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Research article

Posturographic destabilization in eating disorders in female patients exposed to body image related phobic stimuli

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HIGHLIGHTS

- Human postural control is affected by psychological conditions.
- Eating disorder patients' balance is affected by mirror and body ideal image exposure.
- Balance destabilization obtained by mirror exposure relates to body dissatisfaction.

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ABSTRACT

Human postural control is dependent on the central integration of vestibular, visual and proprioceptive inputs. Psychological states can affect balance control: anxiety, in particular, has been shown to influence balance mediated by visual stimuli. We hypothesized that patients with eating disorders would show postural destabilization when exposed to their image in a mirror and to the image of a fashion model representing their body ideal in comparison to body neutral stimuli. Seventeen females patients attending a day centre for the treatment of eating disorders were administered psychometric measures of body dissatisfaction, anxiety, depression and underwent posturographic measures with their eyes closed, open, watching a neutral stimulus, while exposed to a full length mirror and to an image of a fashion model corresponding to their body image. Results were compared to those obtained by eighteen healthy subjects. Eating disordered patients showed higher levels of body dissatisfaction and higher postural destabilization than controls, but this was limited to the conditions in which they were exposed to their mirror image or a fashion model image. Postural destabilization under these conditions correlated with measures of body dissatisfaction. In eating disordered patients, body related stimuli seem to act as phobic stimuli in the posturographic paradigm used. If confirmed, this has the potential to be developed for diagnostic and therapeutic purposes.

1. Introduction

The maintenance of an upright stance in humans depends on the central integration of vestibular, visual and somatosensory inputs, and on the integrity of the motor efferent neural pathway, which continuously provides postural adjustment to environmental and body position changes. While research has addressed how organic vestibular end-organ diseases, visual, and somatosensory impairment may disrupt postural control and lead to gait and balance disorders, little is known about the interaction between psychological variables and whole body posture disturbance [1–3].

Various studies have shown a possible link between static postural control and anxiety in normal subjects [4], and in both adults and children affected by psychological distress [5,6]. Results suggest that anxiety and depression are associated to an abnormal upright stance. This seems to be particularly the case when postural control is tested in environmental conditions presenting a sensory mismatch between the vestibular, somatosensory and visual systems [7]. One of the most common experimental settings used to trigger a visual-vestibular mismatch is quietly standing in front of a full-

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field moving scene, so that peripheral retinal activation generates a sensation of motion conflicting with the sense of stationariness provided by the labyrinths and the muscular-skeletal and plantar receptors. In such a sensory conflict paradigm, anxiety appears to disrupt the ability of the central nervous system to ignore the misleading visual information, leading to an increased body sway [8]. This seems to apply to an even greater degree in anxious patients, who are known to be particularly dependent on vision for balance maintenance [9]. In addition, the visual destabilization of posture induced by full-field optokinetic stimulation is reinforced by anxiety in patients with peripheral vestibular disorders. In particular, the posturographic body sway area is significantly increased in anxious patients when the optokinetic stimulation is delivered toward the defective labyrinth, suggesting a close balance-anxiety link mediated by manipulation of the visual information in humans [10]. Moreover, the destabilizing effect of anxiety on human postural control seems to mainly affect the central processing of visual information, and appears less prominent in eye-closed conditions [11,12].

The neuro-anatomical pathway that hypothetically subserves this emotion-balance link has been identified in the neural circuit connecting vestibular nuclei to the parabrachial nucleus and central amygdale, infralimbic cortex and hypothalamus, the latter three structures been strongly involved in the "fear network" processing emotionally charged visual stimuli [13]. The final emotional and behavioural output is mediated by both nucleus tractus solitarii for autonomic responses and by hypothalamic paraventricular nucleus for stress axis activation [14]. In humans several pieces of evidence confirm that the processing of emotional visual stimuli activates limbic areas, such as amygdale and insula, in which isolated lesions are a possible cause of pseudo-vestibular syndrome [15].

Galeazzi et al. [16] explored the links between visual information processing, emotion and posture in a posturographic study of healthy human participants exposed to their own images reflected by a full-length mirror. Increased body sway, as detected by posturography, was directly related to the severity of body-image preoccupations and to trait anxiety. This postural disturbance was interpreted as stemming from the aversion caused by the visual stimulus in participants with greater body dissatisfaction, which disrupts emotional status similarly to the 'phobic stimulus' experienced by patients with bulimia nervosa when exposed to their own body image reflected by a mirror [17] or exposed to a thin-ideal image [18].

In order to further investigate the destabilizing effect on posture previously described and to be able to specifically attribute the effects to negative feelings an individual has about their body image, we compared the postural control of patients with an eating disorder diagnosis to that of healthy participants without diagnosable psychiatric disorders when exposed 1) to their own image reflected on a full-length mirror, 2) to their thin-ideal image embodied by a fashion model image reproduced on a frontal full-field screen. We hypothesized that patients with an eating disorders would show higher posturographic destabilization when exposed to these stimuli in comparison to the control group and that destabilization would correlate to body dissatisfaction psychometric measures.

2. Material and methods

Participants comprised two groups:

- the clinical population, eating disorders group (EDG) was composed of 17 female patients, aged from 18 to 42 consecutively admitted to the Psychiatric Day Hospital Unit of Modena University Hospital (Italy) who were diagnosed with an eating disorder (anorexia nervosa n = 10, bulimia n = 3, eating disorder not otherwise specified n = 4), with diagnosis confirmed according to the Italian Version of the Structured Clinical Interview- DSM-IV (SCID-I) [19] and the Mini International Neuropsychiatric Interview (MINI) [20];

- the healthy control group (CG), composed of 18 females selected from the students and staff of the same University Hospital, matched to patients according to age; this group was screened negative on the same diagnostic instruments and had no history of psychiatric disorder. Sample size was dictated by the number of patients presenting to the service in one year period with their matched controls.

Both patients and controls had their Body Mass Index (BMI) and socio-demographic data recorded. They completed the following psychometric standardized instruments, using validated Italian versions:

- Body Cathexis Scale (BCS) [21] a 46 item questionnaire evaluating the dissatisfaction level toward different body parts and functions. Higher scores indicate higher levels of body satisfaction;

- Body Uneasiness Test – A (BUT-A) [22]: a 34 item questionnaire exploring concerns with one's body image. It provides various subscale scores: total score, weight phobia, body image concerns, avoidance, compulsive self-monitoring and depersonalisation; the higher the score, the more severe the level of uneasiness with one's body;

- State Trait Anxiety Inventory (STAI) [23]: a 40 item questionnaire exploring both habitual experience of anxious feelings (trait anxiety, 20 items) and the respondent's emotional status at the time of administration (state anxiety, 20 items). Each item is scored on a four-point graduation and higher scores indicate higher levels of anxiety;

- Beck Depression Inventory (BDI) [24]: a 21 item scale investigating depressive feelings and attitudes. Higher scores indicate more severe depression.

Patients and controls also underwent vestibular examinations (Computerized electrooculography Toennies Pro System, Erich Jaeger GmbH & Co. KG, Wurzburg, Germany, 1994). The electro-oculo-graphic battery included tests for exploring oculomotor (saccades and smooth-pursuit) and optokinetic functioning, spontaneous and gaze nystagmus, three cycles of sinusoidal rotation testing with a maximum speed of 60°/s for vestibulo-oculo-motor reflex and bithermal irrigation (33 °C and 44 °C) of both ear canals for labyrinthine activity. We used the vestibular paresis formula of Jongkees et al. [25]: $\frac{(R_{30^\circ C}+R_{44^\circ C})-(L_{30^\circ C}+L_{44^\circ C})}{R_{30^\circ C}+R_{44^\circ C}+L_{30^\circ C}+L_{44^\circ C}} \times 100$ where, for example, $R_{30\,^\circ C}$ is the maximum slow phase velocity of nystagmus induced by the caloric irrigation of the right ear canal with 30 °C water. Vestibular paresis was defined as more than a 25% asymmetry between the right-side and left-side responses [26]. A priori exclusion criteria were having an asymmetry greater than 25% suggesting the presence of a labyrinthine hypo-function, showing bilateral labyrinthine hypofunction, and presenting signs and symptoms suggesting a central vestibular system involvement.

Static posturography was then performed in all subjects by means of a stable force-plate sensible to vertical force. This commercial stabilometer (SVeP/Standard Vestibology Platform, Politecnica, Modena, Italy) was built and standardized according to the specifications of the French Association of Posturology [27,28]. The force plate was mounted on three strain-gauge force transducers positioned at the vertices of an equilateral triangle, providing description of body sway in terms of displacement of participants' centre of pressure. Sway path was computed by detecting the body's centre of pressure continuously and calculating an elliptic area corresponding to 90% of the positions of the centre of pressure over time. The mean magnitude of the sway path (expressed in square millimetres) was computed following each trial. The duration of each trial was 52.2 s. Stabilometric data were recorded at