Functional MRI Correlations in Women Diagnosed with Borderline Personality Disorder Exposed to Self-Harm Imagery

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Purpose Borderline Personality Disorder (BPD) is a multidimensional impulsive personality condition leading to emotional dysregulation and self-harm (1). Previous fMRI studies have found abnormal prefrontal and amygdala activation in BPD subjects compared to normal subjects when presented with aversive or autobiographical stimuli (1-3). However, most BPD patients have a history of psychological drug treatment, and to date no fMRI studies have accounted for possible drug-induced brain activation in analyses between BPD and control groups. The purpose of this work was to eliminate the effects of psychological drug treatment in the neurological study of BPD by incorporating a medicated-control group into an fMRI study of BPD.

Materials and Methods ***Subjects:*** Three groups of six women, classified into BPD, depressed medicated, and age-matched normal subject categories (aged 18-30). All patients were right handed with normal IQ and no color blindness. All patients in the BPD and depressed medicated groups were currently being treated with selective serotonin reuptake inhibitors. ***Scanning Procedure:*** All experimental data were acquired using a 1.5-T GE scanner. A high-resolution anatomical scan was first acquired for each subject using a T1-weighted spin-echo sequence (TR/TE: 625/20). Next, fMRI images were acquired using a SSEPI sequence with a TR/TE: 2000/40. A block design paradigm developed with neutral and aversive images was presented as 8-epochs, 24-sec long with 12 images presented every 2-sec. The neutral images were those of hands and arms performing day-to-day activities. The aversive stimulus contained explicit public domain photographs of self-injurious cuts to the legs, abdomen, hands, wrists and arms. ***Data Analysis:*** The fMRI data were processed and analyzed using MedX, FSL and SPM. Raw fMRI data for each individual were motion corrected, spatially filtered, normalized to the SPM space and detrended. Intra-group analyses were performed using a t-test to identify significantly activated voxels using a linear model to compute statistical contrasts with a threshold set to a statistical significance of $p<0.05$ for each group. Inter-group analyses were performed using a parametric paired t-test with a threshold set to a statistical significance of $p<0.05$ for each pairing (BPD vs Normal, Medicated vs Normal, BPD vs Medicated). The resulting activation maps were registered to the Talairach space (4) and the average voxel intensity was computed for all brain regions.

Results BPD as well as medicated subjects showed high activation in the frontolimbic and occipital regions of the brain. The normal group showed significant activation in the primary sensory cortex pre-central gyrus. Inter-group analyses indicated significant correlation between the activated regions of the BPD and medicated groups compared to the normal group (Fig. 1). When the medicated group was used as the control, activation in the temporal and occipital lobes vanished while significant activation in the right frontal lobe was pronounced. Three-dimensional surface renderings of the activation results are shown in Fig. 2. The average voxel intensity for specific regions of interest are given Tabel I. These results confirm the most significant activation when using medicated subjects as the control group is in the right frontal lobe.

Conclusion Graphic visual representations of self-mutilation substantially enhanced activation of frontolimbic regions in BPD and medicated subjects, but not in normals. Such findings have been previously attributed to a contrasting control of brain regions involved in recognition, association and reward. A significant difference in BOLD signal between groups indicates distinct activation patterns that occur either due to underlying neuropsychological processes, or due to drug interactions. The results of this study indicate activation in the right frontal lobe is correlated with BPD, while activation in the occipicital and temporal lobes, and cerebellum, is due to the effects of psychological drug therapies. Further research involving quantitative analyses of diffusion tensor fiber tracts using regions of interest defined by activation in the BPD vs Med group may prove valuable to identify the subtle structural and functional abnormalities associated with BPD.

References

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Figures and Tables

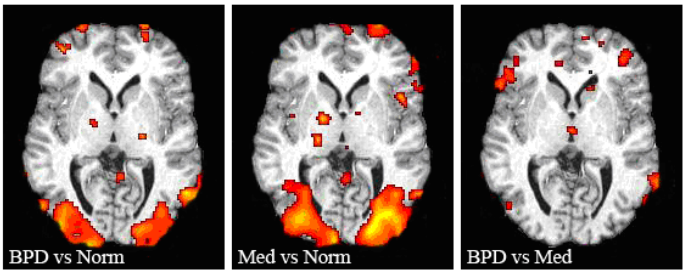

Fig. 1 – Inter-group activation results. The BPD vs MED image indicates activation in the occipital and temporal lobes may be drug-induced.

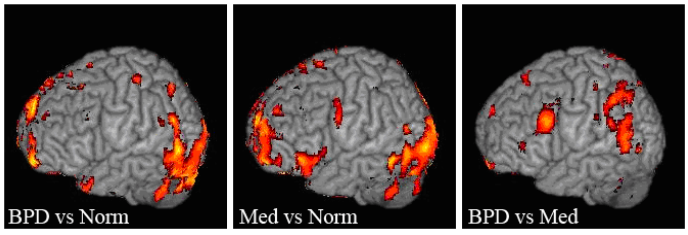

Fig. 2 – Surface renderings of the inter-group activation results.

Table I. Average voxel intensity in select regions for the inter-group analyses

Region	BPD vs Normal	Med vs Normal	BPD vs Med
Right frontal lobe	0.02	0.05	0.21
Right occipital lobe	0.44	0.85	0.01
Left temporal lobe	0.04	0.12	0.06
Right cerebellum	0.24	0.84	0.03
Left cerebellum	0.30	1.19	0.03