

SUPRASPINAL RESPONSES TO AUTOMATED, REPETITIVE BLADDER FILLING IN HEALTHY SUBJECTS - AN FMRI STUDY

Hypothesis / aims of study

Recent fMRI studies revealed supraspinal networks in response to bladder filling involved in perception and processing of bladder distension. However significance of supraspinal network activity and network localizations varied largely due to the different filling protocols. Therefore, our first aim was to standardize filling paradigms using a MR-synchronized pump system for accurate timing and filling volume.

Moreover, there are two known fibre types (A-delta and C-fibers) of the lower urinary tract (LUT). C-fibers seem to be involved in the pathomechanisms of LUT dysfunction. However, their involvement of supraspinal control has not yet been completely revealed. Therefore, our second aim was to evaluate supraspinal processing of cold bladder sensation.

Study design, materials and methods

31 right-handed healthy subjects, 16 women and 15 men, mean age 33 years (range 19-54) with no history of urinary urgency and/or urinary urgency incontinence were included. Neuroimaging data was acquired in a 3 Tesla Phillips scanner in supine position.

After catheterization, for the first task bladder was pre-filled with body warm saline until a persistent desire to void (high volume) was perceived by each subject. The scan paradigm comprised automated, repetitive bladder filling of 100mL body warm saline over 15sec by using a MR-compatible pump system, i.e. block design study. The second measurement comprised automated, repetitive bladder filling of 100mL cold saline (between 4 and 8 centigrade) starting from an empty bladder.

Using SPM8, blood-oxygenation-level dependent signals during bladder filling was compared to rest, i.e. pre-filled (high volume) or empty bladder (cold).

Second-level random effects group analysis was corrected for gender, age and total intracranial volume and was performed to account for between-subject variability, i.e. within-group results at $p=0.05$ familywise error rate (FWE).

Results

4 subjects, 2 women and 2 men, were excluded from further analysis due to excessive head motions. Within-group results from the remaining subjects ($n=27$) revealed activation in the following brain regions during the first task (high volume): bilateral insula, left inferior parietal lobe (Brodmann area (BA) 40) and right frontal inferior operculum (BA44).

Supraspinal activity during the second task in response to bladder filling with cold saline was present in the following brain regions: anterior left insula, right postcentral gyrus (primary somatosensory cortex), right middle frontal gyrus (BA9), right inferior temporal gyrus (BA20), bilateral middle temporal gyrus (BA21), right superior temporal gyrus (BA22), the inferior parietal lobe, i.e. left angular gyrus (BA39) and bilateral supramarginal gyrus (BA40), right frontal inferior operculum (BA44) and right rolandic operculum (BA44).

Interpretation of results

Automated, repetitive bladder filling of body warm saline elicited robust brain activity on a high significance level in specific areas known to be involved in supraspinal lower urinary tract control.

Next to typical interoceptive areas, i.e. insula, automated, repetitive bladder filling of cold saline activated supraspinal areas primarily involved in processing of temperature and discomfort (primary somatosensory cortex) as well as encoding and memorization of new unfamiliar stimuli (temporal gyrus).

Concluding message

We report different supraspinal activation in response to automated, repetitive bladder filling with either body warm or cold saline. The latter supraspinal activation pattern seems to represent the involvement of C-fibers in supraspinal LUT control.

Disclosures

Funding: Swiss National Science Foundation **Clinical Trial:** No **Subjects:** HUMAN **Ethics Committee:** Kantonale Ethikkommission Zurich, Switzerland **Helsinki:** Yes **Informed Consent:** Yes