Available online at www.sciencedirect.com
ScienceDirect
Journal of Psychiatric Research 41 (2007) 1005–1011
JOURNAL OF PSYCHIATRIC RESEARCH
www.elsevier.com/locate/jpsychires

Does regional brain perfusion correlate with eating disorder symptoms in anorexia and bulimia nervosa patients?

Ingeborg Goethals [a,*], Myriam Vervaet [b], Kurt Audenaert [b], Filip Jacobs [a], Hamphrey Ham [a], Cees Van Heeringen [b]

[a] *Department of Nuclear Medicine, Polikliniek 7, Ghent University Hospital, De Pintelaan 185, B-9000, Belgium*
[b] *Department of Psychiatry and Medical Psychology, Ghent University Hospital, Belgium*

Received 22 March 2006; received in revised form 31 August 2006; accepted 5 September 2006

Abstract

Objective: Using single photon emission computed tomography (SPECT), we sought brain perfusion correlates of eating disorder symptoms in anorexia and bulimia nervosa patients.
Method: We investigated 67 female eating disordered (ED) patients. Eating disorder symptoms were measured by the Eating Disorders Inventory (EDI). Determination of brain areas in which regional perfusion co-varied with drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness and maturity fears was done by open explorative correlation analysis using Statistical Parametrical Mapping (SPM).
Results: A significant positive correlation between scores on body dissatisfaction and ineffectiveness, and brain perfusion in the prefrontal and parietal cortex was demonstrated. There were no correlations between other eating disorder symptoms and brain perfusion.
Conclusion: Based on the finding of an association between regional brain flow and body dissatisfaction and ineffectiveness, we argue that neurobiological findings in ED patients may not only reflect emotional and behavioural factors but cognitive–evaluative features as well.

Keywords: Eating disorders; Regional cerebral blood flow; Single photon emission computed tomography; Statistical Parametrical Mapping; Correlation analysis

1. Introduction

Eating disorder (ED) research is increasingly focusing on the precipitating factors for disordered eating behaviour. Such factors range from cultural over social and familial interactions to narrowly biological factors. Also, psychological features such as cognition and affective states may be involved. Moreover, the relationship between these antecedents and (disordered) eating behaviour seems complex (Polivy and Herman, 2002).

Recent research has shown that body dissatisfaction (BD) is a prominent risk factor (Stice and Shaw, 2002), and most conceptualisations of EDs, including DSM, make reference to it. BD refers to negative evaluations of one's body, such as shape, size and weight. This dissatisfaction is primarily a function of the obsession with thinness and/or fear of weight gain (Harvey et al., 2002; Williamson et al., 2002). Importantly, a central feature in both anorexia (AN) and bulimia nervosa (BN) is the use of one's body weight and shape as the basis for self-evaluation (McFarlane et al., 2001, 1998). Thus, negative feelings about the self are associated with negative feelings about the body, although the direction of the association is not clear.

EDs also feature several cognitive dysfunctions, including obsessive thoughts (Halmi et al., 2003), and attentional and memory bias, especially for material related to food, body weight and shape (Lee and Shafran, 2004). Usually,

* Corresponding author. Tel.: +32 9 240 30 28; fax: +32 9 240 38 07.
E-mail address: ingeborg.goethals@ugent.be (I. Goethals).

0022-3956/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jpsychires.2006.09.003

attention is measured by the performance on experimental strategies. However, performance can be either facilitated or impaired due to the selective processing of information related to the person's concerns. For example, in the Stroop Colour Word test, colour naming is significantly slowed if the ink colour and meaning of the colour word differ (MacLeod, 1991). Similarly, in the emotional version of the Stroop test, performance is impaired if the presented words are personally and emotionally salient in comparison with words that are emotionally neutral (Taghavi et al., 2003). With EDs, this means that performance is disturbed when the words to be colour named are related to food and body size and shape (Dobson and Dozois, 2004). Further, ED patients tend to spend a great amount of time obsessing about food, eating, and related matters (Sunday et al., 1995), inasmuch that an obsession with becoming thin may be seen as the driving force of both AN and BN. Another putative causal obsession-related factor is the strive to be perfect (Shafran et al., 2002). Perfectionism is readily applied to eating, weight and shape, and ED patients desperately become invested in achieving a perfect body.

In this study, we investigated a group of female AN and BN patients with brain perfusion SPECT and sought regional perfusion correlates of ED symptoms measured with the Eating Disorders Inventory (EDI) (Garner et al., 1983). Because BD is presumed to be primarily a function of body image disturbances (Gupta and Johnson, 2000), including both perceptual body size distortion and cognitive–evaluative disturbances (Fassino et al., 2002; Skrzypek et al., 2001), we hypothesized that particularly BD would be associated with regional cerebral blood flow (rCBF) in brain regions that are assumed to mediate the foregoing functions, i.e. in a network of frontal and parietal cortical areas. The study was carried out in accordance with the latest version of the Declaration of Helsinki and approved by the local ethics committee. Written informed consent was obtained from each subject after the procedure had been fully explained.

2. Methods

2.1. Subjects

In this study, we investigated 67 female ED patients with AN of the restrictive type (AN-R) ($n = 31$), AN with binge/purging features (AN-B/P) ($n = 16$) and BN of the purging type (BN-P) ($n = 20$), according to DSM-IV criteria. Patients were recruited from the in-patient eating disorder unit at the department of psychiatry at the Ghent University Hospital and were selected by the second author on the basis of DSM-IV based structured interviews. To create diagnostically homogeneous groups of patients, only restrictive anorectics with long duration of illness were included (mean duration of illness = 5 years, range 2.5–33). In these patients no transition to AN-B/P type could be expected, as clinical observation suggests that transition from restrictive to binge/purging type rarely occurs after a few years of illness duration (Wentz et al., 2001). There was no history of AN in the bulimic patients. Although the majority of patients had depressive symptoms at the moment of the SPECT scanning, none of them fulfilled DSM-IV criteria for depression nor any other psychiatric axis I disorder. Patients were free of psychotropic medication at least 1 year before the scanning. Additional exclusion criteria were a history of major medical or neurological disorder, previous electro-convulsive therapy, and pregnancy or lactation period.

2.2. Eating disorder symptoms

Core eating disorder symptoms were assessed by using the EDI (Dutch translation) with scales for drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness and maturity fears (Garner et al., 1983).

2.3. ^{99m}Tc-ECD perfusion brain SPECT

Image acquisition was performed with a triple head Toshiba gamma camera (model GCA/9300A; Toshiba Medical Systems, Dutoit, Belgium) equipped with low-energy super-high-resolution fan-beam collimators. The full-width at half-maximum (FWHM) of this system, as measured in-house, was 7.4 mm for ^{99m}Tc. Triple energy data were acquired for 90 projections during a 20-min continuous SPECT scan with a 20% main energy window centred around 140 keV and two adjacent 7% scatter windows. Butterworth filters of order 8 and cut-off frequencies of 0.16 and 0.09 cycles per cm were used for the main energy window and the scatter windows respectively. Data were scatter corrected using the Triple Energy Window method provided by Toshiba. Scatter corrected data were subsequently pre-filtered with a Butterworth filter of order 8 and cut-off frequency of 0.12 cycles per cm. Image reconstruction was performed with filtered back-projection and a Shepp and Logan filter. Uniform Sorensen attenuation correction was applied with a linear attenuation coefficient of 0.09 cm^{-1}. The resulting pixel size was 1.72 mm.

2.4. Statistical parametrical mapping

Reconstructed images were converted into ANALYZE format by means of an in-house conversion program, i.e. (X)MedCon, and Statistical Parametrical Mapping SPM2 (Wellcome Department of Cognitive Neurology, Institute of Neurology, London, UK) was used to determine brain regions that significantly correlated with core eating disorder symptoms. Correlation analysis was done in the entire group because the number of subjects in each of the subgroups was rather small. SPM calculations were performed with Matlab 5.3 (MathWorks Inc., Sherborn, MA, USA) on a Toshiba Satellite Pro 4600 laptop. Images were spatially normalized onto an in-house constructed ^{99m}Tc-labeled ethyl cysteinate dimer (ECD) SPECT template placed in MNI (Montreal Neurological Institute) space. Non-linear registration was allowed with a cut-off