Functional Brain Activity in Patients with Conversion Disorder

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Background

Conversion disorder (CD) is characterized by neurological symptoms and/or signs for which there is no medical explanation. Patients experience sensory or motor deficits, and their lack of demonstrable medical origin, along with the general incidence of a significant psychological stressor prior to symptom onset, has led to the explanation that the symptoms are psychologically induced. However, the pathogenic and neurobiological mechanisms leading to the conversion are as yet unknown. Of further note, some forms of conversion disorder are surprisingly common. For example, 1-5% of patients attending ophthalmology clinics have unexplained and presumably psychogenic visual loss (Werring et al., 2004).

Recently, functional imaging has been used to identify and elucidate the conversion process, and has suggested an inhibitory process of normal neural networks. The source of this inhibition, however, has not been consistently indicated, with its anatomical locations varying between orbital frontal cortex, anterior and posterior cingulate gyrus, insula and the thalamus. Additionally, most studies have compared CD only with healthy controls, without comparing them to people with similar sensory or motor deficits. Here we compare subjects with CD induced tunnel vision to both healthy controls and a control with organically-induced tunnel vision.

Methods

Subjects:
- 2 subjects with conversion disorder induced tunnel vision (aged 23 and 37)
- 2 healthy controls (aged 22 and 23)
- 1 subject with organically-induced tunnel vision (aged 47).

Image Acquisition:
- Scanners: 3T GE short-bore for conversion disorder patients and healthy controls; 3T GE long-bore for the subject with organically-induced tunnel vision.
- Structural images: axially acquired 176 slice SPGR image 1mm x 1mm x 1mm.
- Functional images: axially acquired EPIBOLD sequence, 39 slices, 3.75mm x 3.75mm x 4mm, 2s TR.

Visual Field Stimuli:
- 2 blocks of expanding and contracting checkerboard ring stimuli, flickering at 6Hz.
- Rings displayed for 2.5s at each of 14 eccentricities.
- 4 cycles of expansion or contraction per block.
- Covered approximately 20° of visual field at any point in the experiment.

Image Processing:

Voxel-wise Fourier Analysis
- Phase and amplitude of fMRI signal calculated voxel-by-voxel.
- Amplitude: how well the signal correlates with the stimulus frequency.
- Phase: point in the cycle where the response is greatest.
- Opposite blocks (i.e. contracting and expanding rings) are averaged for hemodynamic delay.
- Analysis performed on images realigned and smoothed in SPM5 using a 4mm smoothing kernel.

SPM visual field analysis
- SPM5 was used to realign the EPI images, normalize them to SPM’s EPI atlas, and smooth them with a 6mm smoothing kernel.
- 1st level analysis with set up with 3 conditions:
  - rings that only subtended 0-15 degrees (within visual field of conversion disorder subjects)
  - rings that were only visible at eccentricities >15 degrees (outside the visual field of conversion disorder subjects)
  - rings visible at eccentricities both within and beyond 15 degrees (modeled as condition of no interest)

Results

Healthy controls showed highly coherent normal retinotopic phase mapping in V1, as expected. However, the subjects with conversion disorder showed activation to stimuli beyond their apparent field of view and in non-visual cortical areas. The subject with organically induced restricted field showed somewhat more limited activation. When separately analyzing activation for stimuli in the conversion disorder subjects’ field of view as compared to beyond it, these subjects had more activation in posterior parietal areas, that were not seen in either healthy or organic disorder subjects.

Discussion

The pattern of posterior parietal activation in the conversion disorder subjects resembles lesion locations in patients with simultanagnosia, a disorder which causes a lack of “visual awareness” and spatially restricted “visual attention”. However, the fact that this activation is more prominent when stimuli are presented within their field of view, rather than outside of this field, speaks against this activation being “inhibitory” in nature. Further studies are needed to confirm our findings, as well as to better understand the relationship between this posterior parietal region and visual perception and processing.

Reference