

Real-Time Changes in Brain Activity during Sacral Neuromodulation for Overactive Bladder

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Abstract

Purpose: We performed functional magnetic resonance imaging to identify changes in brain activity during sacral neuromodulation in women with overactive bladder who were responsive to therapy. **Materials and Methods:** Women recruited into the study had nonneurogenic refractory overactive bladder, responded to sacral neuromodulation and had had a stable program for at least 3 months with no subsequent overactive bladder treatment. Enrolled patients completed validated symptom and quality of life instruments before functional magnetic resonance imaging. Stimulus settings were recorded, devices were switched off for a 5-day washout and instruments were repeated. Three functional magnetic resonance imaging scans with simultaneous sacral neuromodulation stimulation were performed below, at and above stimulus sensory threshold using a block design. This yielded brain activity maps represented by changes in blood oxygenation level dependence. A total of 5 stimulator off and 4 stimulator on cycles of 42 seconds each were imaged. Group analysis was done using a single voxel p value of 0.05 with a false-positive error of 0.05 on cluster analysis. **Results:** Six of the 13 patients enrolled completed functional magnetic resonance imaging. Median age was 52 years (range 36 to 64). Urinary symptoms and voiding diary data worsened with washout. Overall brain activation generally progressed with increasing stimulation amplitude. However, activation of the right inferior frontal gyrus remained stable while deactivation of the pons and the periaqueductal gray matter only occurred with subsensory stimulation. Sensory stimulation activated the insula but deactivated the medial and superior parietal lobes. Suprasensory stimulation activated multiple structures and the expected S3 somatosensory region. All devices had normal impedance after functional magnetic resonance imaging. **Conclusions:** Functional magnetic resonance imaging confirmed that sacral neuromodulation influences brain activity in women with overactive bladder who responded to therapy. These changes varied with stimulus intensity..

Keywords

urinary bladder, brain mapping, overactive, implantable neurostimulators, magnetic resonance imaging, surveys and questionnaires.