Stimulation of the Posterior Hypothalamus for Medically Intractable Impulsive and Violent Behavior

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Introduction

In 1970, Sano [1] reported that the lesion of the posterior hypothalamus by means of stereotactic radiofrequency was effective in treating disruptive and aggressive behavior. More recently, positron emission tomography (PET) has shown activation of ipsilateral posterior-inferior hypothalamic gray matter during attacks of chronic cluster headache (CH) [2, 3]. The high frequency electrical chronic stimulation (HFS) of the hypothalamic area has been found to be effective in CH [4–6], a condition in which violent behavior and psychomotor agitation may develop during pain attacks [7, 8].

High-dose neuroleptics are employed to control aggressive and acting out patterns but in some patients this pharmacological treatment is ineffective and associated with severe extrapyramidal side effects [9, 10].

Two male patients came to our observation, aged 36 and 37 years, respectively, suffering from mental retardation with aggressive and disruptive behavior, resistant to pharmacological treatment. The first patient also complained of grand mal seizures and the EEG showed the presence of many multifocal spikes. He was unable to speak and could only modulate inarticulate sounds. He had been under treatment with neuroleptics and anti-epileptics and lab examinations showed signs of liver function failure, probably related to the prolonged administration of elevated doses of the medicines. This made it compulsory to resort to an alternative treatment.

The second patient showed labio-palatoschisis, chorioretinitis and moderate oligophrenia probably attributable to congenital toxoplasmosis. At the age of 17 he had been admitted to a psychiatric institution. Many attempts to reintroduce him to a domestic environment had failed. Treatments with neuroleptics, anti-epileptics and benzodiazepines were unsuccessful in controlling aggressiveness.

Methods

After the informed consent was obtained from the parents, under general anesthesia both patients underwent stereotactic bilateral electrode implant in the medial portion of the posterior hypothalamus. Two 4-contact electrodes (Quad 3387, Medtronic Inc.) were inserted through a 3 mm, coronal paramedian twist-drill hole at the appropriate coordinates. Postoperative stereotactic computerized tomography (CT) was merged with pre-operative magnetic resonance imaging (MRI) to confirm the correct placement of electrodes. Two pulse generators (Soletra, Medtronic) were placed in the subclavicular region and connected to the brain electrodes. The day after
surgery, bilateral continuous monopolar 185 Hz, 1 volt, 60 µs electrical stimulation was started. No side effects occurred.

Results

Neuroleptic administration was interrupted in the first patient 2 weeks after the start of stimulation. The patient appeared calmer and more cooperative and a few weeks later he was able to stand and walk. One year later these effects were still present: the patient had regained a normal circadian rhythm, was able to take care of himself and to undergo rehabilitation. His family relationships and social interests markedly improved. Epileptic seizures decreased from 7–10 to 4–7 per day.

In the second patient, aggressive behavior, including acting-out, completely disappeared and dosage of neuroleptics could be reduced. Three months later his psychiatric condition was stable, and he was transferred to a specialized center for occupational therapy.

Conclusions and Implications for Clinical Practice Today

Deep Brain Stimulation (DBS) is thought to act through the functional inhibition of targeted areas produced by HFS, an effect similar to the one reported by Sano with radiofrequency lesions [1]. The result is an attenuation of behavioral abnormalities of patients with mental retardation secondary to brain damage. Hypothalamus is a core structure of the limbic system which connects hippocampus, involved in learning and memory, and amygdala, associated with emotions, affiliative behavior and with autonomic and endocrine functions. Hypothalamus is also connected to the orbito-frontal cortex via the amygdala and the limbic thalamus. Stimulation of the posterior hypothalamus has been shown to be effective in patients with CH without producing behavioral effects [5], while in the 2 cases reported in this paper, it caused disruptive behavior to disappear, at the same time markedly improving social relationships and quality of life of the subjects. This seems to suggest that the neurostimulation of the same brain target may induce different effects according to the different existing clinical conditions.

Future Directions

HFS of hypothalamus appears to be a clinically and ethically acceptable technique in patients with aggressive behavior when conservative treatments are not applicable and pharmacological treatment is ineffective or causes important, unacceptable side effects.

References