



Original Investigation | Neurology

Efficacy of High-Intensity Focused Ultrasound as an Intervention for Parkinson's Disease: A Systematic Review

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Key Points

Question:

How effective is High-Intensity Focused Ultrasound (HIFU) in treating symptoms of Parkinson's disease compared to standard interventions?

Findings:

HIFU shows ~33.9% symptom improvement (UPDRS III) vs. 5.5% for sham procedures in limited RCTs. All studies reported symptom improvements, but adverse effects like dyskinesias and speech issues were noted. Small sample sizes, limited RCTs, and need for re-intervention remain major limitations.

Meaning:

HIFU is a promising non-invasive alternative to deep brain stimulation, but more RCTs are needed to establish efficacy and address safety concerns.

Abstract

Importance:

High-intensity focused ultrasound (HIFU) is a relatively novel technology that can be used as an intervention for Parkinson's disease by non-invasively thermo-ablating tissue in the brain, usually in the basal ganglia. It is therefore an exciting alternative to deep brain stimulation (DBS), as it alleviates a lot of the risks associated with surgical implantation. However, due to its novelty, there is relatively limited research on its efficacy, and is therefore not routinely used worldwide, with regulatory approval not yet available in many countries.

Objective:

Explore the efficacy of HIFU in treating symptoms of Parkinson's disease

Evidence Review:

A literature search was conducted on PubMed, Web of Science and the Cochrane Library for randomized controlled trials (RCT) and observational studies with inclusion criteria of HIFU, its synonyms and Parkinson's disease. No time-period limits were set, only English language papers were used, and any location of the lesion (thalamus, globus pallidus etc.) was accepted. Exclusion criteria were animal studies or patients with previous interventional treatment i.e. DBS. Quality assessment was done using CASP guidelines.

Findings:

Overall, 42 papers were analyzed, with 10 being used for the review. Of this, only 3 RCTs were available due to the technology's novelty. In most papers, ~100% of the patients had some qualitative improvement in symptoms. Further quantitative analysis was done by comparing symptoms from an on-medication baseline to symptoms 3-6 months post-procedure using UPDRS III criteria from the RCTs only. A mean symptom improvement of 33.9% was noted using HIFU, and 5.5% using a sham procedure. However, there is a large variance of the data in these studies.

Conclusions and Relevance:

All trials and observational studies showed remarkable improvements in both motor and non-motor Parkinsonian symptoms. However, small sample sizes and limited RCTs are major limitations of the literature. Reported needs for re-intervention 6-12 months later in some patients due to remission of symptoms, as well as new dyskinesias, speech and motor problems stand out as adverse effects of the procedure. Further RCT's comparing efficacy with DBS, and comparison between sites of lesions (thalamus vs. globus pallidus etc.) are recommended to properly assess efficacy.

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