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Brain function in spider phobia

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Abstract

Measurements of regional cerebral blood flow (rCBF) were performed in 16 women suffering from spider phobia. The non-invasive ^{133}Xe inhalation method, giving information about the blood flow of superficial areas, was used. The subjects were studied under three conditions: during resting, when exposed to a videotape showing nature scenery, and finally when watching a video with living spiders. During the rCBF measurements the subjects' behaviour was registered systematically and respiration, blood pressure, P_{CO_2}, and heart rate were monitored. Eight subjects who showed and reported severe panic during the spider exposure had marked rCBF decreases in frontal areas, especially in the right hemisphere. The remaining eight subjects displayed a more efficient control of their emotions and became frightened, but not panic-stricken, during the spider exposure. These showed a consistent rCBF increase in the right frontal area compared to neutral stimulation. Thus, results revealed significant functional changes in the frontal cortex in subjects with spider phobia during phobogenic exposure. It seems likely that these frontal changes are related to the experience and control of phobic anxiety.

Keywords: Frontal lobe; Panic; Regional cerebral blood flow; Anxiety

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1. Introduction

Advances in neuroimaging methods are providing new evidence on brain function in mental disorders. To the extent that a psychiatric disorder reflects a problem in emotional self-regulation rather than a straightforward brain lesion, a neuroimaging study must examine the patient's brain function under the psychological conditions that are specifically coupled to the patient's mental dysfunction. In the present study, patients suffering from spider phobia were examined with regional cerebral blood flow (rCBF) measurements as they viewed a video showing living spiders. The purpose was to improve understanding of the brain mechanisms in the phobic response. This response includes both the affective experience and the regulatory processes that determine whether an encounter with the phobic stimulus results in mastery or panic.

The vast literature shows the importance of frontal cortical as well as subcortical regions in the processing of emotion and behaviour (Luria, 1966; Damasio and Van Hoesen, 1983; Tucker and Liotti, 1989; Tucker and Derryberry, 1992). The frontal lobe, especially its prefrontal part and fronto-limbic connections, plays a major role in planning, initiation and control of mental activity and of executive functions. There are strong functional connections between the orbito-frontal cortex, the anterior limbic system and the reticular formation and thereby also with regulation of arousal and attention. The importance of these brain regions is also indicated by intimate and reciprocal connections with other cortical and subcortical brain regions (Pribram, 1961; Nauta, 1973; Sanides, 1976; Aggleton and Mishkin, 1986; Benson and Stuss, 1990; Stuss et al., 1992; Le Doux, 1994; Tucker et al., 1995).

Efforts to relate mood disorder to hemispheric function have thrown light upon many interesting questions for a neuropsychological model of emotion. The right hemisphere is assumed to play an important role in emotional communication and might thus be involved in manifestations of anxiety (Davidson, 1984). Some researchers, however, view the left hemisphere as responsible for anxiety (Jorge et al., 1993).

Brain-imaging techniques have been used to study the relationship between anxiety and regional brain activity. Reiman et al. (1984) used positron emission tomography (PET) to measure cerebral blood flow (CBF) in patients with panic disorder. They found a higher blood flow in the right parahippocampal gyrus compared to the left. Gur et al. (1988) found a higher rCBF for a medium anxiety group than for low and high anxiety subjects combined. In another study (Zohar et al., 1988), 10 patients with obsessive–compulsive disorder underwent regional cerebral blood flow (rCBF) measurements during relaxation, imagining and direct exposure to a phobic stimulus. The authors reported an rCBF increase in the temporal region, particularly marked in the left hemisphere during imagining, while a general decrease was seen during in vivo exposure, more obvious in the right hemisphere. Mountz et al. (1989), using PET in seven subjects with phobic reactions to small animals, did not find any significant flow differences in either global or regional CBF between rest and activation.

We have in a previous study found significant blood flow increases in the fronto-temporal region of the cortex in the left hemisphere during anxiety activation in 16 patients diagnosed as suffering from Generalised Anxiety Disorder (Johanson et al., 1992). Six subjects with snake phobia examined with PET showed a significant rCBF increase in the visual associative cortex bilaterally during the specific phobic activation (Fredrikson et al., 1993). Additional data (Fredrikson et al., 1995) revealed reduced relative rCBF in the hippocampus and in the prefrontal, orbitofrontal, temporopolar and posterior cingulate cortex. Rauch et al. (1997) suggest that parts of the paralimbic belt, right inferior frontal cortex and subcortical nuclei are related to symptoms in different anxiety disorders.

Varying conditions exist in phobic anxiety: On encountering the phobic object, patients show more or less severe attacks of anxiety. As the frontal lobes are responsible for control of affects, we assume that these areas will be particularly involved during symptom provocation. The aim of this study was to examine psychological