

ORIGINAL ARTICLE

Cognitive Flexibility and Problem-solving in Patients with Bipolar Disorder

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ARTICLE INFO

Article history:

Received 16 August 2019

Received in revised form 08

September 2019

Accepted 10 October 2019

Available online 31 October 2019

Keywords:

Cognitive flexibility,

Problem-solving,

Bipolar.

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ABSTRACT

Introduction: This study focuses on the cognitive impairment in patients with bipolar disorder and also the distribution of cognitive flexibility and problem-solving by degree of education, chronicity, and episode of patient is in at the time of evaluation.

Methods: This was a cross sectional descriptive study with purposive sampling method. The population was the Harmony in Diversity Group in Surabaya, Indonesia. Twenty-two patients agreed to be subjects and each of them finished the Wisconsin Card Sorting Test (WCST) to measure cognitive flexibility and the Tower of London (TOL) to measure problem-solving.

Results: The WCST score are below normal for 90.9% of the patients. Higher cognitive flexibility is found in patients with bachelor's degree and euthymic patients, while lower cognitive flexibility is found in patients in depression episode, manic episode, and mixed episode. No patients could finish the TOL within the minimum required steps. Better problem-solving is found in patients in manic episode and euthymic patients while lower problem-solving is found in mixed episode and depressive episode.

Conclusion: The cognitive flexibility and problem-solving in patients with bipolar disorder are lower than the normal cut off. The type of episode and chronicity are contributing factors. Euthymic patients tend to have better cognitive flexibility and manic patients tend to have better problem-solving ability.

Introduction

Bipolar Disorder (BD) was estimated to affect 2.2% of the population or approximately 5.3 million adults aged 18 or older in the United States in 2014. About 51% of people with BD are untreated.¹ At least 25-50% of people with BD have attempted suicide at least once, and it reduces 9.2 years of the life expectancy.^{2,3}

In patients with BD, extreme mood changes in every episode can affect their perception and thinking process, thus affect their flexibility and ability to solve problems. Patients could have trouble adapting as a result of having less cognitive flexibility and having trouble solving their everyday problems. This cognitive disability can affect social function, resulting in psychosocial disability, because cognitive function is also related to functional and emotional domain.^{4,7} According to Lara E, et al. (2015), worse cognitive function is related to more frequent suicidal ideas in patients in depression.⁸

Previous studies have found cognitive impairments in patients with BD. Around 40-60% patients with BD have clinically significant cognitive impairment.⁷ In a study conducted by Martínez-Arán, et al. (2014), stable bipolar patients showed worse results in memory, attention, and cognitive flexibility tests compared to healthy subjects.⁹

Other studies found that regardless of the episodes the BD patients were in, they showed significant deficit in working memory, episodic memory, spatial attention, attention, problem-solving, executive function, emotional process, and the ability to produce a solution to a social problem.^{10,12}

There are still lack of literatures about cognitive flexibility and problem-solving ability in BD patients. Therefore, we aim to see the distribution of cognitive flexibility and problem-solving ability among BD patients in Surabaya.

Methods

This study was a cross sectional descriptive study, conducted from June until August 2015. Participants taken purposively from members of the Harmony in Diversity group in Surabaya, Indonesia; a consumers' group for BD. The subjects were patients who had been diagnosed with BD by a psychiatric according to the Indonesian guidelines for psychiatric diagnosis (Pedoman Penggolongan dan Diagnosis Gangguan Jiwa ke-III). Cognitive tests were performed once, without any intervention given to the subjects. Patients with mental retardation, dementia, history of stroke, alcohol use, substance abuse, and history of head trauma were excluded. Cognitive flexibility was measured with the Wisconsin Card Sorting Test (WCST), with the



normal cut off point is $\leq 12.4\%$.^{13,14} Problem-solving ability was measured with the Tower of London (TOL) which is supposed to be finished within minimum 63 steps. More steps mean worse problem-solving ability. were conducted for high accuracy.

Results

Twenty two subjects had been tested, with the characteristics shown on Table 1. The mean age was 31 ± 10.23 years, with the age span of 17 to 48 years old. The mean chronicity of the BD was 9 ± 7.5 years. 90% of the subjects got lower than normal WCST score, which resembled the result of a study conducted by Martínez-Arán, et al. (2014).⁹ No patients could finish the TOL within the minimum required steps.

Table 1. Baseline Characteristics of the Patients

Characteristic	n (%) (n=22)
Sex	
Male	9 (40.91)
Female	13 (59.09)
Age	
<17 years	0
17-35 years	13 (59.09)
36-45 years	6 (27.27)
46-59 years	3 (13.63)
≥ 60 years	0
Mean \pm SD	31 ± 10.23
Degree of Education	
Elementary/Junior High/High School	11 (50.00)
Diploma	2 (9.09)
Bachelor	9 (40.91)
Chronicity	
≤ 2 years	6 (27.27)
> 2 years	16 (72.72)
Mean \pm SD	9 ± 7.50
Episode	
Manic/Hypomanic	4 (18.18)
Depression	3 (13.64)
Mixed	5 (22.73)
Remission	10 (45.45)
Cognitive Flexibility	
$\leq 12.4\%$ (normal cut off)	2 (9.09)
$> 12.4\%$	20 (90.90)
Mean SD	17.58 ± 5.75
Problem-solving Ability	
=63 steps (minimum required steps)	0 ^Δ
> 63 steps	22 (100)
Mean \pm SD	78 ± 9.18

* Both are patients in remission

^Δ No patients could finish the TOL within the minimum required steps

The distribution of cognitive flexibility according to degree of education, chronicity, and episode can be seen in Table 2. In terms of education degree, cognitive flexibility was better in subjects with bachelor's degree (mean: $16.12 \pm 2.64\%$), followed by elementary/junior high/high school subjects (mean: $17.88 \pm 7.53\%$). On the aspect of chronicity, cognitive flexibility was better in patients who have had BD for more than 2 years (mean: 15.21 ± 5.47). Meanwhile, better WCST scores were obtained by patients in remission (mean: $14.50 \pm 2.36\%$, best score is 10%) and worse WCST scores were found in patients in mixed episode (mean: $22.67 \pm 9.02\%$, worst score is 33.34%).

The distribution of problem-solving ability according to degree of education, chronicity, and episode can be seen in Table 3. The differences of the TOL scores between education groups were not significant. In the chronicity aspect, better problem-solving ability was found in subjects who have had BD for more than 2 years (mean: 74 ± 7.80 steps). In terms of episode, problem-solving ability was better in patients in manic episode (mean: 74 ± 10.40 steps, best score is 64 steps) and worse was found in patients in mixed episode (mean: 80 ± 10.66 steps) and depression episode (mean: 81 ± 11.50 steps). Worst TOL score (95 steps) was the result of a patient in mixed episode.

Twenty two subjects had been tested, with the characteristics shown on Table 1. The mean age was 31 ± 10.23 years, with the age span of 17 to 48 years old. The mean chronicity of the BD was 9 ± 7.5 years. 90% of the subjects got lower than normal WCST score, which resembled the result of a study conducted by Martínez-Arán, et al. (2014).⁹ No patients could finish the TOL within the minimum required steps.

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Table 2. Distribution of Cognitive Flexibility in Patients with BD

Variable	Groups	Wisconsin Card Sorting Test		Mean±SD
		≤ 12.4 % n (%)	> 12.4 % n (%)	
Degree of Education	Elementary/Junior High/High School	1 (9.09)	10 (90.91)	17.88 ± 7.53
	Diploma	0	2 (100)	22.50 ± 1.17
	Bachelor	1 (11.11)	8 (88.89)	16.12 ± 2.64
Chronicity	≤ 2 years	0	6 (100)	19.45 ± 6.56
	> 2 years	2 (12.50)	14 (87.50)	15.21 ± 5.47
Episode	Manic/Hypomanic	0	4 (100)	19.17 ± 3.97
	Depression	0	3 (100)	17.25 ± 4.20
	Mixed	0	5 (100) ^Δ	22.67 ± 9.02
	Remission	2 (25) •	8 (75)	14.50 ± 2.36

*The best WCST score is 10%, obtained by a patient in remission

^ΔThe worst WCST score is 33.34%, obtained by a patients in mixed episode

Table 3. Distribution of Problem-solving Ability in Patients with BD

Variables	Groups	Tower of London		Mean ± SD
		= 63 steps • n (%)	> 63 steps n (%)	
Degree of Education	Elementary/Junior High/High School	0	11 (100)	77 ± 10.43
	Diploma	0	2 (100)	81 ± 11.31
	Bachelor	0	9 (100)	79 ± 8.10
Chronicity	≤ 2 years	0	6 (100)	81 ± 12.40
	> 2years	0	16 (100)	74 ± 7.80
Episode	Manic/Hypomanic	0	4 (100)	74 ± 10.40
	Depression	0	3 (100)	81 ± 11.50
	Mixed	0	5 (100) ^Θ	80 ± 10.66
	Remission	0	10 (100) ^Δ	78 ± 8.37

*No patients could finish the TOL within the minimum required steps

^ΔThe best TOL score is 64 steps, obtained by a patients in remission

^ΘThe worst TOL score is 95 steps, obtained by a patient in mixed episode

Discussion

During the test, few subjects felt that the test was too difficult and almost gave up. Some patients started talking to the examiner about random things and they almost forgot that they were still doing a test, the examiner had to remind them to stay focused on the test. On the contrary, some patients did the test in a hurry, and stopped after realizing that they had made a mistake. They had to retrace their steps, resulting in more steps needed to finish the test. There were also a few patients that did not listen to the examiner's comment during the WCST test. This simple observation shows that patients with BD have difficulties in performing simple tasks. Pessimism, hopelessness, and lack of concentration show depression, meanwhile flight of ideas and excessive energy show manic episode. These extreme moods can affect the patient's emotion and perception, resulting in impaired social cognition.¹⁵

The WCST and TOL scores in degree of education is

not significantly different, this may be because the episode of the patient plays a bigger role in affecting the social cognition. Patients who have had BD for more than 2 years tend to show better scores than the ones who have had for less than 2 years. This result is different from previous study conducted by Torrent C, et al. (2012), which showed that the impairment in attention, psychomotor skills, and verbal memory is stable, but the other executive functions gradually decline in patients with BD. Executive function is found to be related with duration of illness and the presence of sub-depressive symptoms.¹⁶ In another study by Mur M, et al. (2008), executive function deficits are still stable in 2 years of observation.¹⁷ In this study, the better result of WCST and TOL in patients who have had BD for more than 2 years may happened because the patients have been treated, adapted, and learned to deal with their unstable mood, compared to patients who have had BD for less than 2 years. Another possibility is that this result does not have any relation to the chronicity of the patient, because

the course of the disease is different in every patient, with different contributing factors.¹⁸

In manic episode, the presence of flight of ideas and grandiose ideas will result in stubbornness and difficulty accepting or adapting to different ideas or situations, which will affect the cognitive flexibility. This result was similar to previous studies by Vrabie M, et al. (2015) and Clark L, et al. (2001), which showed that patients in manic episode had worse executive function (including cognitive flexibility).^(19,20) On the contrary, manic episode subjects in this study showed better problem-solving ability than other episodes. This was different from prior studies.^{19,20} It might be caused by the increase of energy and optimism in patients in manic episode. According to Bearden CE, et al. (2006), patients in manic episode showed lack of concentration and made decisions impulsively.²¹ If patients' ideas are more logical, not grandiose nor impulsive, this should be able to help them to solve problems better (like in hypomanic episode). As stated by Abé C, et al. (2015), there is a decreased brain mass in patients in manic episode which is not found in patients without manic episode. Unfortunately, this study did not observe hypomanic patients.²²

In depression episode, the pessimistic thoughts and hopelessness could make the patient decline any new ideas, resulting in decreased cognitive flexibility. Meanwhile, loss of interest, low self-esteem and worthlessness could impede patient's problem-solving ability. Kapczinski NS, et al. (2016) had demonstrated that the impairment of executive function is worse in patients with severe depression compared to moderate depression.²³ This study did not observe the severity of the depression episode in patients with BD. Depp CA, et al. (2016), stated that there are three pathways of cognitive impairment in bipolar depression; (1) Sustained and recurrent mood symptoms may directly impact neurobiological pathways that diminish cognitive ability; (2) Mood symptoms may indirectly contribute to and exacerbate negative health behaviors that impact cognitive ability; and (3) Disability may reciprocally impact the determinants of cognitive deficits and depressive symptoms.⁷

In mixed episode, patients experience symptoms of elevated and decreased mood at the same time, or the mood exchanges rapidly. The WCST score in patients in mixed episode was shown to be the worst, and the TOL score showed a decline in problem-solving ability. This resembles the study by Vrabie M, et al. (2015) where patients in mixed episode got lower scores in executive function tests (including cognitive flexibility) and problem-solving ability.¹⁴ According to Berk M, et al. (2005) and Sax KW, et al. (1995), the presence of both manic and depressive symptoms worsen the cognitive deficit in patients in mixed episodes.^{24,25}

In remission, the patient's mood is stable, no elevation or depletion. Patient will be more open-minded and adaptable, which results in better cognitive flexibility. Compared to other episodes, the WCST score of patients in remission are the best. Still, 75% of the patients in remission have impaired WCST score compared to the normal cut off score, and no patients in remission could finish the TOL within the minimum required steps. This was in line with the study by Vrabie M, et al. (2015), which showed that

BD patients in remission shown better scores than other episodes, but still significantly worse than the control group.¹⁴ There is evidence of cognitive deficit in patients in remission and this supports the idea that euthymic phase is not necessarily an improvement period.^{6,26,27,28}

The cognitive deficit in patients with BD can be the result of several factors like younger age of onset, higher number of previous episodes, higher numbers of previous hospitalizations, and greater presence of psychotic features.¹⁸ Some studies found a change in the prefrontal and frontal cortex and decreased brain mass in patients with BD.^{12,19,20,22} Prefrontal cortex is found to be more active in healthy subjects compared to patients with BD. The frontal cortex is important in changing the behavior of a patient from a routine response into a new and flexible response, adapting to new situations. This frontal cortex will become smaller if BD is uncontrolled.⁴

Even though patients have had regular therapy and stable mood, cognitive function will still be impaired. To improve cognitive function, patients with BD should be given cognitive therapies. Cognitive therapy is important in managing BD, because cognitive function is a critical factor in psychosocial disability, which will impact the patient's quality of life.⁴ A study by Veeh J, et al. (2017), showed that cognitive remediation could help improve the executive function of BD patients. Cognitive remediation also has positive effects on residual symptoms.²⁹ An intensive therapy for BD patients is important to improve cognitive deficits.²³ There is also a functional remediation therapy for patients in remission which can improve the functional outcome.⁵

Limitation of this study is that the small number of participants made it difficult to control the variable (age, degree of education, number of episodes, medication and therapy). Another study with a bigger number and homogenous sample should be conducted to test the correlation of the variables.

Conclusion

In patients with BD, cognitive flexibility and problem-solving ability are lower than the normal cut off. The episode and chronicity of the patient are among the contributing factors. Patients in remission tend to have better cognitive flexibility, and patients in manic episode tend to have better problem-solving ability. Patients in depression episode tend to have worse problem-solving ability and patients in mixed episode tend to have worse cognitive flexibility and problem-solving ability. Patients who have had BD for more than 2 years had better cognitive flexibility and problem-solving ability.

Conflict of Interest

The author would like to declare that there is no conflict of interest in conducting this study.

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