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Standing postural instability in patients with schizophrenia: Relationships with psychiatric symptoms, anxiety, and the use of neuroleptic medications

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ABSTRACT

The purpose of this study was to assess postural instability in patients with schizophrenia using a pressure-sensitive platform and to examine the effects of anxiety, psychiatric symptoms, and the use of neuroleptic medications on postural sway. Participants were 23 patients with schizophrenia and 23 healthy controls. We found that the patients showed greater overall postural instability than the controls. Furthermore, they demonstrated greater instability when the test was performed with the eyes closed than with the eyes open. However, removal of visual input had less impact on the indices of postural instability in the patients than in the controls, suggesting that schizophrenia is associated with difficulties in integrating visual information and proprioceptive signals. Furthermore, in contrast to the controls, anxiety exacerbated postural instability in the patients. There were significant associations between postural stability and psychiatric symptoms in the patients without extrapyramidal symptoms, whereas medication dose did not significantly correlate with postural stability.

1. Introduction

Schizophrenia is characterized by positive symptoms (e.g. delusions and hallucinations), negative symptoms (e.g. blunted affect and withdrawal), and cognitive deficits that impair social functioning [1]. There have been many studies showing abnormalities of brain structure and neurological soft signs (e.g. motor coordination deficits and disorders of equilibrium and gait) in patients with schizophrenia [2]. Abnormalities of postural control and movement have also been reported in such patients [3,4]. Furthermore, schizophrenia has been associated with stiffness of posture and awkwardness in clinical case studies of Dohsa-hou [5], a Japanese body-oriented psychotherapy approach [6]. A few studies have shown that the cerebellum, which controls the balance of the body by integrating visual, vestibular, and proprioceptive signals, is smaller in patients with schizophrenia than in healthy individuals. Atrophy of the cerebellar vermis has also been reported [7].

In addition to the described structural abnormalities, antipsychotic medications and psychological factors may influence postural stability as well as induce cognitive impairment [8]. Extrapyramidal symptoms can be caused by antipsychotics, and it has been reported that the use of such agents with a chlorpromazine equivalent higher than a certain limit has negative effects on postural stability in patients with schizophrenia [9]. Abnormalities in postural stability are also affected by the chronic psychological strain in patients with schizophrenia. Tsuru suggested that the increased awareness of the external world in individuals suffering from schizophrenia results in physical expression of this mental tension, which may influence postural stability [10]. In healthy individuals, influence of anxiety on postural stabilities is more complicated in previous studies. Although the level of anxiety did not influence the area of body sway, spectrum analysis revealed that high anxiety individuals showed greater power of low frequency components (that were

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associated with vestibular system) and smaller power of high frequency components (that were associated with proprioceptive inputs) [11]. Additionally, an increase of state anxiety was correlated with instability of balance on anterior–posterior axis with eyes open [12]. Such correlations were diminished when the eyes were closed. Lower anxiety was associated with higher ability to use sensory inputs to maintain balance, whereas anxiety did not correlated with latency of muscular responses to perturbations [13]. Thus, relationships between anxiety and body sway may be more complicated.

While there are many indications of the association between postural instability and schizophrenia, few patient studies have been conducted using stabilometry. It has been reported that patients with schizophrenia have greater postural sway than healthy controls [9,14,15] and cannot utilize visual information effectively [4]. In particular, unlike healthy controls, patients with schizophrenia showed greater postural sway when pursuing a target with horizontal eye movements [15], whereas there was no difference in their postural sway when tested with the eyes closed or open [16]. Therefore, the effect of visual information on postural sway in individuals with schizophrenia may differ from that in healthy individuals.

The purpose of this study was to quantitatively assess postural instability in patients with schizophrenia using a pressure-sensitive sway platform and to examine the relationships between postural sway, anxiety, psychiatric symptoms, and neuroleptic medications.

2. Methods

2.1. Participants

A total of 23 patients with schizophrenia (14 male and 9 female) and 23 healthy controls (7 male and 16 female) participated in this study. The individuals with schizophrenia were recruited during inpatient and outpatient visits of the Department of Psychiatry, Osaka University Hospital. Consensus diagnoses were established by experienced senior psychiatrists according to the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) [17] criteria using the Structured Clinical Interview for DSM-IV (SCID) for schizophrenia. All patients were treated through antipsychotic medications. The mean dose of antipsychotic medications was 1256.8 mg in chlorpromazine equivalent and Table 1 shows detail lists of antipsychotic medications for the patients. Healthy controls were recruited from the community through local advertisements at Osaka University.

All participants provided written informed consent after the study procedures were fully explained. All procedures were approved by the Ethical Committee of the Osaka University.

2.2. Measurements

2.2.1. Measurement of postural sway

Stability of the body when standing was assessed using a pressure-sensitive platform (Win-Pod, Medicapteurs, France). The postural sway platform was placed at a distance of 2 m from a visual target on the wall. Participants stood on the baseline of the platform with the arms at their sides and feet together.

The location of the center of pressure on the platform was determined using the supplied software. In compliance with the standard of the Japan Society for Equilibrium Research [18], measuring time was 60 s, and the sampling frequency was set at 10 Hz. We calculated locus length, area of sway, locus length per unit area, standard deviation of sway in medio-lateral direction (ML), and standard deviation of sway in anterior–posterior direction (AP) as indices of postural stability. Locus length, the total length of migration of the position of the center of pressure, is considered a typical parameter reflecting postural stability. Area of sway is the area surrounding the perimeter of locus length, and it decreases with better stability. Locus length per unit area is the migration length per square centimeter, and it shows the details of postural sway control. Smaller values of ML and AP indicate better stability.

Table 1
Detailed list of antipsychotic medications for the patients with schizophrenia.

No.	Medication at assessment	Extrapyramidal symptoms
1	Clozapine (600 mg)	+
2	Clozapine (600 mg)	+
3	Clozapine (500 mg)	+
4	Clozapine (500 mg)	+
5	Clozapine (500 mg)	+
6	Clozapine (500 mg)	+
7	Olanzapine (15 mg)	+
8	Risperidone (15 mg), Blonanserin (24 mg)	+
9	Risperidone (12 mg), Quetiapine (200 mg)	+
10	Risperidone (12 mg), Olanzapine (20 mg), Quetiapine (750 mg)	+
11	Perospirone (48 mg), Olanzapine (20 mg), Aripiprazole (30 mg)	+
12	Quetiapine (750 mg), Blonanserin (24 mg), Risperidone (9 mg),	+
13	Aripiprazole (6 mg)	–
14	Blonanserin (4 mg)	–
15	Clozapine (600 mg)	–
16	Clozapine (400 mg)	–
17	Olanzapine (20 mg)	–
18	Olanzapine (10 mg)	–
19	Risperidone (6 mg)	–
20	Risperidone (12 mg), Perospirone (16 mg)	–
21	Olanzapine (20 mg), Risperidone (9 mg)	–
22	Perospirone (48 mg), Risperidone (6 mg), Chlorpromazine (25 mg), Levomepromazine (50 mg)	–
23	Perospirone (48 mg), Olanzapine (20 mg), Quetiapine (750 mg), Zotepine (450 mg)	–

2.2.2. Assessment of anxiety and psychiatric symptoms

State anxiety was evaluated using the Japanese version of State-Trait Anxiety Inventory (STAI) [19] consisting of 20 questions. A four-point scale was used for determining the score. A higher score indicated more severe anxiety. STAI was completed by 23 healthy controls and 10 patients with schizophrenia who were judged suitable for reporting self-report questionnaire by primary physicians. Due to severe psychiatric symptoms and lack of insight, other patients have problems in evaluating state anxiety properly by themselves.

Psychiatric symptoms (positive symptoms, negative symptoms, and general psychopathology) were evaluated with the Positive and Negative Syndrome Scale (PANSS) [20] containing 30 items using a seven-point scale.

Extrapyramidal symptoms (EPS) were evaluated using the drug-induced extrapyramidal symptoms scale (DIEPSS) [21] that included nine items and utilized a five-point scale.

2.3. Measurement procedures

The questionnaires were administered first. Visual target on the wall was then adjusted to the eye level of the participant. After a training session that lasted for 30 s, two 60-s measurement sessions were conducted with the participant standing on the pressure-sensitive platform with the eyes open or closed. During a 30-s break between these sessions, the participant sat on a chair. Each trial began with a 5-s adjustment period to avoid the influence of early postural sway. The order of the two sessions (with the eyes open and closed) was counterbalanced.