Available online at www.sciencedirect.com
ScienceDirect
Psychiatry Research: Neuroimaging 163 (2008) 223–235
PSYCHIATRY RESEARCH NEUROIMAGING
www.elsevier.com/locate/psychresns

Neural correlates of attachment trauma in borderline personality disorder: A functional magnetic resonance imaging study

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Received 25 March 2007; received in revised form 4 July 2007; accepted 4 July 2007

Abstract

Functional imaging studies have shown that individuals with borderline personality disorder (BPD) display prefrontal and amygdala dysfunction while viewing or listening to emotional or traumatic stimuli. The study examined for the first time the functional neuroanatomy of attachment trauma in BPD patients using functional magnetic resonance imaging (fMRI) during the telling of individual stories. A group of 11 female BPD patients and 17 healthy female controls, matched for age and education, told stories in response to a validated set of seven attachment pictures while being scanned. Group differences in narrative and neural responses to "monadic" pictures (characters facing attachment threats alone) and "dyadic" pictures (interaction between characters in an attachment context) were analyzed. Behavioral narrative data showed that monadic pictures were significantly more traumatic for BPD patients than for controls. As hypothesized BPD patients showed significantly more anterior midcingulate cortex activation in response to monadic pictures than controls. In response to dyadic pictures patients showed more activation of the right superior temporal sulcus and less activation of the right parahippocampal gyrus compared to controls. Our results suggest evidence for potential neural mechanisms of attachment trauma underlying interpersonal symptoms of BPD, i.e. fearful and painful intolerance of aloneness, hypersensitivity to social environment, and reduced positive memories of dyadic interactions.

Keywords: Borderline Personality Disorder; fMRI; Attachment disorganization; Anterior cingulate cortex; Superior temporal sulcus; Parahippocampal gyrus

1. Introduction

Borderline personality disorder (BPD) is characterized by extreme and enduring emotional instability involving a range of intense affects, including rage, panic, emptiness, loneliness, and characteristically

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doi:10.1016/j.pscychresns.2007.07.001

multifaceted emotional pain and fear of abandonment (Lieb et al., 2004). Childhood maltreatment by a caregiver (emotional neglect, physical and sexual abuse) is one of the most important psychosocial risk and prognostic factors for BPD pathology (Zanarini, 2000; Zanarini et al., 2006).

Clinically, an essential dimension of BPD patients is their dysfunction of emotion-regulation systems combined with the inability to adjust emotional responses (Lieb et al., 2004). Studies using the startle reflex as a measure for emotional hyper-reactivity reported evidence that favored (Ebner-Priemer et al., 2005) and failed (Herpertz et al., 1999) to support this hypothesis. Two recent fMRI studies reported emotional hyper-reactivity as measured by increased amygdala activation in response to emotional pictures (Herpertz et al., 2001) or faces (Donegan et al., 2003). Two further recent studies investigated brain activation during processing of autobiographical memory. One study found less activation in emotion processing areas (Schnell et al., 2007) whereas an other study looking at unresolved life events compared to resolved life events found, among other regions, increasing activation of amygdala and anterior cingulated cortex (Beblo et al., 2006). Finally, reductions in amygdala (and hippocampal) volume have been reported for BPD patients (e.g. Driessen et al., 2000; Tebartz van Elst et al., 2001; Irle et al., 2005). PET studies showed prefrontal dysfunction in BPD patients in response to listening to personal scripts of abandonment and abuse (Schmahl et al., 2003, 2004).

No patient study to date has examined neural patterns in relation to attachment, a basic behavioral system that processes relationship-based emotional experience and regulation.

Attachment theory provides a powerful framework for understanding the nature of close relationships, the links between mental representations in patterns of emotion regulation and psychopathology (Westen et al., 2006). Researchers have used two measurement strategies for assessing adult attachment, based on narrative assessment or self-report. In the present study we refer on the narrative tradition using interview assessments (George et al., 1996; George and West, 2003; Main et al., 1985). This approach classifies attachment through examination of the person's state of mind with respect to attachment as expressed in linguistic qualities of the narratives. Classification falls into two main attachment groups: organized/resolved and disorganized/unresolved. Disorganized/unresolved individuals are flooded with painful affect, often evidenced through verbal descriptions of intense fear or linguistic disorientation (Main et al., 1985). Studies concur that the unresolved attachment classification predominates in BPD patients, related particularly to lack of resolution of physical and sexual abuse (Fonagy et al., 2000; Agrawal et al., 2004). Attachment disorganization is considered to be one core feature in understanding BPD psychopathology in the context of affective and interpersonal problems (Fonagy et al., 2003; Gabbard, 2005).

The attachment relationship is an essential biological system that influences motivational and emotional processes related to survival (Bowlby, 1969). Animal studies suggest that limbic structures are involved in attachment deprivation (Insel, 1997; Bauman et al., 2004). Structural neuroimaging studies show reduced hippocampus and amygdala volumes in patients reporting traumatic attachment histories (Tebartz van Elst et al., 2003; Wignall et al., 2004).

Functional imaging studies investigating social attachments have focused on healthy subjects so far. Pictures of loved ones (e.g., spouse versus friend or own versus other baby) (e. g. Bartel and Zeki, 2004; Leibenluft et al., 2004) evoked cortical and subcortical responses, including the cingulate cortex, insula, basal ganglia, and orbitofrontal cortex. No fMRI studies have examined brain activation while subjects tell stories when the attachment system is activated.

fMRI data gathered while participants were speaking continuously demonstrated that this approach can be reliably applied to healthy controls and schizophrenic patients with severe formal thought disorder (Kircher et al., 2001). Recently, we measured attachment representation in an fMRI environment in which healthy participants told stories in response to the Adult Attachment Projective (AAP), a validated attachment measure described in detail below. We found robust activation of visual, motor and language related areas while talking to AAP pictures and activation of the right amygdala related to attachment status and involvement in the course of the task (Buchheim et al., 2006).

One key feature of interpersonal problems in BPD patients is their intolerance of aloneness (Gunderson, 1996). In a recent BPD study using the AAP measure in a non-fMRI-environment (Buchheim and George, in press), we examined different narrative responses to "monadic" attachment pictures (characters facing attachment threats alone) and "dyadic" attachment pictures (interaction between characters in an attachment context). Attachment related traumatic dysregulation was operationally defined as the frequency of occurrence of "traumatic fear indicators" in the narratives. The results showed a higher frequency of these words in unresolved patients than controls in response to stories to monadic pictures, but not to dyadic pictures.