showed more significant dysfunction (dysfunction rating 3) compare to normal i.e. remote memory (mania = 20%, normal = 0%), mental balance (mania = 62.5%, normal = 31.3%), attention and concentration (mania = 60%, normal = 12.5%), delayed recall (mania = 55%, normal = 2.5%), immediate recall (mania = 68.8%, normal = 6.3%), retention for similar pairs (mania = 53.8%, normal = 1.3%), retention for dissimilar pair (mania = 71.3%, normal = 6.3%), visual retention (mania = 60%, normal = 0%), recognition (mania = 45%, normal = 2.5%) and BGT (mania = 23.8%, normal = 0%).

The most of the subject of patient group performed within 0 dysfunction rating on performance quotient (73.8%), TQ on information (85.0%), difference between PQ & VQ (75.0%), Nahor & Benson test (90.0%) variables of PGI-BBD. It showed intact functioning in these areas of subject of the patient group.

Table 4: Showing different dysfunction rating categories (0, 2, and 3) and Chi-square of different variables of mania and normal group on PGI-BBD

Variable	Group						Chi-square (df = 158)
	Mania (N=80)			Normal (N=80)			
	0 (N%)	2 (N%)	3 (N%)	0 (N%)	2 (N%)	3 (N%)	
Remote Memory	42 (52.5%)	22 (27.5%)	16 (20.0%)	75 (93.8%)	5 (6.3%)	0 (0%)	36.011***
Recent Memory	51 (63.8%)	27 (33.8%)	2 (2.5%)	75 (93.8%)	5 (6.3%)	0 (0%)	21.696***
Mental Balance	7 (8.8%)	23 (28.8%)	50 (62.5%)	42 (52.5%)	13 (16.3%)	25 (31.3%)	36.12***
Attention & Concentration	15 (18.8%)	17 (21.3%)	48 (60.0%)	55 (68.8%)	15 (18.8%)	10 (12.5%)	47.879***
Delayed Recall	14 (17.5%)	22 (27.5%)	44 (55.0%)	58 (72.5%)	20 (25.0%)	2 (2.5%)	65.332***
Immediate Recall	7 (8.8%)	18 (22.5%)	55 (68.8%)	52 (65.0%)	23 (28.8%)	5 (6.3%)	76.598***
Retention for Similar Pair	15 (18.8%)	22 (27.5%)	43 (53.8%)	68 (85.0%)	11 (13.8%)	1 (1.3%)	77.601***
Retention for Dissimilar Pair	11 (13.8%)	12 (15.0%)	57 (71.3%)	39 (48.8%)	36 (45.0%)	5 (6.3%)	71.293***
Visual Retention	14 (17.5%)	18 (22.5%)	48 (60.0%)	59 (73.8%)	21 (26.3%)	0 (0%)	75.970***
Recognition	16 (20.0%)	28 (35.0%)	36 (45.0%)	65 (81.3%)	13 (16.3%)	2 (2.5%)	65.551***
$^{P}/_{K} \times 100$	51 (63.8%)	21 (26.3%)	8 (10.0%)	72 (90.0%)	5 (6.3%)	3 (3.8%)	15.704***
Performance Quotient	59 (73.8%)	20 (25.0%)	1 (1.3%)	79 (98.8%)	1 (1.3%)	0 (0%)	21.089***
TQ on Information	68 (85.0%)	11 (13.8%)	1 (1.3%)	78 (97.5%)	2 (2.5%)	0 (0%)	7.916*
TQ on Digit Span	37 (46.3%)	39 (48.8%)	4 (5.0%)	78 (97.5%)	2 (2.5%)	0 (0%)	52.008***
TQ on Arithmetic	53 (66.3%)	23 (28.8%)	4 (5.0%)	70 (87.5%)	10 (12.5%)	0 (0%)	11.471**
TQ on Comprehension	68 (85.0%)	10 (12.5%)	2 (2.5%)	79 (98.8%)	1 (1.3%)	0 (0%)	10.187**
Different between PQ & VQ	60 (75.0%)	14 (17.5%)	6 (7.5%)	62 (77.5%)	14 (17.5%)	4 (5.0%)	.433
Nahor &	72	8	0	80	0	0	8.421**

Variable	Group						Chi-square (df = 158)
	Mania (N=80)			Normal (N=80)			
	0 (N%)	2 (N%)	3 (N%)	0 (N%)	2 (N%)	3 (N%)	
Benson Test	(90.0%)	(10.0%)	(0%)	(100.0%)	(0%)	(0%)	
BGT	40 (50.0%)	21 (26.3%)	19 (23.8%)	77 (96.3%)	3 (3.8%)	0 (0%)	44.201***

** = P < .05, ** = P < .01, *** = P < .001,*
0 = No dysfunction, 2 = Borderline dysfunction, 3 = Severe dysfunction

t-test was applied to understand the actual intellectual function of mania and normal group. Table 5 shows that there were significant difference between mania and normal group on performance quotient, verbal quotient and overall intellectual quotient.

Table 5: Showing difference (mean, SD, and t value) of intellectual function of mania and normal group

Variable	Group				t-value (df = 158)
	Mania (N = 80)		Normal (N = 80)		
	mean	SD	mean	SD	
Performance Quotient (PQ)	86.16	10.34	101.65	13.87	8.006***
Verbal Quotient (VQ)	88.42	11.97	102.71	10.35	8.072***
Intelligent Quotient (IQ)	87.35	9.03	102.35	10.50	9.684***

**** = p<0.001; ** = p<0.01; * = p<0.05*
Chi-square was applied to understand the differences in categories on intellectual function of mania and normal group.

Table 6 shows that most of the subjects from mania group were in below average on PQ, VQ and IQ, whereas in normal group most subjects were in average on PQ, VQ and IQ. It also shows significant differences on each variable between both groups.

Table 6: Showing different level and Chi-square of intellectual function of mania and normal group

Variable	Group						Chi-square (df = 158)
	Mania (N = 80)			Normal (N = 80)			
	Bel. Av. N(%)	Av. N (%)	Ab. Av. N(%)	Bel. Av. N(%)	Av. N (%)	Ab. Av. N(%)	
Performance Quotient (PQ)	56 (70.0)	22 (27.5)	2 (2.5)	18 (22.5)	40 (50.0)	22 (27.5)	41.406***
Verbal Quotient (VQ)	44 (55.0)	32 (40.0)	4 (5.0)	8 (10.0)	53 (66.3)	19 (23.8)	39.894***
Intelligent Quotient (IQ)	52 (65.0)	27 (33.8)	1 (1.3)	9 (11.3)	52 (65.0)	19 (23.8)	54.423***

**** = p<0.001; ** = p<0.01; * = p<0.05; Bel. Av. = Below Average; Av. = Average; Ab. Av. = Above Average; Bel. Av. = Below Average; Av. = Average; Ab. Av. =Above Average*

Pearson r was applied to find out the relationship between clinical variable of BAD—M and subtests of PGI-BBD.

Table 7 shows that total score in PGI-BBD was positively correlated (high score shows high dysfunction) with duration of present episode. The correlation was significant at $p<0.01$ level. However, the negative correlation with various subtests of PGI-BBD suggests that few functions improved with duration of illness. Statistically significant negative correlation was found on immediate recall, retention for dissimilar pair and recognition. It suggests that as the duration of present episode increased patients show improved performance on these subtests.

Table 7: Showing relationship between clinical features and different variables of PGI-BBD of mania group

Variable	N = 80			
	Episode	**Age of onset (in year)**	**Total duration after 1st episode (in month)**	**Duration of the present episode (in month)**
Total score on PGIBBD	.035	.195	.167	.341**
Remote Memory	.001	.037	-.151	-.083
Recent Memory	-.069	-.054	-.211	.173
Mental Balance	.149	-.088	.026	-.084
Attention and Concentration	-.054	-.046	-.021	-.065
Delayed Recall	.009	-.161	-.015	-.092
Immediate Recall	.031	-.027	-.033	-.256*
Retention for Similar Pair	-.053	-.268*	.004	-.217
Retention of Dissimilar Pair	.014	-.015	-.072	-.305**
Visual Retention	.063	-.161	-.040	-.109
Recognition	-.083	.090	-.167	-.379**
$^{P}/_{K} \times 100$	.040	.203	.187	-.064
Performance Quotient	-.105	.095	.012	-.078
TQ on Information	.091	.204	.114	.104
TQ on Digit Span	-.218	.026	-.212	.024
TQ on Arithmetic	-.219	-.160	-.217	-.082
TQ on Comprehension	-.056	.061	.013	-.107
Difference between PQ & VQ	.001	.110	.145	.018
Nahor and Benson Test	-.110	-.022	-.106	-.132
BGT	-.017	-.208	-.226*	-.207

*** = Correlation is significant at the 0.01 level (2-tailed); * = Correlation is significant at the 0.05 level (2-tailed)*

DISCUSSION

Bipolar disorder influences multiple aspects of behaviour which may affect daily functioning, including cognitive skills. There are many ways to conceptualize and classify cognitive abilities, although some major rubrics are commonly used. These categories include global cognitive functioning, intellectual functioning, academic achievement, attention/concentration, executive function, language, visuo-spatial abilities, learning and memory and psychomotor performance. It is difficult to estimate the prevalence of cognitive function/dysfunction in bipolar disorder, because the neuropsychological presentation of the illness varies, and methodological, clinical, and diagnostic differences across studies make direct comparison difficult. Although, studies have been somewhat inconsistent concerning

reports of the nature and extent of cognitive function/dysfunction in bipolar disorder, a recent review of the literature indicated that deficits in executive function, verbal fluency, attention, and memory were most commonly reported (Malhi et al., 2004; Deckersbach et al., 2004).

Since, the major aims of the present study were to study and compare cognitive function of bipolar affective disorder (mania) and normal control and to find out its' relationship with clinical variables the PGI Battery for Brain Dysfunction (PGI-BBD) (Pershad and Verma, 1990) was used. It has been accepted for both clinical utility and cost effectiveness in Indian setting, and is frequently used to measure the cognitive function (Kar, 2006). This battery widely measure the three domains of cognitive function i.e. memory, intellectual function and visuospatial abilities under five sections. Section one is related to memory scale measuring-remote memory, recent memory, mental balance, attention/concentration, delayed recall, immediate recall, retention for similar pair, retention for dissimilar pair, visual retention and recognition. Section second and third are related to intelligence test including performance test of intelligence (Koh's Block design test and Pass-a-long tests) and verbal intelligence scale (information, digit span, arithmetic and comprehension). Fourth and fifth sections are related to visuospatial/perceptuomotor ability (Nahor and Benson test, and Bendor Gestalt Test).

When compared the gross performance on PGI-BBD, a battery that measures memory, intellectual function, and visuospatial/perceptuomotor ability, all bipolar affective disorder (mania) (BAD—M) showed score above cut-off point whereas most of the normal control scored below cut-off point.

Memory

In the present study, all subjects were assessed for their memory using PGI-BBD—Memory Scale which includes remote memory, recent memory mental balance, attention and concentration, delayed recall, immediate recall, retention for similar pair, retention for dissimilar pair, visual retention, and recognition. Result revealed that manic state appeared to play an important role in influencing the nature of memory impairment associated with BAD—M. Present study showed that patients with BAD—M performed significantly poorer than the normal control. Significant impairment was found in remote memory, recent memory mental balance, attention and concentration, delayed recall, immediate recall, retention for similar pair, retention for dissimilar pair, visual retention, and recognition. Previous studies also demonstrated that manic patients showed poorer performance on different subtests of PGI-BBD—Memory Scale except remote memory and visual recognition in comparison to normal control (Kar, 2006). Furthermore, impairment of attention and concentration has been also found in other studies of bipolar patients (Quraishi et al., 2002; DeBello et al., 2004; Martinez-Aran et al., 2004; Torrent et al., 2006; Kolur et al., 2006), delayed recall (Van Gorp et al., 1998; Cavanagh et al., 2002; Deckersbach et al., 2004; Martinez-Aran et al., 2004; Thompson et al., 2005). Deficits in immediate recall (Cavanagh et al., 2002; Clark et al., 2002; Martinez-Aran et al., 2004), and in recognition (Murphy et al., 1999; Martinez-Aran et al., 2004) were also reported in previous studies. In adult bipolar disorder, previous studies assessing the influence of manic or depressive state on performance in memory scale yielded mixed result. Large number of studies reported significant impairment in different domains of memory, using variety of memory tests (Henry et al., 1971; Taylor & Abrams, 1986; Wolfe et al., 1987; Kar, 2006; Rubinsztein et al., 2000; Martinez-Aran et al., 2000, 2004; Cavanagh et al., 2002; Quraishi et al., 2002; Malhi et al., 2004; Deckerbach et al., 2004, Rubinson et al., 2006; Torrent et al., 2006 etc.).

Though, McKay et al. (1995) reported no impairment in memory during patients' remission of affective symptoms except patients with chronic and/or severe affective disorder. As has been noted in some studies, bipolar patients even during their remission, euthymic or manic phase, showed deficits in some specific areas of memory, attention or learning i.e. sustained attention (Malhi et al., 2004; Harmer et al., 2002; Quraishi et al., 2002; Martinez-Aran et al., 2004; Kolur et al., 2006), spatial attention (Sweeney et al., 2000), verbal learning (Robinson et al., 2006; Van Gorp et al., 1998; Quraishi et al., 2002; Martinez-Aran et al., 2004; Bearden et al., 2006), spatial recognition memory (Murphy et al., 1999; Rubinsztein et al., 2000; Thompson et al., 2005), delayed visual recognition (Murphy et al., 1999), episodic memory (Sweeney et al., 2000), working memory (Sweeney et al., 2000; Torrent et al., 2006), and verbal memory (Martinez-Aran et al., 2004). However, no significant deficits were reported in few specific areas of memory for example, remote memory (Kar, 2006), retention in long-term memory (Thompson et al., 2005), visual recognition (Kar, 2006; Thompson et al. 2005), non-verbal memory (VanGorp et al., 1998), and spatial working memory (Clark et al., 2002). There are possibilities that early diagnosis and active treatment could potentially reduce the neurocognitive morbidity associated with bipolar disorder. There is another possibility in result variation that methodological variation for example variation in sample sizes, gender, age, education, age at onset, and duration of the illness in previous studies.

Intellectual Functioning

Whether the bipolar affective disorder influences the intellectual function or not, very less studies has been conducted separately in this regard. In this study, PGI-BBD—Intelligence Scale was administered which includes the subtests are Kohs' Block Design Test and Pass-A-Long Test under Battery of Performance Tests of Intelligence, and Information, Digit Span, Arithmetic and Comprehension under Verbal Adult Intelligence Scale. Significant impairment was found in both verbal and performance domains of intelligence. BAD—M performed significantly poorer in $^{P}/_{K} \times 100$, Performance Quotient, and different subtests of verbal intelligence i.e., TQ on Information, TQ on Digit Span, TQ on Arithmetic and TQ on Comprehension. However, BAD—M and normal controls were similar on difference between PQ and VQ (performance quotient and verbal quotient). One previous study also demonstrated that manic patients showed poorer performance on different subtests of PGI-BBD—Intelligence Scale except TQ on Information (Kar, 2006). Most of the previous studies were conducted to determine the premorbid IQ (Van Gorp et al., 1998; Clark et al., 2002; Cavanagh et al., 2002; Minassian et al., 2004; Thompson et al., 2005) to control with normal subjects. Finding from one study suggested that bipolar disorder performed significantly lower than normal controls on verbal intelligence while measuring their premorbid IQ (Minassian et al., 2004). However, whatever studies has been conducted separately to measure intellectual functions those were related to different phases of bipolar affective disorder. That is why; results were also varied from one study to another. For example, some studies reported significant impairment in intelligence during manic state, (Pandey et al., 1980; Kar, 2006; Malhi et al., 2004; Quraishi et al., 2002), but, no significant impairment during remission or euthymic phase of illness (McKay et al., 1995; Goldberg, 1999; Quraishi et al., 2002; Malhi, 2004).

Visuospatial/Perceptuomotor ability

In the present study PGI-BBD—Nahor-Benson Test and Bendor Visuo-Motor Gestalt Test were administered to assess visuospatial/perceptuomotor ability. Findings of this study revealed that manic state appeared to play an important role in influencing the nature of visuospatial/perceptuomotor ability associated with BAD—M. Patient group shows

significant impairment in visuospatial/perceptuomotor function during manic state of bipolar affective disorder. The present study BAD—M patients performed significantly poorer on Nahor-Benson Test and Bendor Visuo-Motor Gestalt Test. Though, there is scarcity of previous studies in this regard that measures visuospatial/perceptuomotor ability in patients with bipolar affective disorder, however, similar findings were reported in a study that indicated poorer performance in Nahor-Benson Test and Bendor Visuo-Motor Gestalt Test during manic state of bipolar affective disorder than normal control (Kar, 2006). Some previous studies reported varied findings. Some studies reported no significant impairments in visuospatial ability in patients with bipolar affective disorder during euthymic state of the illness (Sapin et al., 1987; Van Gorp et al., 1998; Pavuluri et al., 2006), but, on the other hand some studies reported impairment in perceptuomotor function during first-episode of illness and it was more impaired than multiple-episodes of bipolar affective disorder (Nehra et al., 2006). The fact that there are mixed finding with regard to visuospatial abnormalities in adult as well as in pediatric studies in this domain appears to be largely because of variation in tasks and use of varied terminology across divergent but partially overlapping concepts.

Correspondingly, the patient with bipolar affective disorder—mania group showed significantly poor performance in all domains of cognitive functions compared to a healthy control group. They showed impairment in memory, intellectual function and visuospatial/perceptuomotor ability.

Clinical Correlates

In the present study correlation was calculated among cognitive measures (memory, intellectual functioning, and visuo-spatial ability) and number of present episode, age of onset (in year), total duration (in months) after first episode, and duration (in month) of the present episode. In this study, significant negative correlation was found between retention for similar pair (PGI-BBD—Memory Scale) and age of onset, retention for dissimilar pair, immediate recall, recognition and duration (in months) of the present episode. However, total score on PGI-BBD was positively correlated with duration (in months) of the present episode. As previous studies suggests, several authors have found significant negative correlation between memory (CVLT) and duration of illness (Van Gorp et al., 1998; Cavanagh et al., 2002; Martinez-Aran et al., 2004), life time number of months manic (Van Gorp et al., 1998), life time number of months depressed state (Van Gorp et al., 1998), and number of manic episode (Cavanagh et al., 2002; Robinson et al., 2006); spatial working memory, digit symbol test, delayed matching and number of hospitalization (Thompson et al., 2005); learning and duration of illness (Thompson et al., 2005).

CONCLUSION

Despite the nature of bipolar affective disorder is episodic and is expected to premorbid functioning during inter episodic period, residual cognitive deficits in the areas of memory, intellectual function and visuospatial/perceptuomotor ability may be present in remission phase and most of them (77.5%) can be differentiated from normal subjects among memory, intelligence and visuospatial function. Most discriminating variables are retention for similar pair, immediate recall, visual retention, recognition, recent memory, digit span, performance quotient and BGT.

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Conflict of Interest

The author declared no conflict of interest.

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