

Deep Brain Stimulation and Cluster Headache (2005)

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Background

Cluster headache (CH) is among the most severe pain syndromes in human beings. The syndrome is characterized by highly stereotypical attacks compared to the great variability found in migraine patients. CH attacks may occur up to 8 times a day, are relatively short-lived (15-180min) and characterized by strictly unilateral excruciating head pain accompanied by autonomic phenomena (1). During the attacks, cluster patients are restless and prefer to pace the floor or to go back and forth. The autonomic symptoms such as ptosis, miosis, lacrimation, conjunctival injection, rhinorrhoea, and nasal congestion happen only during the pain attack and are exclusively ipsilateral to the pain. A clinical landmark of CH is the circadian rhythmicity of the painful attacks. About 80% of cluster headaches are episodic in nature, (meaning that attacks occur daily for some weeks followed by a period of remission). On average, a cluster period lasts 6-12 weeks while remissions can last up to 12 months. In the chronic form (CCH), attacks occur without significant periods of remission. Less than 20% of chronic CH become unresponsive to drug therapies (2). When chronic CH is unresponsive to medical treatments, it represents a major medical problem. In such patients surgical procedures have to be considered (3). Candidates for destructive surgery are chronically intractable cluster patients whose headaches are unilateral with no history of side shift (4). In patients whose attacks alternate sides, the risk of a contralateral recurrence after surgery is rather high. Various procedures that interrupt either the trigeminal sensory or autonomic (cranial parasympathetic) pathways can be performed although few are associated with long-lasting benefit; in addition side effects can be severely debilitating (3). In the past, lack of knowledge of CH pathophysiology has hampered development of new therapeutic strategies. In recent years, neuroimaging data have greatly improved our understanding of CH pathophysiology. Positron emission tomography studies (PET) have shown that the posterior inferior hypothalamic gray matter is activated during cluster headache attacks (5, 6). Voxel-based morphometric MRI has also documented alteration in the same area in cluster headache patients (7). These data suggested that the cluster headache generator is located in this region. This view was supported by the observation that high frequency stimulation of the ipsilateral hypothalamus prevented attacks in an otherwise intractable chronic cluster headache patient previously treated unsuccessfully by surgical procedures to the trigeminal nerve (8, 9, 10).

Hypothalamic deep brain stimulation to relieve drug-resistant chronic cluster headache

By analogy with the use of electrode stimulation for intractable movement disorders, it was reasoned that stereotactic stimulation of the posterior inferior hypothalamic gray area might interfere with the "cluster headache generator" and so relieve intractable forms of CH (8). The first patient who received hypothalamic stimulation for cluster headaches was suffering from severe chronic intractable cluster headaches on the right. Destructive surgery helped on the right, but cluster headaches then recurred on the left. Destructive surgery to the left trigeminal nerve was absolutely contraindicated (due to fear of left corneal trauma in this patient who was already blind on the right). Electrode implantation and continuous stimulation of the left posterior inferior hypothalamus produced resolution of the left attacks (8, 9). After a total of four destructive operations on the right trigeminal, right side attacks recurred. Electrode implantation (with continuous stimulation) on the right resulted in immediate resolution of the right side pain. On several occasions, both known and unknown to the patient, the stimulators were turned off: in all cases crises reappeared and, in all instances, pain disappeared relatively quickly after turning stimulation back on. The only reported adverse effects were transient and observed during long-term bilateral stimulation. After 42 months (left) and 31 months (right) of follow-up the patient remains crisis-free without the need for pharmacological prophylaxis (9, 10). 15 other patients with intractable CCH have been successfully treated by hypothalamic stimulation (11, 12). The procedures were well tolerated with no significant adverse events (11, 12). Similar high-rate effectiveness of hypothalamic stimulation has been recently reported by another group (13). These authors reported on six intractable CCH patients who underwent hypothalamic electrode implantation. In their small series, the approach was not without dangers: one of the patients died post-operatively following intracerebral hemorrhage (13). All deep brain electrode implantation procedures are associated with a small risk of mortality due to intracerebral haemorrhage.

Notwithstanding its efficacy, hypothalamic stimulation has still to be regarded as an experimental procedure. We do recommend that very strict selection criteria be applied and suggest the procedure be performed only by a highly experienced neurosurgical team.

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