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BRIEF COMMUNICATION

Sensorimotor performance in euthymic bipolar disorder: the MPraxis (PennCNP) analysis

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Background: Sensorimotor deficits are an important phenomenological facet observed in patients with bipolar disorder (BD). However, there is little research on this topic. We hypothesize that the MPraxis test can be used to screen for motor impairments in BD aiming movements.
Method: The MPraxis, which is a quick and easy-to-apply computerized test, measures sensorimotor control. During the test, the participant must move the computer mouse cursor over an ever-shrinking green box and click on it once. We predict that the MPraxis test is capable of detecting differences in sensorimotor performance between patients with BD and controls. We assessed 21 euthymic type I BD patients, without DSM-IV-TR Axis I comorbidity, and 21 healthy controls.
Results and conclusions: Compared to the controls, the patients with BD presented a lower response time in their movements in all conditions. Our results showed sensorimotor deficits in BD and suggested that the MPraxis test can be used to screen for motor impairments in patients with euthymic BD.

Keywords: Psychomotor performance; bipolar disorder; neuropsychological test

Introduction

Sensorimotor deficits are an important phenomenological facet observed in bipolar disorder (BD).[1-4] According to published research, the morphological[5,6] and functional[7] abnormalities in the frontostriatal network observed in patients with BD as compared with healthy subjects are a likely explanation for these disabilities. Although previous studies[2,8] have specifically investigated motor abnormalities in BD,[1] there is little research on this topic.

The University of Pennsylvania Computerized Neuropsychological Test Battery (PennCNP) is a computer test battery that has been used in many research studies.[9-11] The full PennCNP battery comprises an emotions battery, an executive functioning and abstract reasoning battery, and a memory battery.[11] A test of motor praxis control (MPraxis) should be administered before the PennCNP commences to allow participants to familiarize themselves with the use of the computer mouse and the computer-based testing procedures.[9-12] We hypothesize that the MPraxis test can be used to screen for motor impairments in clinical populations. This computerized test is quick and easy to apply and can contribute to both research and clinical assessment of sensorimotor deficits in patients with BD and other psychiatric disorders.

In the present study, we aimed to investigate whether the MPraxis test can be used to screen for motor impairments in goal-directed manual aiming movements in patients with BD. We are not aware of any previous study that has used the MPraxis test to measure sensoriomotor performance in euthymic BD-I subjects without DSM-IV-TR Axis I comorbidities. We predict that the MPraxis task will be capable of detecting differences in sensorimotor control between patients with BD and healthy subjects.

Methods

Study sample and assessment schedules

We screened 45 patients with BD-I aged 18 to 65 years, of whom 21 patients (10 male and 11 female) fulfilled the inclusion criteria for the study. The patients were recruited at the Núcleo de Transtornos Afetivos (a tertiary service that specializes in mood disorders) of Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil. All patients were evaluated by a psychiatrist who used the Mini-International Neuropsychiatric Interview plus version (MINI-PLUS); all fulfilled the DSM-IV-TR criteria for BD-I. The study was approved by the UFMG Research Ethics Committee (no. ETIC 0431.0.203.000-10). We obtained written informed consent from all participants after they had received a complete description of the study. All participants were right-handed (Edinburgh Inventory score $>$ 40). We

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excluded subjects with self-reported clinical comorbidities. We also excluded patients who received typical antipsychotics, because these drugs are likely to have an effect on motor control. We included only BD-I patients in euthymia, defined as a score < 8 on the Young Mania Rating Scale (YMRS) and in the 21-item Hamilton Depression Rating Scale (HAM-D). Of the 45 patients initially evaluated, 18 were excluded due to psychiatric comorbidities (10 with anxiety disorders and eight with mental disorders due to alcohol abuse and dependence), one was excluded due to the use of a pacemaker, three were excluded because they were not right-handed, and two were excluded because they were receiving typical antipsychotics. These selection procedures sought to minimize the likely confounding effects of brain laterality and use of typical antipsychotics on motor performance. The strategy of excluding comorbidities sought to reduce the risk of increased heterogeneity in a cross-sectional BD evaluation.

Twenty-one healthy subjects were selected from the same community as the BD-I patients to serve as controls. A psychiatrist used the MINI-PLUS to evaluate the healthy subjects; those who had current or past DSM-IV-TR Axis I psychiatric disorders or had first-degree relatives with any such disorders were excluded from the study. Healthy controls and patients did not differ in age (t[df = 32.98]= -0.317, p = 0.75) or educational attainment (t[df = 40]= -0.226; p = 0.79).

Finally, we compared the MPraxis test performance between the patient group and the control group.

MPraxis test

The MPraxis test measures sensorimotor control. It is also designed to familiarize the participant with the computer mouse, which is used in all of its tasks. During the MPraxis trial practice session, the participant must move the computer mouse cursor over an ever-shrinking green box and click on it once. The box appears in a different location on the test screen each time. If the participant cannot complete the MPraxis, it is likely that he or she will not be able to complete any other PennCNP test. The volunteers perform two tasks. In these two tasks, a non-randomized scenario is presented 20 times. As soon as the participant clicks on the box, the box will disappear and reappear at another location on the test screen, now in a smaller size. This scenario will continue until all 20 sizes/locations of the green box are presented. In the first task, the participant has no time limit to click on the green box. However, in the second task, the participant must click on the green box within 5 seconds; otherwise, the green box will automatically move to the next location on the computer screen. The total correct responses on the test trial and the mean of the response time for correct responses were selected as performance measures.

Statistical analyses

The Shapiro-Wilk W test revealed that all measures violated the assumption of a normal distribution ($p < 0.05$). The Mann-Whitney *U* test was thus used for data analyses. The significance level was set at 0.05 for all analyses. For the analysis of sociodemographic data, we used the Student *t*-test for discrete quantitative data (age and educational attainment) and the chi-square test for nominal qualitative data (sex).

The effect size analysis of the Mann-Whitney *U* was calculated using the *r* equation as follows[13]:

$$r = \frac{Z}{\sqrt{N}}$$

Results

Clinical and sociodemographic data

Mean age, educational attainment, and handedness distribution were not significantly different between the patients with BD-I and the healthy participants ($p > 0.05$). We did not observe differences in gender distribution (chi-square ^{1} = 0.95, p = 0.76) between the two groups. The BD-I sample was evaluated naturalistically.

MPraxis task performance

All participants (BD and control) scored a total of the correct responses. Data analysis indicated that patients with BD exhibited a lower response time in Task 1 (z = -3.434; p = 0.001, r = -0.52) and Task 2 (z = -4.063; $p < 0.001$, r = -0.63), with a large effect size.

Discussion

Confirming our hypothesis, we found that the MPraxis test can be used to screen for motor impairments in aiming movements. This test has been underutilized and limited only to familiarization of subjects with the use of the computer mouse and computer-based testing procedures for the PennCNP battery.

We observed that the MPraxis test demonstrated a floor effect in relation to the total number of correct responses. However, patients with BD exhibited an increased response time in the MPraxis test as compared with healthy subjects. An increased response time reflects slowness of movement, or bradykinesia.[14] This difference in response time can be explained by the different motor control strategy used by patients with BD as compared with healthy subjects. Lage et al.[1] found that patients with BD exhibited a lower degree of automatization than healthy subjects. Patients with BD used a more closed-loop control strategy, i.e., their manual control relies more on visual feedback. In contrast, healthy subjects used more open-loop control, i.e., a type of control whereby movements are made without sensory feedback during the action and require an internal model for accuracy. Such actions can occur rapidly because there is no need to account for sensory feedback. One of the primary explanations for this difference in motor control is the abnormal functioning of the frontostriatal circuitry. Our findings are consistent with another study

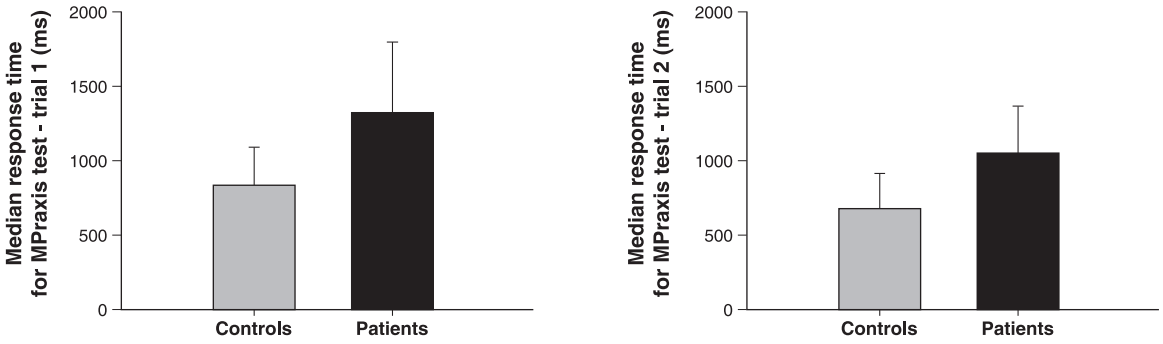

Figure 1 Means and standard deviations of the dependent measures obtained in tasks 1 and 2 in patients with bipolar disorder and healthy subjects

by Lage et al.,[1] which demonstrated that sensorimotor deficits persist in patients with BD even during euthymia.

The results reported herein should be interpreted with caution due to the methodological limitations of our study. Although we excluded patients who used typical antipsychotics, we selected a sample of patients with BD who received medication. We know that several medications may alter motor performance.[15,16] Future research is warranted to explore medications and their effects on sensorimotor performance in patients with BD.

Despite these limitations, our results can be interpreted based on the findings of previous studies with regard to impaired motor skills in patients with BD. Within this context, our results suggest that the MPraxis test can be used to screen for motor impairments in aiming movements.

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Disclosure

The authors report no conflicts of interest.

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