УДК 616.895
https://doi.org/10.20538/1682-0363-2022-3-28-33

Executive dysfunction in affective disorders: differences in bipolar affective disorder and depressive episode

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ABSTRACT

Aim. To identify the differences in executive function (inhibitory control, working memory, cognitive flexibility) between patients with bipolar affective disorder and depressive episode.

Materials and methods. A total of 72 patients with affective disorders aged 20–40 years were examined. Of them, 30 patients had bipolar affective disorder, a current episode of mild or moderate depression, and 42 patients had a mild, moderate, and severe depressive episode without symptoms of psychosis. The executive function was evaluated using PsyToolkit, a set of software tools for programming psychological experiments. Computerized Go/No–go tasks (assessment of inhibitory control and psychomotor functions), the Corsi block-tapping test (assessment of visual and spatial working memory capacities), and the Stroop Color and Word Test (assessment of cognitive flexibility) were used.

Results. An intergroup comparison of patients revealed that patients with bipolar disorder significantly more often demonstrated false button press in the Go/No–go task (p = 0.043); however, they exhibited a greater working memory capacity in the Corsi block-tapping test (p = 0.049) compared with patients with a depressive episode.

Conclusion. Important data were obtained regarding the specifics of executive dysfunction depending on the type of affective disorder. The presented data expand and supplement available information about the cognitive characteristics of patients with bipolar affective disorder and depressive episode, which may be useful in clinical practice and serve a focus of future research.

Keywords: affective disorders, bipolar affective disorder, depressive episode, executive function, cognitive deficit

Conflict of interest. The authors declare the absence of obvious or potential conflicts of interest related to the publication of this article.

Source of financing. The study was conducted within the state assignment No. 075-01184-22-00, the topic "Biopsychosocial mechanisms of pathogenesis and clinical polymorphism, adaptive potential and predictors of therapy effectiveness in patients with mental and behavioral disorders in Siberia" No. 122020200054-8.

Conformity with the principles of ethics. All patients signed an informed consent to participate in the study. The study was approved by the Ethics Committee at Mental Health Research Institute (Protocol No. 114 of 22.10.2018).

For citation: Galkin S.A., Vasilieva S.N., Simutkin G.G., Ivanova S.A. Executive dysfunction in affective disorders: differences in bipolar affective disorder and depressive episode. *Bulletin of Siberian Medicine.* 2022;21(3):28–33. https://doi.org/10.20538/1682-0363-2022-3-28-33.

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Нарушения исполнительных функций при аффективных расстройствах: различия при биполярном аффективном расстройстве и депрессивном эпизоде

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РЕЗЮМЕ

Цель – выявить различия в исполнительном функционировании (ингибиторный контроль, рабочая память, когнитивная гибкость) между пациентами с биполярным аффективным расстройством и депрессивным эпизодом.

Материалы и методы. Обследованы 72 пациента в возрасте 20–40 лет с аффективными расстройствами. Из них 30 пациентов с биполярным аффективным расстройством, текущий эпизод легкой или умеренной депрессии, и 42 пациента с депрессивным эпизодом легкой, умеренной и тяжелой степени без психотических симптомов. Оценка исполнительного функционирования осуществлялась с помощью программного пакета для разработки психологических тестов PsyToolkit. Использовались компьютеризированные тесты Go/No–go (оценка ингибиторного контроля и психомоторной реакции), Corsi (определение объема пространственной рабочей памяти) и цветовой тест Струпа (Color Stroop) (оценка уровня когнитивной гибкости).

Результаты. При межгрупповом сравнении пациентов обнаружено, что пациенты с биполярным аффективным расстройством статистически значимо чаще совершали ошибки на сигнал «No–go» (ложное нажатие кнопки) в тесте Go/No–go (p = 0,043), однако у них отмечался больший объем рабочей памяти в тесте Corsi (p = 0,049) по сравнению с пациентами с депрессивным эпизодом.

Заключение. Получены важные данные относительно специфики дефицита исполнительного функционирования в зависимости от типа аффективного расстройства. Представленные данные расширяют и дополняют имеющиеся сведения о когнитивных особенностях пациентов, страдающих биполярным аффективным расстройством и депрессивным эпизодом, что может быть полезным в клинической практике и служить дальнейшим направлением для будущих исследований.

Ключевые слова: аффективные расстройства, биполярное аффективное расстройство, депрессивный эпизод, исполнительные функции, когнитивный дефицит.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Исследование проведено в рамках выполнения государственного задания № 075-01184-22-00, тема «Биопсихосоциальные механизмы патогенеза и клинического полиморфизма, адаптационный потенциал и предикторы эффективности терапии у больных с психическими и поведенческими расстройствами в регионе Сибири» № 122020200054-8.

Соответствие принципам этики. Все пациенты подписали информированное согласие на участие в исследовании. Исследование одобрено этическим комитетом НИИ психического здоровья (протокол № 114 от 22.10.2018).

Для цитирования: Галкин С.А., Васильева С.Н., Симуткин Г.Г., Иванова С.А. Нарушения исполнительных функций при аффективных расстройствах: различия при биполярном аффективном расстройстве и депрессивном эпизоде. *Бюллетень сибирской медицины.* 2022;21(3):28–33. https://doi.org/10.20538/1682-0363-2022-3-28-33.

INTRODUCTION

Cognitive impairment is a common symptom of affective disorders (mood disorders). In particular, a number of studies have noted impaired memory, attention, thinking, and other symptoms in patients with affective disorders [1–4]. A number of methods were developed for assessing cognitive functions, but only a few of them are currently used in clinical practice. Given partial coincidence of data on the type and magnitude of cognitive deficits in patients with depressive episode (DE) and bipolar affective disorder (BD), it seems unlikely that standard tests can be used as an additional tool for differential diagnosis. In this regard, studies should focus on searching for specific cognitive neuromarkers of affective disorders. Executive function can become one of such neuromarkers.

Executive functions are a system of higher-level processes that support many everyday activities including planning, selecting, and successfully monitoring behaviors that facilitate the attainment of common goals [5]. Executive functions are basic cognitive processes, which include attention, inhibitory control, working memory, and mental flexibility [5, 6]. According to a number of authors, patients with affective disorders have executive dysfunction of varying severity, if compared with a healthy control group [1, 4]. However, we also failed to find data on the features of executive dysfunction between patients with BD and DE.

Based on various studies [1, 2, 4], we assume that patients with BD will have more pronounced executive dysfunction than patients with DE. Nevertheless, there are a few studies that directly compare patients with BD and DE.

The aim of this study was to identify the differences in executive function (inhibitory control, working memory, and mental flexibility) between patients with BD and DE.

MATERIALS AND METHODS

The study was carried out at the Affective States Department of the Mental Health Research Institute of Tomsk National Research Medical Center of the Russian Academy of Sciences (Mental Health Research Institute of Tomsk NRMC), according to the protocol approved by the local Ethics Committee at the Mental Health Research Institute (Protocol No. 114 of 22.10.2018). All patients signed an informed consent to participate in the study.

As part of the study, 72 patients (average age 28.92±6.97 years) were examined with the established diagnosis of Mood [affective] disorders according to the International Classification of Diseases, Tenth Revision (ICD–10). Of them, 30 patients (14 men, 16 women) had BD, a current episode of mild or moderate depression (F31.3), and 42 patients (18 men, 24 women) had a mild, moderate, and severe DE without symptoms of psychosis (F32.0–2).

Inclusion criteria were the established diagnosis of affective disorder with BD or DE, the age of 20–40 years, and a voluntary consent to participate in the study. Exclusion criteria encompassed the presence of pronounced organic brain disorders, mental retardation, administration of medications that affect brain activity, and refusal to participate in the study.

Information about the patients was obtained by means of a questionnaire which allowed to collect data on mental and somatic health. The diagnosis was made by qualified psychiatrists in accordance with the ICD–10 criteria. Clinical symptoms were assessed using psychometric scales, such as the Hamilton Rating Scale for Depression – 17 (HRSD–17) [7] and the Hamilton Anxiety Rating Scale (HAM-A) [8].

Cognitive deficit was diagnosed using PsyToolkit, a set of software tools for programming psychological experiments [9]. Computerized Go / No–go tasks [10] (assessment of inhibitory control and psychomotor functions), the Corsi block-tapping test [11] (assessment of visual and spatial working memory capacities), and the Stroop Color and Word Test [12] (assessment of cognitive flexibility) were used.

Statistical data processing was performed using Statistica 12 software package (StatSoft Inc., USA). Statistical data were presented as the median and the interquartile range $Me\ [Q_1; Q_3]$. The Mann–Whitney U test was used to assess intergroup differences. The differences were considered statistically significant at $p < 0.05$.

RESULTS

First, we analyzed clinical parameters in the studied groups of patients (Table 1).

Table 1

Clinical evaluation of patients with affective disorders, $Me\ [Q_1; Q_3]$

Parameter	Patients with DE, $n = 42$	Patients with BD, $n = 30$	p
Age, years	28 [23; 34]	27 [21; 36]	0.992
Duration of the disease, years	5 [2; 10]	6 [2; 11]	0.586
HDRS–17	23 [18; 24]	20 [16; 25]	0.503
HARS	16 [10; 22]	15 [12; 23]	0.782

The compared groups of patients did not differ in age (p = 0.992), duration of the disease (p = 0.586), severity of depressive symptoms (p = 0.503), and anxiety level (p = 0.782). Thus, patients with unipolar depression and BD were comparable in the clinical parameters. Additionally, all the study participants had incomplete or complete higher education, which allows us to conduct a full-fledged comparison.

Then we compared the parameters of cognitive function (data from cognitive tests) between patients with unipolar depression and BD (Table 2).

Table 2

Data of cognitive tests in patients with DE and BD, *Me* [Q_1; Q_3]

Test		Patients with DE, n = 42	Patients with BD, n = 30	p
Go/No–go tasks	false button press in the Go tasks	3 [2; 6]	4 [1; 7]	0.890
	false button press in the No–go tasks	0 [0; 1]	2 [1; 3]	0.043*
Corsi block-tapping test (working memory capacity)		5 [5; 6]	6 [5; 7]	0.049*
Stroop Color and Word Test (time), s		63 [54; 74]	65 [52; 73]	0.796

It was found that patients with BD significantly more often demonstrated false button press in the Go/No–go tasks (p = 0.043); however, they exhibited a greater working memory capacity in the Corsi block-tapping test (p = 0.049) compared with patients with DE.

DISCUSSION

In this study, executive function (inhibitory control, working memory, cognitive flexibility) was evaluated in patients with BD and DE. The results of the study clearly showed that in patients with affective disorders changes in executive function of varying severity were noted.

In contrast to patients with unipolar depression, patients with BD made significantly more errors in the No–go tasks, which indicated a pronounced impairment of inhibitory control. A number of studies also found deficient inhibitory control in patients with BD, which is consistent with the results in our study [1, 2]. Deficient inhibitory control is a basic cognitive dysfunction that can underlie psychopathology of mania and lead to more complex behavioral characteristics that are typical of the disease, such as impulsivity, distractibility, and a poor ability to suppress emotional reactions [13]. According to neuroimaging studies, brain regions that are functionally associated with inhibitory processes, such as the ventrolateral prefrontal cortex, dorsolateral prefrontal cortex, and the right inferior frontal gyrus, often underwent structural and / or functional changes in patients with BD [14, 15]. However, no such changes were found in patients with DE with respect to cognitive testing data in our study, which indicates the differences in the psychopathology of the disorders in question.

At the same time, the results of the Corsi block-tapping test revealed a greater decrease in working memory capacity in patients with DE, compared with patients with BD. Working memory is of great importance for performing many cognitive tasks in everyday activities [16]. According to a number of studies, a decline in working memory correlates with overload with distracting information [17, 18]. It is believed that people with stronger working memory filter out distractions better and focus only on important information at a given time. According to D.C. Glahn et al. [18], a decline in working memory is the mainstay for recurrent depressive disorders. No such changes were found in patients with BD, which once again indicates the differences in the psychopathology of the disorders.

On the other hand, we found that the cognitive flexibility parameters in the Stroop Color and Word Test and psychomotor functions in the Go/No–go tasks (the Go signal) were equally lower in patients with BD and DE, compared with the normal values, which indicates similar psychopathogenesis of these disorders. Psychomotor function is related to the cognitive concept of information processing speed. Manifestations of psychomotor retardation may include slow speech and a delay in motor activity. These changes are symptoms characteristic of a depressive state [19].

However, according to the results obtained, in patients with BD, a decline in the psychomotor speed and poor inhibitory control were simultaneously noted. These features may underlie manic (disruption of inhibitory control) and depressive (decreased psychomotor speed) symptoms in patients with BD. Cognitive flexibility is an ability to switch between different tasks depending on changing conditions; it plays an important role in a person's ability to adapt to the environment. According to the literature data, in addition to promoting purposeful behavior, cognitive flexibility is involved in the regulation of emotions, and its impairment is typical of mood disorders [19, 20]. Cognitive flexibility is an important component in the pathogenesis of BD and DE.

CONCLUSION

Following the conducted study, important data were obtained regarding the specifics of executive dysfunction depending on the type of affective disorder. The presented data expand and supplement available information about the cognitive characteristics of patients with BD and DE, which may be useful in clinical practice and serve as a focus of future research.

REFERENCES

1. MacQueen G.M., Memedovich K.A. Cognitive dysfunction in major depression and bipolar disorder: assessment and treatment options. *Psychiatry Clin. Neurosci*. 2017;71(1):18–27. DOI: 10.1111/pcn.12463.
2. Kessing L.V., Miskowiak K. Does cognitive dysfunction in bipolar disorder qualify as a diagnostic intermediate phenotype? – a perspective paper. *Front Psychiatry*. 2018;(9):490. DOI: 10.3389/fpsyt.2018.00490.
3. Fett A.J., Velthorst E., Reichenberg A. Long–term Changes in Cognitive Functioning in Individuals with Psychotic Disorders: Findings from the Suffolk County Mental Health Project. *JAMA Psychiatry*. 2020;77(4):387–396. DOI: 10.1001/jamapsychiatry.2019.3993.
4. Trivedi M.H., Greer T.L. Cognitive dysfunction in unipolar depression: implications for treatment. *J. Affect Disord*. 2014;(1):19–27. DOI: 10.1016/j.jad.2013.09.012.
5. Ferguson H.J., Brunsdon V., Bradford E. The developmental trajectories of executive function from adolescence to old age. *Sci. Rep.* 2021;11(1):1382. DOI: 10.1038/s41598–020–80866–1.
6. Gunzenhauser C., Nückles M. Training executive functions to improve academic achievement: tackling avenues to far transfer. *Front Psychol*. 2021;12:624008. DOI: 10.3389/fpsyg.2021.624008.
7. Hamilton M. A rating scale for depression. *Journal of Neurology, Neurosurgery and Psychiatry*. 1960;23(1):56–62. DOI: 10.1136/jnnp.23.1.56.
8. Hamilton M. The assessment of anxiety states by rating. *Br. J. Med. Psychol.* 1959;32(1):50–55. DOI: 10.1111/J.2044-8341.1959.TB00467.X.
9. Stoet G. PsyToolkit: A software package for programming psychological experiments using Linux. *Behavior Research Methods*. 2010;42(4):1096–1104. DOI: 10.3758/BRM.42.4.1096.
10. Gomez P., Ratcliff R., Perea M. A model of the go/no-go task. *J. Exp. Psychol. Gen.* 2007;136(3):389–413. DOI: 10.1037/0096-3445.136.3.389.
11. Kessels R., van Zandvoort M., Postma A., Kappelle L., de Haan E. The Corsi Block-Tapping Task: Standardization and Normative Data. *Applied Neuropsychology*. 2000;7(4):252–258. DOI: 10.1207/s15324826an0704_8.
12. Stroop J.R. Studies of interference in serial verbal reactions. *Journal of Experimental Psychology.* 1935;18:643–662.
13. Roberts W., Fillmore M.T., Milich R. Linking impulsivity and inhibitory control using manual and oculomotor response inhibition tasks. *Acta Psychol. (Amst.)*. 2011;138(3):419–428. DOI: 10.1016/j.actpsy.2011.09.002.
14. Monkul E.S., Malhi G.S., Soares J.C. Anatomical MRI abnormalities in bipolar disorder: do they exist and do they progress? *Aust. N. Z. J. Psychiatry*. 2005;39(4):222–226. DOI: 10.1080/j.1440–1614.2005.01571.x.
15. Cousins D.A., Grunze H. Interpreting magnetic resonance imaging findings in bipolar disorder. *CNS Neurosci. Ther*. 2012;18(3):201–207. DOI: 10.1111/j.1755–5949.2011.00280.x.
16. Hu Z., Barkley C.M., Marino S.E., Wang C., Rajan A., Bo K. et al. Working memory capacity is negatively associated with memory load modulation of alpha oscillations in retention of verbal working memory. *J. Cogn. Neurosci*. 2019;31(12):1933–1945. DOI: 10.1162/jocn_a_01461.
17. Endres M.J., Houpt J.W., Donkin C., Finn P.R. Working memory capacity and redundant information processing efficiency. *Front Psychol*. 2015;(6):594. DOI: 10.3389/fpsyg.2015.00594.
18. Glahn D.C., Curran J.E., Winkler A.M., Carless M.A., Kent J.W., Charlesworth J.C. High dimensional endophenotype ranking in the search for major depression risk genes. *Biol. Psychiatry*. 2012;71(1):6–14. DOI: 10.1016/j.biopsych.2011.08.022.
19. Gvozdetsky A.N., Petrova N.N., Akulin I.M. Influence of residual symptoms on cognitive functions of patients with recurrent depression in remission. *Siberian Herald of Psychiatry and Addiction Psychiatry*. 2020;107(2):26–33 (in Russ.). DOI: 10.26617/1810–3111–2020–2(107)–26–33.
20. Gabrys R.L., Tabri N., Anisman H., Matheson K. Cognitive control and flexibility in the context of stress and depressive symptoms: the cognitive control and flexibility questionnaire. *Front Psychol*. 2018;(9):2219. DOI: 10.3389/fpsyg.2018.02219.

Authors contribution

Galkin S.A. – conception and design, collection of the material, analysis and interpretation of the data, drafting of the manuscript. Vasilieva S.N. – collection of the material, clinical and psychopathological examination of patients. Simutkin G.G., Ivanova S.A. – final approval of the manuscript for publication.

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Received 27.09.2021;
approved after peer review 09.02.2022;
accepted 17.03.2022