

## CHANGES IN BRAIN ACTIVITY ON FUNCTIONAL MAGNETIC RESONANCE IMAGING DURING SACRAL NEUROMODULATION FOR OVERACTIVE BLADDER

### Hypothesis / aims of study

Sacral neuromodulation (SNM) is used for refractory overactive bladder (OAB). Its mechanism of action is unknown, but likely involves spinal reflexes and afferent signaling to the brain. This study assessed SNM effects on brain activity in OAB, as measured by functional magnetic resonance imaging (fMRI).

### Study design, materials and methods

Following IRB approval, women with non-neurogenic refractory OAB who responded to SNM via InterStim II device, had a stable program for 3 or more months, and received no adjuvant OAB treatment were recruited. Enrolled patients completed pre-fMRI validated symptom and quality of life instruments [UDI-6, IIQ-7, PGI-S, Perceived Urgency Intensity (PUI)]. Stimulus settings were recorded, devices switched off for a 5-day washout, and instruments repeated.

Three fMRI scans below, at, and above stimulus sensory threshold were done after washout. Images were 2-dimensional gradient echo-planar imaging blood-oxygenation level dependent contrast (EPI-BOLD) acquired over 5 stimulator-off and 4 on cycles of 42 seconds each. Output images use single voxel p-value 0.05 with false positive error of 0.05 (cluster-analysis determined).

### Results

A total 13 patients enrolled (3 did not undergo fMRI, 4 were excluded for poor OAB symptom control or low image quality) and 6 completed fMRI with analyzable data. The sample median age was 52[36–64] years. Urinary bother and symptoms worsened with the 'washout' period and voiding diary data supported this.

An overall pattern of brain activation generally increased with stronger stimulation (Figure 1). Activation of the right inferior frontal gyrus remained stable with stimulus intensity, while deactivation of the pons and periaqueductal gray matter was only noted with sub-sensory stimulation. Sensory stimulation activated the insula but deactivated the medial and superior parietal lobes. Suprasensory stimulation activated multiple structures and the expected S3 sensory region. After fMRI, all devices had normal impedances and neither PUI (p0.36) nor PGI-S (p0.36) changed from baseline.

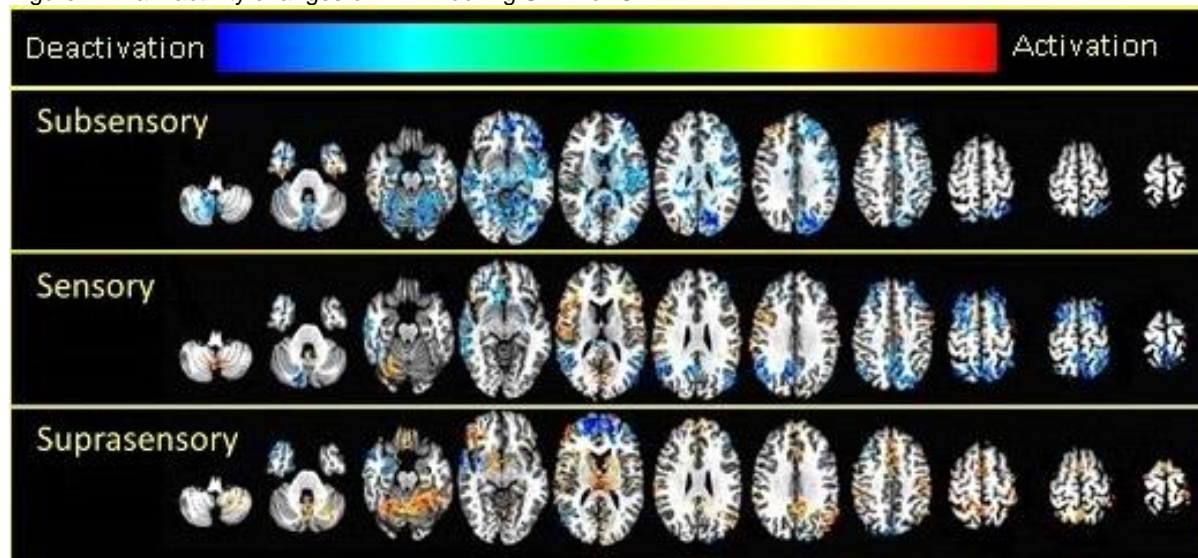
### Interpretation of results

Varying SNM stimulus influenced fMRI signal intensity, suggesting SNM alters brain activity in a dose-related fashion in OAB. These results support the theory that SNM has a centrally-mediated mechanism of action in OAB treatment. The findings also raise the question of what role stimulus parameters play in the therapy.

### Concluding message

SNM for OAB appears to have a dose-related centrally-mediated mechanism of action.

Figure 1: Brain activity changes on FMRI during SNM for OAB



### Disclosures

**Funding:** Medtronic Unrestricted Research Grant **Clinical Trial:** No **Subjects:** HUMAN **Ethics Committee:** Cleveland Clinic Institutional Review Board **Helsinki:** Yes **Informed Consent:** Yes