Movement Disorders
CLINICAL PRACTICE

LETTERS: NEW OBSERVATIONS

Magnetic Resonance Imaging-guided Focused Ultrasound Thalamotomy for Parkinson's Disease with Cardiac Pacemaker: A Case Report

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Surgical intervention for the ventral intermediate nucleus (Vim) became recognized as a therapeutic option for medication-refractory tremor, and transcranial MRI-guided focused ultrasound (MRgFUS) is a new neurosurgical tool for several neurological disorders.[1] We report the case of a 75-year-old, right-handed man with a 15-year history of tremor-dominant Parkinson's disease (PD). He suffered from refractory tremor of the right hand despite 300 mg of levodopa with benserazide plus 6 mg of trihexyphenidyl. The Unified Parkinson's Disease Rating Scale (UPDRS) score off medication was 15 and 17 (part 2 and 3, respectively). Patient suffered from sick sinus syndrome since 69 years old and had been implanted with a MR-conditional cardiac pacemaker system (Advisa DR MRI SureScan and Capsure Z Novus 5054/5554, Medtronic Japan), programed in DDD mode, with 60/130 bpm. Patient refused to continue exploring different drug schedules as well as deep brain stimulation as a possible treatment. Following institutional review board approval, MRgFUS thalamotomy was proposed. The patient provided written informed consent in accordance with the Declaration of Helsinki before treatment.

Using 1.5-Tesla MRI (Signa HDx, GE Healthcare) and a focused ultrasound system (Exablate 4000, Insightec), we employed a similar methodology to that in MRgFUS thalamotomy.[1] Before the procedure, we programed the pacemaker in DOO mode with 100 bpm and prepared resuscitation equipment, including an automated external defibrillator. Intraprocedurally, we monitored electrocardiographically and a cardiologist stood by. The shortest distance from the hemisphere with ultrasound transducers to the pacemaker was 20.5 cm. We chose the target in the left Vim at a point 6.8 mm anterior to the posterior commissure, 18.6 mm lateral from the midline (12.3 mm from the ventricle), and 1.5 mm above the anterior commissure–posterior commissure line. Gradually we increased the sonication energy and the resting tremor in the right hand disappeared. The total sonication time was 133 seconds in 8 sonications (mean: 16.6 $\pm$ 5.2 seconds, range: 10–25 seconds). The mean energy was 10,181.9 $\pm$ 7,662.6 J (range: 1,510–22,050 J) with a maximum temperature of 56°C. Mild headache and a floating sensation occurred during sonications; however, heat sensation, burn, and pacemaker malfunctioning were not observed. Bradykinesia and mild right-sided weakness resulting from the surrounding edema after thalamotomy were improved by prednisolone. The UPDRS score off medication was 5 and 13 (part 2 and 3) at 3 weeks (Fig. 1).

MRgFUS is characterized by minimum invasiveness, no exposure to radiation, and an immediate therapeutic effect.[1] However, to date it has not been performed for patients with cardiac pacemakers. Despite the lack of evidence, some pacemakers have no limitation regarding the MR imaging time and intervals; also, therapeutic ultrasound is considered acceptable with precaution.[2] PD is a common neurological disorder and over 700,000 new cardiac pacemakers are implanted per year.[3] However, this is the first report of MRgFUS thalamotomy for a patient with a cardiac pacemaker. Further investigations concerning the safety of MRgFUS for patients with cardiac pacemakers are necessary.

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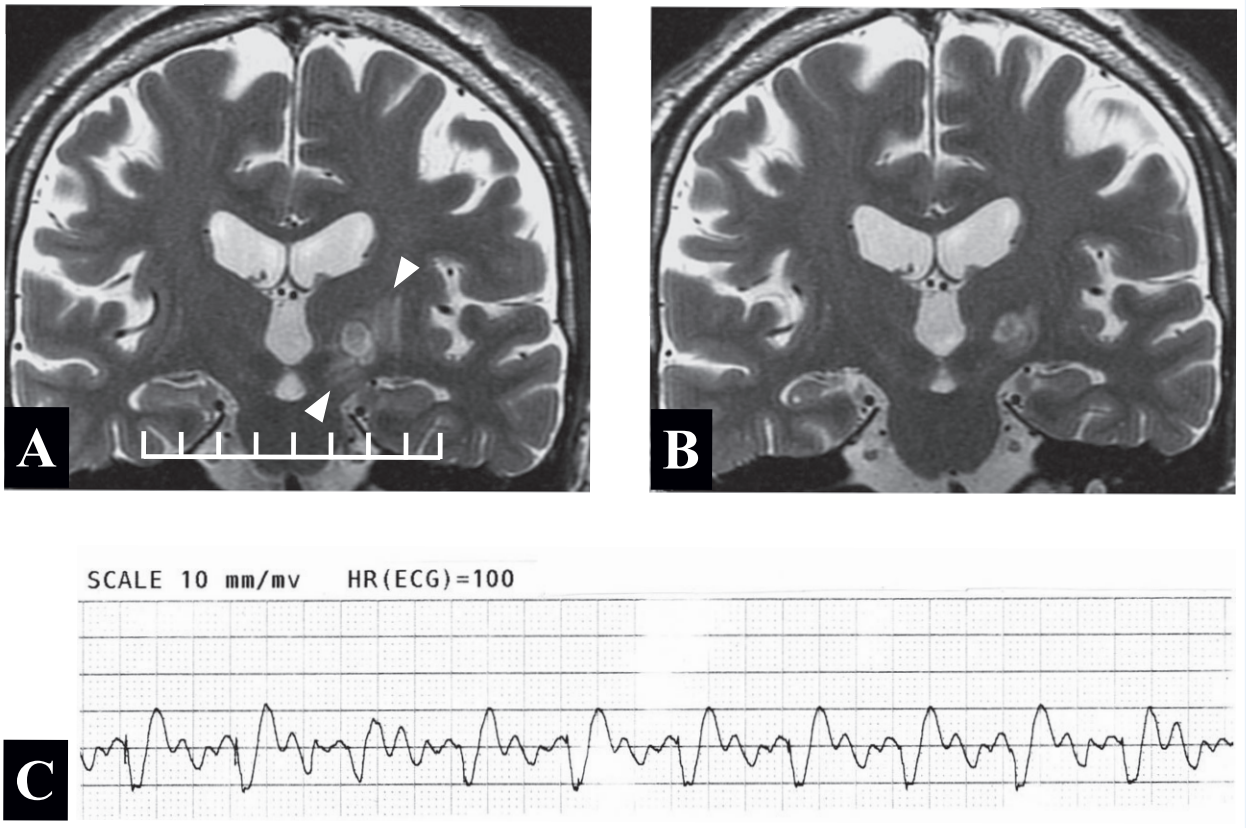

FIG. 1. T2 image of brain MRI: **(A)** after 1 day, **(B)** after 3 weeks, and **(C)** an electrocardiogram during the procedure. Surrounding edema of the left Vim (arrowheads) improved with prednisolone. The pacemaker was programed in DOO mode with 100 bpm.

Author Roles

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