Preliminary Results of Novel Noninvasive Cortical Modulation using Transcranial Rotating Permanent Magnet Stimulator in Improving Voiding Dysfunction in Female Multiple Sclerosis Patients

This pilot clinical trial investigates the therapeutic effects of Transcranial Rotating Permanent Magnet Stimulator (TRPMS) – a noninvasive, multifocal, individualized cortical stimulation device – in improving voiding dysfunction in female multiple sclerosis patients. Following two weeks of TRPMS treatment, patients showed more activation in brain regions involved in the micturition circuit, reflected in significant subjective and objective clinical improvement in voiding.

### Background and Rationale

- **Voiding dysfunction (VD)**
  - Common in neurogenic patients such as multiple sclerosis (MS).
  - Only available therapies with modest effectiveness for VD is catheterization.
- **Rationale:** Shift treatment focus from the bladder to the brain.

### Objectives

- To assess blood oxygen-level-dependent (BOLD) activation following TRPMS treatment in MS patients with VD.
- To evaluate subjective improvement (via urodynamic (UDS)) and objective improvement (via validated questionnaires) in VD symptoms following TRPMS treatment.

### Subjects

Ambulatory female MS patients with VD (n=6), defined as:
- Having post-void residual ≥ 40% of bladder capacity; or
- Falling below 10th percentile on Liverpool nomogram; or
- Performing self-catheterization.

### Methods

#### Rotate 1
- History
- Physical Exam
- UroFlow/PVR
- Questionnaires
- Consent

#### Rotate 2
- Video-Urodynamic Testing (VUDT)

#### Rotate 3
- 2-day Bladder diary
- UroFlow/PVR
- Anovulatory MRI
- UDS
- Concurrent MRI/UDS

#### Rotate 4-13
- 2-day Bladder diary
- UroFlow/PVR
- Questionnaires
- Anovulatory MRI
- Concurrent MRI/UDS

#### Rotate 14
- Follow-up T-12/MS
- UroFlow/PVR
- UDS
- Questionnaires

#### Rotate 15
- Follow-up T-12/MS
- UroFlow/PVR
- UDS
- Questionnaires

#### Rotate 16
- Follow-up T-12/MS
- UroFlow/PVR
- UDS
- Questionnaires

10 treatment sessions, 40 mins/session

### Results: Neuroimaging data

- **Figure 1.** BOLD activation during full void, post minus baseline (p<0.05), Warm colors indicate increased activation, cool colors indicate decreased activation.
- **Figure 2.** BOLD activation during voiding initiation, post minus baseline (p<0.05), Warm colors indicate increased activation, cool colors indicate decreased activation.

### Conclusions

- After treatment:
  - More activation in brain regions involved during full urge and voiding initiation, including deeper brain regions.
  - Significant clinical improvement in %PVR/BC (objective).
  - Significant clinical improvement in some questionnaires regarding voiding symptoms (subjective).
- Cortical modulation might have helped increase the strength of connectivity of the voiding network, hence produced significant changes in deeper regions involved in the micturition circuit, resulting in clinical improvement.

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