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DIFFERENT SUPRASPINAL RESPONSES TO AUTOMATED, REPETITIVE BLADDER FILLING IN PATIENTS WITH OVERACTIVE BLADDER COMPARED TO HEALTHY SUBJECTS - AN FMRI STUDY

Hypothesis / aims of study

In patients with overactive bladder (OAB), characterised by urinary urgency and frequency, supraspinal control and specifically sensory processing might be altered. Functional magnetic resonance imaging (fMRI) has been demonstrated to be a powerful tool to investigate the supraspinal network of lower urinary tract control in response to distinct stimuli such as repetitive bladder filling. To reveal potential pathomechanisms in the central processing of LUT sensations associated with OAB, we compared the supraspinal correlates of bladder filling sensation between healthy subjects and OAB patients.

Study design, materials and methods

Twenty-four right-handed female participants, 12 OAB patients and 12 matched healthy subjects, i.e. age and gender, participated in a block design fMRI study using a 3 Tesla MR scanner. The scan paradigm comprised automated, repetitive bladder filling of 100 mL body warm saline over 15s.

After catheterisation, bladder was pre-filled until a persistent desire to void was reported from each subject. Blood-oxygenation-level dependent (BOLD) signal change during bladder filling was compared to rest, i.e. pre-filled bladder using SPM8.

Second-level random effects analysis included one-sample t-tests for each group. Within-group results are shown at a voxel-threshold at $p=0.05$ familywise error rate (FWE) and at $p<0.001$ using the false discovery rate (FDR) correction with a strict cluster threshold correction of $p<0.05$ (cluster extend: $k>42$ voxels) to adjust for multiple comparisons using Monte Carlo simulations.

For group comparisons, whole-brain (WB) analyses as well as region of interest (ROI) analyses were computed. WB analysis was conducted for a comprehensive overview. ROI approach was performed to explore regional differences between both groups. Thus, the ROIs were included as a mask in order to restrict the voxel-by-voxel statistical analysis (including FWE-correction) to pre-specified brain areas. ROIs were generated using the WFU Pickatlas.

Results

In healthy subjects bilateral activation in frontal and prefrontal areas, i.e. inferior frontal gyrus pars triangularis (BA45) and pars orbitalis (BA47), and medial frontal gyrus (BA10 and 46), were observed.

In OAB patients activation patterns included the right (insula, supramarginal gyrus (BA40), rolandic operculum (BA44), and postcentral gyrus (primary somatosensory cortex)), and left (superior frontal gyrus (BA8), caudate, angular gyrus (BA39), and thalamus) hemisphere as well as bilaterally (middle cingulate cortex (MCC, BA24)).

No group differences were detected on WB analysis. The ROI analysis revealed significant stronger activations in the right posterior insula, left MCC, and left cerebellum for OAB patients compared to healthy subjects.

Interpretation of results

The findings reveal that task-related BOLD signal changes in response to automated, repetitive bladder filling with body warm saline differ greatly in OAB patients from those in healthy subjects.

Concluding message

The different brain activations found in OAB patients might reflect the abnormal and unpleasant sensation of urinary urgency as well as fear of leakage, since both, the right insula and MCC have been associated with processing of complex somatosensory information involving emotions and sensory discomfort.

Disclosures

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