

Clinical Outcomes of MR-Guided Focused Ultrasound for Movement Disorders: A Single-Center Experience in 48 Patients in Argentina.

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Abstract

Introduction: Magnetic Resonance-guided focused ultrasound (MRgFUS) in functional neurosurgery is a non-invasive treatment for medically refractory movement disorders. While its efficacy has been well-established, further real-world evidence on clinical outcomes across different diagnoses and targets is essential to inform patient selection and optimize results. Moreover, while MRgFUS is a established procedure in high-income countries, its efficacy, safety, and feasibility remain largely uncharacterized in middle-income regions, particularly in Latin America.

Method: We conducted a prospective analysis of data from 48 consecutive patients who underwent MRgFUS at our center in Argentina, between December 2024 and June 2025. Eligible patients presented with Parkinson's disease, essential tremor, or pantothenate kinase-associated neurodegeneration. Preoperative evaluation included neurological assessment, MRI, and multidisciplinary case review. Procedures were performed using a 3T MR-compatible focused ultrasound system with stereotactic targeting based on the AC-PC coordinates system. The ventral intermediate nucleus (VIM) was targeted for tremor, and the nucleus subthalamicus (NST) for bradykinesia and rigidity. Clinical outcomes were assessed using physician-rated improvement and patient-reported symptom reduction. Statistical analysis included Kruskal-Wallis, Chi-square, and Pearson correlation, with $p < 0.05$ considered statistically significant. Patient consent was obtained to share this information.

Results: The cohort included 26 males (54.2%) and 22 females (45.8%) with a mean age of 69.2 ± 11.6 years. Parkinson's disease was the most common indication ($n=25$, 52.1%), followed by essential tremor ($n=22$, 45.8%) and one case of pantothenate kinase-associated neurodegeneration. VIM was the primary target in 75.0% ($n=36$) of patients, NST in 20.8% ($n=10$), with two patients undergoing multi-targeting. There was a predominance of left-sided procedures (62.5%,

$n=30$). On average, objective improvement was $92.9 \pm 7.5\%$, and subjective improvement was $91.5 \pm 8.1\%$, with a moderate but statistically significant correlation between the two ($r=0.465$, $p=0.001$). Only 4% ($n=2$) of patients experienced subtherapeutic results. Parkinson's disease patients showed significantly greater objective improvement than those with essential tremor (96.0% vs 89.3%, $p=0.001$); subjective improvement followed a similar trend but did not reach significance ($p=0.057$). Efficacy was comparable between VIM and NST targets. Three patients (6.25%) experienced transient adverse events including gait instability, paresthesias, and mild pain, all of them resolved without intervention.

Discussion: The described clinical outcomes reported from a single center in Argentina, covering a range of diagnoses and treatment targets, demonstrate the feasibility of implementing this technique in regions with limited access to cutting-edge technologies. MRgFUS provides robust symptom relief for movement disorders, particularly Parkinson's disease and essential tremor, with high patient satisfaction and a favorable safety profile.

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