Ventromedial prefrontal cortex

It is defined as the part of the prefrontal cortex that receives projections from the magnocellular, medial dorsal nucleus, and is thought to represent emotion and reward in decision making¹⁾.

The ventromedial prefrontal cortex (vmPFC) is a part of the prefrontal cortex in the mammalian brain.

It is located in the frontal lobe at the bottom of the cerebral hemispheres and is implicated in the processing of risk and fear. It also plays a role in the inhibition of emotional responses, and in the process of decision making.

Impaired social cognition, including emotion recognition, may explain dysfunctional emotional and social behaviour in patients with lesions to the ventromedial prefrontal cortex (VMPFC).

The VMPC can be sub-divided into orbital and medial sectors.

Anterior skull base meningiomas are frequently associated with changes in personality and behavior. Although such meningiomas often damage the ventromedial prefrontal cortex (vmPFC), which is important for higher cognition, the cognitive and behavioral effects of these meningiomas remain poorly understood.

Case series

2016

Abel et al reviewed neuropsychology and lesion mapping records of 70 patients who underwent resection of meningiomas. The patients were drawn from the Neurological Patient Registry at the University of Iowa. Patients were sorted into 2 groups: those with lesions involving the vmPFC and those with lesions that did not involve the vmPFC. Neuropsychological data pertaining to a comprehensive array of cognitive and behavioral domains were available preoperatively in 20 patients and postoperatively in all 70 patients.

No change occurred in basic cognitive functions (e.g., attention, perception, memory, construction and motor performance, language, or executive functions) from the preoperative to postoperative epochs for the vmPFC and non-vmPFC groups. There was a significant decline in the behavioral domain, specifically adaptive function, for both the vmPFC and non-vmPFC groups, and this decline was more pronounced for the vmPFC group. Additionally, postoperative data indicated that the vmPFC group had a specific deficit in value-based decision making, as evidenced by poor performance on the Iowa Gambling Task, compared with the non-vmPFC group. The vmPFC and non-vmPFC groups did not differ postoperatively on other cognitive measures, including intellect, memory, language, and perception.

Lesions of the vmPFC resulting from meningiomas are associated with specific deficits in adaptive function and value-based decision making. Meningioma patients showed a decline in adaptive function postoperatively, and this decline was especially notable in patients with vmPFC region meningiomas. Early detection and resection of meningiomas of the anterior skull base (involving the gyrus rectus) may prevent these deficits 2 .

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2014

Jenkins et al sought to investigate social cognition in patients with discrete, surgically circumscribed prefrontal lesions. Twenty-seven patients between 1 and 12 months post-neurosurgery were divided into groups based on Brodmann areas resected, determined by post-surgical magnetic resonance imaging. They hypothesised that patients with lesions to the VMPFC (n=5), anterior cingulate cortex (n=4), orbitofrontal cortex (n=7) and dorsolateral prefrontal cortex (DLPFC, n=11) would perform worse than a control group of 26 extra-cerebral neurosurgery patients on measures of dynamic facial emotion recognition, theory of mind (ToM) and empathy.

Results indicated the VMPFC-lesioned group performed significantly worse than the control group on the facial emotion recognition task overall, and for fear specifically, and performed worse on the ToM measure. The DLPFC group also performed worse on the ToM and empathy measures, but DLPFC lesion location was not a predictor of performance in hierarchical multiple regressions that accounted for other variables, including the reduced estimated verbal IQ in this group. It was concluded that isolated orbital or medial prefrontal lesions are not sufficient to produce impairments in social cognition.

This is the first study to demonstrate that it is the combination of lesions to both areas that affect social cognition, irrespective of lesion volume. While group sizes were similar to other comparable studies that included patients with discrete, surgically circumscribed lesions to the prefrontal cortex, future large, multi-site studies are needed to collect larger samples and confirm these results ³⁾.

1)

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