Original Research Article

Comparative study of neurocognitive deficits in bipolar disorder and schizophrenia

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Abstract

Background: The central features of schizophrenia are cognitive impairments and are related to functional status and other aspects of the illness.

Aim: The aim of the study was to compare the neurocognitive deficits in patients with bipolar disorder and schizophrenia.

Materials and methods: 50 Schizophrenia patients and 50 Bipolar Disorder patients who were diagnosed as per ICD-10 attending the OPD of Santhiram Medical College and General Hospital, Nandyal were included in the study.

Results: The current study measured phonemic fluency using controlled oral word association test, category fluency using animal names test and working memory using N-Back tests (verbal and visual) and the patients with BPAD performed better than schizophrenia patients. The pattern of similarity varied between the two groups in that more number of BPAD patients were able to tell words in the higher ranges and more number of schizophrenia patients were able to tell words in the lower ranges. On N-Back tests the patients with schizophrenia consistently performed poorer than bipolar disorder patients in the higher ranges of performance as shown by the results of both verbal and visual 1-back and 2-back tests hits and errors where the patients with bipolar disorder produced more hits and less errors than the patients with schizophrenia. The mean values showed that patients

with bipolar disorder produced more hits and less errors than the patients with schizophrenia. On the domain of executive functions, BPAD patients were performing better than schizophrenia patients on all tests with statistically significant differences on N-back tests and statistically no significant differences on Controlled oral word association and Animal names tests.

Conclusion: The pattern of non-significant differences between the two disorders followed a trend, which suggests that patients with BPAD were performing better than those with schizophrenia.

Key words

Introduction

Cognitive impairments are central features of schizophrenia and are related to functional status and other aspects of the illness [1]. They are reliably present in the majority of patients, independent of positive symptoms such as delusions and hallucinations, and a major cause of poor social and vocational outcome [2, 3]. These deficits have been recognized for years but their status as important features of the disorder has recently received greater attention. Cognitive deficits in schizophrenia are not completely caused by the symptoms of the illness or aspects of its treatment, and they are stable over time across fluctuations in other aspects of clinical state [4]. It is trait-like and present throughout the course of the illness. Thus, impairment is largely stable over intervals ranging for months to years. Comparisons of the profile and magnitude of the cognitive deficits of patients with schizophrenia with those of patients with other neuropsychiatric disorders can provide information about potential etiological factors and neurobiological substrates of the deficits. For example, neuropsychological and neuropathological studies that discriminate between subjects with alzheimer's disease and those with schizophrenia have suggested that the cognitive impairments in these illnesses have different biological substrates [5], as have comparative studies contrasting subjects with schizophrenia and subjects with temporal lobe epilepsy. Cognitive impairment in bipolar affective disorder (BPAD) has lately come under increasing scrutiny. Several earlier studies of euthymic patients with bipolar disorder have found deficits in a number of cognitive domains.

Methodological hitches, however, such as lack of operational definitions of euthymia, or failure to control for residual affective symptoms cast doubts on the results of many of these studies. These problems have been overcome to a large extent by more recent studies. These demonstrate impairments in visuospatial memory, verbal learning, executive functions, and sustained attention among remitted patients with BPAD [6]. These findings have been further validated by a recent meta-analysis that confirmed the presence of relatively marked impairment in aspects of executive function and verbal memory among euthymic bipolar disorder patients. The aim of the study was to compare the neurocognitive deficits in patients with bipolar disorder and schizophrenia.

Materials and methods

50 Schizophrenia patients and 50 Bipolar Disorder patients who were diagnosed as per ICD-10 attending the OPD of Santhiram Medical College and General Hospital, Nandyal were included in the study and they were assessed for severity using Hamilton depression rating scale, Young mania rating scale and PANSS scale for remission and stable patients were assessed for neurocognitive deficits using the NIMHANS neuropsychological battery. Patients who had been diagnosed with bipolar disorder and schizophrenia according to ICD-10, Patients who had clinically stable cases of bipolar disorder and schizophrenia who were on medication and who were cooperative and those patients who had given their consent were included in the study. Acute cases of mania and psychosis till stabilization, clinically stable patients who had

experienced an acute episode in the past month, patients who had been on a sedative/benzodiazepine within 12 hours of testing, substance dependence in past 6 months, substance abuse in past month, life time history of loss of consciousness for greater than one hour due to head trauma, significant neurological disorder were excluded from the study. The various cognitive domains that are compared in this study are executive functions like phonemic fluency which is calculated by controlled oral word association test, category fluency which is done by animal names test, working memory which is done by N - Back tests (verbal and visual), Learning and memory which is done by Rey's auditory verbal learning test, Sustained attention which is done by digit symbol substitution test and digit vigilance test, Motor speed which is done by Finger tapping test. They are administered as per the procedures described in the test manual. For the comparison purposes each test findings are divided as follows: Phonemic fluency test, Auditory verbal learning test immediate recall and delayed recall: 0-5, 6 - 10 and 11-15. Auditory verbal learning test learning score: 0-25, 26-50, 51-75. Animal names test, N - Back test errors: 0-5, 6-

10, 11-15 and 16-20. N - Back test hits: 0-4 and 5-9. Digit vigilance tests: 0-300, 301-600, 601-900 and 901-1200. Digit symbol substitution test: 0-300, 301-600 and 601-900. Finger tapping test: 0-50, 51-100, 101-150. The data was analyzed by T- test in Statistical Package for the Social Sciences (SPSS).

Results

Table - 1 shows that Out of the total 50 BPAD and 50 schizophrenia patients, 30 males and 20 females with BPAD and 32 males and 18 females with schizophrenia were included in the study. Mean age was similar in both the groups. Sex, education, socioeconomic status was all controlled for both the groups. Mean age of onset for BPAD and schizophrenia were also controlled for both the groups with mean age of onset for bipolar disorder being 27.12 and mean age of onset for schizophrenia being 27.72. Number of episodes was same for both the disorders at the time of conducting this study. Before being included in the study both the disorders were also controlled for the euthymic months prior to conducting the study.

Table - 1: Socio-demographic profile and disease pattern (mean±SD).

Demographic Profile		Schizophrenia (n=50)	Bipolar disorder (n=50)
Age (years in mean)		32.54±10.95	32.18±11.04
Sex	Male	32	30
	Female	18	20
Education	Literate	39	37
	Illiterate	11	1
Socio-Economic status	Low (<5000rs/month)	13	13
	Middle(<20000/month)	31	32
	High(<40000/month)	6	5
Age of onset (mean±SD)		27.72±9.34	27.12±9.11
Number of episodes (mean±SD)		1.66±0.89	1.64±0.87
Months euthymic prior to inclusion		2.52±1.31	2.48±1.21

Table - 2 shows that more number of words in the higher range of 11-15 were told by BPAD patients (10%) than schizophrenia patients (2%) and more number of words in the lower ranges of 0-5 were told by schizophrenia patients (38%)

than BPAD patients (32%) as shown in diagrams 1-3. The mean values show that BPAD patients (7.04) were able to tell more words than schizophrenia patients (6.42). The findings were not significant statistically. P value was 0.580.

More number of animal names in the higher ranges of 16-20 were told by BPAD patients (4%) than schizophrenia patients (0%) whereas more number of animal names in the lower range of 0-5 were told by schizophrenia patients (18%) than BPAD patients (6%). The mean values show that bipolar disorder patients (10.38) were able to tell more animal names than schizophrenia patients (9.66). The findings were not significant statistically. P value was 0.222.

Table - 2: Phonemic fluency: controlled oral word association test, Category fluency: animal names test.

	Controlled oral word association test			Mean
	0-5 words	6-10 words	11-15 words	
No. of BPAD patients	16 (32%)	29 (58%)	5 (10%)	7.04
No. of schizophrenia patients	19 (38%)	30 (60%)	1 (2%)	6.42
	Animal names test			Mean
	0-5 words	6-10 words	11-15 words	16-20 words	
No. of BPAD patients	3 (6%)	23 (46%)	22 (44%)	2(4%)	10.38
No. of schizophrenia patients	9 (18%)	17 (34%)	24 (48%)	0	9.66

Table - 3: Working memory-N-back tests: Verbal-1 back test hits, Verbal-2 back test hits.

	Verbal-1 back test hits		Mean
	0-4 words	5-9 words	
No. of BPAD patients	3 (6%)	47 (94%)	7.4
No. of schizophrenia patients	8 (16%)	42 (84%)	6.36
	Verbal-2 back test hits		Mean
	0-4 words	5-9 words	
No. of BPAD patients	5 (10%)	45 (90%)	6.3
No. of schizophrenia patients	12 (24%)	38 (76%)	5.66

Table - 4: Visual 1 back test hits, visual 2 back test hits.

	Visual-1 back test hits		Mean
	0-4 words	5-9 words	
No. of BPAD patients	4 (8%)	46 (92%)	6.72
No. of schizophrenia patients	8 (16%)	42 (84%)	6.02
	Visual-2 back test hits		Mean
	0-4 words	5-9 words	
No. of BPAD patients	5 (10%)	45 (90%)	5.76
No. of schizophrenia patients	18 (36%)	32 (64%)	5.12

Table - 3 shows that more number of correct sounds in the higher ranges of 5-9 sounds were identified by BPAD patients (94%) than schizophrenia patients (84%) whereas more number of correct sounds in the lower ranges of 0-4 sounds were identified by schizophrenia patients (16%) than BPAD patients (6%). The mean values show that BPAD patients (7.4) were able to identify more correct sounds than schizophrenia patients (6.36). The findings were statistically significant. P value was 0.01. More number of correct sounds in the higher ranges of 5-9 sounds were identified by BPAD patients (90%) than schizophrenia patients (76%) whereas more number of correct sounds in the lower range of 0-4 sounds were identified by schizophrenia patients (24%) than BPAD patients (10%). The mean values show that BPAD patients (6.3) were able to identify more correct sounds than schizophrenia patients (5.66). The findings were

however not statistically significant. P value was 0.114.

Table - 4 shows that more number of dots in the higher range of 5-9 dots were identified by BPAD patients (92%) than schizophrenia patients (84%) whereas more number of dots in the lower range of 0-4 dots were identified by schizophrenia patients (16%) than BPAD patients (8%). The mean values show that BPAD patients (6.72) were able to identify more number of dots correctly than schizophrenia patients (6.02). The

findings were statistically significant. P value was 0.025. More number of dots in the higher range of 5-9 dots were identified by BPAD patients (90%) than schizophrenia patients (64%) whereas more number of dots in the lower range of 0-4 dots were identified by schizophrenia patients (36%) than BPAD patients (10%). The mean values show that BPAD patients (5.76) were able to identify more number of dots correctly than schizophrenia patients (5.12). The findings were significant statistically. P value was 0.04.

Table - 5: Digit vigilance test, digit symbol substitution test, Finger tapping test.
(Digit vigilance test and Digit symbol substitution test were performed only for literate patients (37 patients with BPAD and 39 patients with schizophrenia.)

	Digit vigilance test				Patients	Mean
	0-300	301-600	601-900	901-1200		
No. of BPAD patients	2(5.4%)	24(64.8%)	9(24.3%)	2(5.4%)	37	547.57
No. of schizophrenia pts	1(2.56%)	26(66.6%)	10(25.6%)	2(5.1%)	39	550.02
	Digit symbol substitution test			Patients	Mean	
	0-300	301-600	601-900			
No. of BPAD patients	19(51.3%)	16(43.2%)	2(5.4%)	37	327.65	
No. of schizophrenia patients	20(51.2%)	17(43.5%)	2(5.1%)	39	332.05	
	Finger tapping test			Patients	Mean	
	0-50	51-100	101-150			
No. of BPAD patients	0	31(62%)	19(38%)	50	95.18	
No. of schizophrenia patients	0	29(58%)	21(42%)	50	93	

Verbal 1 back test errors showed that more number of errors in identifying correct sounds in the higher range of 11-15 errors were produced by schizophrenia patients (2%) than BPAD patients (0%) and more number of errors in identifying correct sounds in the lower range of 0-5 errors were produced by BPAD patients (90%) than schizophrenia patients (86%). Overall significantly more number of errors were produced by schizophrenia patients (3.36) than BPAD patients (2.2) in identifying the correct sounds as shown by the mean values. The findings were statistically significant. P value was 0.041. Verbal 2 back tests errors showed that more number of errors in identifying correct sounds in the higher range of 16-20 errors were produced by schizophrenia patients (4%) than BPAD patients (0%) and more number of errors in identifying correct sounds in the lower range

of 0-5 errors were produced by BPAD patients (88%) than schizophrenia patients (66%). Overall significantly more number errors were produced by schizophrenia patients (5.64) than BPAD patients (4.28) in identifying the correct sounds as shown by the mean values. The findings were statistically significant. Visual 1 back test errors showed that more number of errors in identifying dots in the higher range of 11-15 dots were produced by schizophrenia patients (8%) than BPAD patients (2%) and more number of errors in identifying dots in the lower range of 0-5 dots were produced by BPAD patients (88%) than schizophrenia patients (80%). Overall significantly more number of errors in identifying dots were produced by schizophrenia patients (4.6) and BPAD patients (4.04) in identifying the dots correctly as shown by the mean values. The findings were statistically

significant. Visual 2 back test errors showed that more number of errors in identifying dots in the higher ranges of 16-20 dots were done by schizophrenia patients (6%) than BPAD patients (0%) whereas more number of errors in identifying dots in the lower ranges of 0-5 dots were done by BPAD patients (56%) than schizophrenia patients (46%). The mean values showed that overall more number of errors in identifying the dots were done by schizophrenia patients (7.12) than BPAD patients (5.98) and the difference was statistically significant.

Rey's auditory verbal learning test showed that BPAD patients (50.4) were able to learn more words when compared to schizophrenia patients (45.8). The findings were not statistically significant. Immediate recall shows that more number of schizophrenia patients (6%) than BPAD patients (0%) were able to recall words in the lower range of 0-5 words whereas more number of BPAD patients (72%) than schizophrenia patients (68%) were able to recall words in the higher ranges of 11-15 words. The mean values show that overall both BPAD patients (12.12) and schizophrenia patients (11.58) were able to recall the same number of words. The findings were not significant statistically. Delayed recall shows that more number of schizophrenia patients (12%) than BPAD patients (4%) were able to recall words in the lower range of 0-5 whereas more number of BPAD patients (58%) than schizophrenia patients (48%) were able to recall words in the higher ranges of 11-15. The mean values show that overall BPAD patients (10.94) were able to recall more number of words than schizophrenia patients (10.02). The findings were not significant statistically.

Table - 5 showed that same time was taken by both BPAD patients (547.57 mins) and schizophrenia patients (550.02 mins) to complete the test. The findings were not statistically significant. Same time was taken by BPAD patients (327.65mins) and schizophrenia patients (332.05 mins) to complete the test. The

findings were not statistically significant. Same number of taps was done by both BPAD patients (95.18 taps) and schizophrenia patients (93 taps). The findings were not statistically significant.

Discussion

Previous comparisons of cognitive profiles of schizophrenia and BPAD have usually suggested that the differences were more in the extent and degree of impairments, rather than having any real qualitative differences [7]. The results in the current study further support this notion that there were no significant differences in the cognitive profiles of schizophrenia and BPAD except in one sub-test of executive functions. Bipolar disorder patients performed similar to schizophrenia patients on almost all measures of cognitive profile although the difference is not statistically significant, except for the N-back tests. Additionally, this study also underscores the importance of several key methodological issues in the conduct of such comparisons of cognitive functions between BPAD and schizophrenia. The similarities in cognitive performance across BPAD and schizophrenia found in the present, as well as earlier studies, have several possible implications for both disorders. This resemblance is not entirely unexpected given the epidemiological, phenomenological, genetic and neurobiological overlap between the two disorders. Indeed, it has been suggested that schizophrenia and BPAD exist on a continuum of cognitive dysfunction and that impaired cognitive functions represent a disordered final pathway common to both these conditions [8-11]. On the domain of executive functions, BPAD patients were performing better than schizophrenia patients on all tests with statistically significant differences on N-back tests and statistically no significant differences on Controlled oral word association and Animal names tests. Patients in both the disorders are impaired in the domain of executive function when compared to normalized standard values reported in the manual of NIMHANS neurocognitive battery and the results in the present study show that the impairments are

more in the degree and extent of impairments rather than qualitative impairments as reported by Zihl J., et al. [7]. The findings of the current study are similar on Controlled oral word association test and animal names test and different on N- back tests to a study done by Basant K. Pradhan, et al., in which executive functions were assessed using Wisconsin Card-Sorting Test (WCST), the Trail-making Test B (Trail B) and the Controlled Words Association Test (CWAT) consisting of the F,A,S test and the Category/ Animal/ Food Naming Test and the study showed that patients with schizophrenia consistently performed worse than patients with BPAD. When the two groups were compared directly, however, none of the differences in neuropsychological performance between schizophrenia and BPAD was found to be significant. This was true for all tests and sub-tests of cognitive function used in their study and for uncontrolled as well as controlled comparisons [12]. In the same study, in uncontrolled comparisons, normal controls performed significantly better than patients with schizophrenia in almost all tests of executive functions, while patients with BPAD were more impaired than normal controls on only some sub-tests of executive function. The study interpreted to suggest that BPAD was situated intermediate between normal controls and schizophrenia in terms of cognitive impairment. The findings of the current study are similar on all subtests of executive functions to a study done by Daban C, et al., which reported a number of previous studies comparing cognitive deficits in schizophrenia and BPAD. In those comparisons schizophrenia patients and euthymic subjects with BPAD both exhibited extensive cognitive impairments. Differences between the disorders are minimal and equivocal in the domains of executive functions. Overall, the pattern of cognitive impairment is similar, suggesting that cross-sectional neurocognitive deficits are not diagnosis specific [8]. At the same time there is evidence that there could be minor and subtle differences in the cognitive profile of schizophrenia and BPAD. The current study is different from a study done by Carissa

N. Kuswanto, et al., which showed that compared to healthy controls, patients with schizophrenia scored lower on cognitive domain of verbal fluency as measured in Brief Assessment of Cognition tasks of semantic and letter fluency, with the total Brief Assessment of Cognition score indicating neurocognitive deficits in fluency. In the same study, compared to healthy controls, patients with bipolar disorder scored lower in Brief Assessment of Cognition tasks of semantic and letter fluency, with the total Brief Assessment of Cognition score indicating almost similar neurocognitive deficits as schizophrenia in fluency [13]. The current study shows that BPAD patients performed better than schizophrenia on verbal fluency. Barrett et al. measured executive functions like Response inhibition and attentional set shifting with Hayling and Brixton Tests and verbal fluency using COWA and concluded that patients with schizophrenia performed poorly than patients with bipolar disorder [14]. The findings of the current study are similar to the above study. The current study is also similar to a study done by Brissos, et al. which measured executive functions using SCT and SCWT, TMT-B, and TOH and verbal fluency using COWA and concluded that schizophrenia patients performed poorly than bipolar disorder patients [15]. Brissos, et al. in an another study measured executive functions using Digit Span backward, SCT and SCWT, TMT-B, TOH, COWA test for animal naming and also measured verbal fluency using WAIS-R comprehension and similarities subtests and concluded that schizophrenia patients performed poorly than bipolar disorder patients [16]. The findings are similar to the current study. Pradhan, et al. (2008) assessed memory using PGI memory scale and in this study when compared to controls, both bipolar disorder and schizophrenia patients were significantly impaired on different tests of memory. Schizophrenic patients consistently performed worse than bipolar disorder patients but the difference was not statistically significant. A study done by Barrett, et al. which measured verbal memory using paired associates WMS and concluded that patients with

schizophrenia performed poorly than patients with bipolar disorder [14]. The current study shows similar findings with regards to delayed recall recall and contradictory findings with regard to immediate recall [12]. The findings of the current study are in contrast to Sanchez-Morla, et al. measured Verbal working memory using WAIS-R digit subtest, digits backward and Verbal learning and memory using CVLT and concluded that the study showed mixed results on tests of verbal memory for both schizophrenia and bipolar patients [17]. The current study show similar findings in terms of memory. Gogos, et al. measured Immediate memory/ learning and delayed memory using RBANS domain scores and total score and concluded that patients with schizophrenia performed poorly than bipolar disorder patients on tests of learning, immediate memory and delayed memory [18]. A study done by Wobrock, et al. which measured Verbal learning and memory using VLMT, similar to the CVLT and concluded that the patients with schizophrenia performed poorly on tests of verbal learning and memory than patients with bipolar disorder [19]. The current study show similar findings on the tests of learning and delayed recall but different findings on tests of immediate recall. The findings of the current study are also similar to that of a study done by Carissa N. Kuswanto, et al. which showed that compared to healthy controls, patients with BPAD scored lower on Brief assessment of cognition battery tasks of symbol coding, total Brief assessment of cognition battery score indicating almost similar neurocognitive deficits as schizophrenia in attention [13]. The findings of the study are also similar to the finding in a study done by Daban C, et al. that shows that differences between the disorders are minimal and equivocal in the domains of executive functions and sustained attention [8]. In the study by Morice, a comparison of the mean Digit Symbol scores of chronically ill treatment-seeking subjects with schizophrenia and with bipolar disorder was not statistically significant which is similar to the findings in the current study [20].

Conclusion

The finding in the current study is that patients with BPAD performed similar to patients with schizophrenia on almost all neurocognitive measures except in the domain of executive function with non-significant differences in Phonemic fluency and category fluency and significant differences in N-back tests. At the same time, the pattern of non-significant differences between the two disorders followed a trend, which suggests that patients with BPAD are performing better than those with schizophrenia.

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