Neurosurgery

Author

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Title

Pedunculopontine nucleus stimulation improves gait freezing in Parkinson's disease.

Neurosurgery. June 2011

Abstract

Background:

Pedunculopontine nucleus (PPN) stimulation is a novel therapy for Parkinson's disease. However, controversies remain regarding the clinical application of this new therapy, including patient selection, electrode positioning and how best to assess outcomes.

Objectives

To clarify the clinical application of PPN stimulation in Parkinson's disease.

Methods:

Five consecutive patients with Parkinson's disease complicated by severe gait freezing, postural instability and frequent falls (all persisting even 'on-medication') received bilateral stimulation of the mid-lower PPN, without co-stimulation of other brain targets. Outcomes were prospectively assessed over two years using gait specific questionnaires and the Unified Parkinson's Disease Rating Scale (part III).

Results:

The primary outcome, Gait and Falls Questionnaire score, improved significantly with stimulation. Benefits were maintained over two years. Unified Parkinson's disease Rating Scale (part III) items assessing gait and posture were relatively insensitive to these treatment effects. Beneficial effects often appeared to outlast stimulation for hours or longer. Thus, single session 'on' versus 'off' stimulation assessments may be susceptible to 'delayed washout effects'. PPN stimulation did not change akinesia scores or dopaminergic medication requirements.

Conclusions:

Bilateral stimulation of the mid-lower PPN (more caudal than previous reports), without co-stimulation of other brain targets, may be beneficial for the subgroup of patients with Parkinson's disease who experience severe gait freezing and postural instability with frequent falls, which persist even 'on medication'. Choosing appropriate outcome measures and accounting for the possibility of prolonged stimulation washout effects appear important for detecting the clinical benefits.

Title

Pedunculopontine nucleus deep brain stimulation produces sustained improvement in primary progressive freezing of gait.

Neurosurgery. October 2010

Abstract

Objective To assess the efficacy of bilateral pedunculopontine nucleus (PPN) deep brain stimulation (DBS) as a treatment for primary progressive freezing of gait (PPFG). Methods A patient with PPFG underwent bilateral PPN-DBS and was followed clinically for over 14 months. Results The PPFG patient exhibited a robust improvement in gait and posture following PPN-DBS. When PPN stimulation was deactivated, postural stability and gait skills declined to pre-DBS levels, and fluoro-2-deoxy-d-glucose positron emission tomography revealed hypoactive cerebellar and brainstem regions, which significantly normalised when PPN stimulation was reactivated. Conclusions This case demonstrates that the advantages of PPN-DBS may not be limited to addressing freezing of gait (FOG) in idiopathic Parkinson's disease. The PPN may also be an effective DBS target to address other forms of central gait failure.

Title

The impact of low-frequency stimulation of the pedunculopontine nucleus region on reaction time in parkinsonism.

J Neurol Neurosurg Psychiatry. October 2010

Abstract

Objectives:

Attentional augmentation and enhanced motor function are potential mechanisms by which stimulation of the region of the pedunculopontine nucleus (PPN) may improve gait in parkinsonism. Here, the authors assess the impact of stimulation of this region on attentional and motor aspects of reaction task performance in patients with parkinsonism.

Methods:

Eleven patients implanted with PPN stimulators underwent computerised assessment of simple, choice and digit vigilance reaction tasks. Patients were assessed 'off medication' during stimulation at different frequencies (0 Hz, 5 Hz, 10 Hz and 'therapeutic' 20-35 Hz). There were two primary endpoints: 'Speed of Reaction' (sum of the mean task reaction times) and 'Accuracy of Reaction' (reflecting omissions and percentage of correct responses). Baseline performance was compared with age- and sex-matched healthy controls. Clinical effects of stimulation were assessed using the Unified Parkinson's Disease Rating Scale and a falls frequency scale.

Results:

Compared with healthy controls, subjects had significant deficits in 'Speed of Reaction' and in all mean task reaction times. 'Accuracy of Reaction' was not different from healthy controls and did not improve with stimulation. 'Speed of Reaction' significantly improved with stimulation at therapeutic frequencies (20-35 Hz). Of the individual tasks, only simple reaction time improved significantly. Simple reaction time distribution analysis revealed a general speeding of responses rather than a selective reduction in outliers. Acute PPN stimulation improved gait and balance but not akinesia scores. Chronic PPN stimulation significantly improved falls frequency. Falls score improvement significantly correlated with changes to simple reaction time with therapeutic stimulation.

Conclusion:

The pattern of reaction time improvement with stimulation of the PPN area suggests a benefit on motor performance, rather than augmentation of attention.