Non-Invasive Neurostimulation In The Control of Familial Essential Tremor Using The Synaptic Neuromodulator.

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Introduction

Familial Essential Tremor is the most common adult movement disorder, being as much as 20 times more prevalent than Parkinson's tremor. Essential Tremor is a little understood hereditary disease that causes violent shaking but no other symptoms. Of those afflicted, 95% have bilateral tremors. Essential Tremor is also the main cause of head tremor which is extremely difficult to treat. Hand shaking becomes so debilitating that eventually it causes extreme embarrassment and destroys the patients ability to work and feed themselves.

The main approach to treatment is the use of drugs. However, 60% of Essential Tremor patients are not helped by drug therapy. When successful, there is a reduction in hand tremors but head tremor responds poorly to drug therapy. The usual pattern with drug therapy is that the efficacy of the drug wears off, necessitating increased doses. This continues until the dose can no longer be increased and therefore a replacement drug is prescribed. The cycle of waning of effects over time and increasing dosage continues with the new drug, and so on. Prior to the approval of the thalamus brain implant for deep brain stimulation in 1997, the only other course of treatment was to surgically destroy part of the thalamus. The purpose of this study was to assess the effects of peripheral neurostimulation on subjects with Essential Tremor.

Materials & Methods

The Synaptic® neuromodulator was used in this study to assess efficacy of a non-invasive and relatively inexpensive approach to treatment using a novel form of electrical therapy that has been marketed for about eight years in the United States. The Synaptic device is a combination of patient-controlled and microprocessor-controlled electronics. The energy output pattern is referred to by the acronym SEA (Synaptic Electronic Activation). The output has an electrical waveform having a fast rise time and a slow decay, mimicking the Action Potential responsible for neural firing in man. Two models were employed in this study. Synaptic 2000 has a frequency range of 30,000 -2500 Hertz and has been available since 1994. The model 3200, which has only been commercially available since August 1998, has output parameters which include 57 volts peak amplitude into a 500 Ohm resistive load paralleled by a 0.1 µfd capacitor and a peak current of 27.5 mA. The device has digital frequency generation over the treatment range of 40,000 to 400 Hertz with the amplitude kept constant. Contrary to other electrical devices, the frequency of all Synaptic devices is adjusted downwards over their entire range during treatment using the hand-held remote controller supplied with the device. This treatment pattern

takes place at each of ten output intensity increments. The device is powered by an internal battery. Adhesive BioSkin® electrode pads are placed in the “central location”; one pair bilateral to the spine at C6 and the second pair bilateral to the spine at L5.

Treatment was carried out on 18 subjects in all, 12 with hand tremor (11 bilateral), and 6 with head tremor (one with spasmodic dysphonia). All subjects who were taking medications for tremor treatment ceased prior to commencing the study. Evaluations before and after treatment included hand to nose co-ordination, Archimedes spiral drawings, pouring water from cup to cup, numerical assessments on a 1-10 scale, and video-taping. Treatment was carried out for 40 minutes by the patient using the hand-held remote controller. An automatic Treatment Pattern Generator was also employed in conjunction with the Synaptic 3200 device with some subjects instead of using the hand-held remote control. In this manner, fully automatic treatments could be carried out using tremor-treatment programs stored in memory.

Results

Neurochemical assays in humans have shown that levels of a number of neurochemicals are modulated after treatment with Synaptic SEA technology and continue in their modulation paths for at least 24 hours after treatment. Treatment with SEA devices results in both profound anesthesia and significant analgesia. By “profound” is meant a degree of anesthesia that enables acute traumatic procedures to be carried out painlessly without an anesthetic, such as dental procedures (Clark, et al, 1987; Mann and Silverstone, 1989).

Mean age of the twelve hand tremor subjects was 66 years, with 56 years being the mean for the six head tremor subjects. Female to male ratios were 6 to 6 for hand tremor and 5 to 1 for head tremor. Age range for hand tremor subjects was 21-83 years, and 34-78 years for head tremor subjects. Mean duration of onset for hand tremor subjects was 4.7 years compared with 7.3 years with head tremor.

Some subjects experienced bilateral control of hand tremor for up to five hours immediately following the first treatment. Three treatments a week for two weeks resulted in excellent control of both hand and head tremor. Single weekly treatments also resulted in good control but to a lesser extent than achieved with multiple treatments. All subjects reported achieving a greater degree of tremor control relative to their drug therapy. The hand tremor subject under treatment for the longest period commenced almost two years ago in February 1997. On a scale of 1-10, with 1 being tremor-free and 10 being where he was prior to treatment, he is rated a 2 and uses the device an average of 3 times a week. The head tremor subject under treatment for the longest period commenced in August 1997 and, with weekly treatments, is rated a 2-3.

Discussion

Neurochemical assays utilizing the Synaptic device have demonstrated that they modulate the levels of neurotransmitters in humans. Neurochemical assays taken from blood samples prior to treatment, at the end of a 20 minute treatment, and 24 hours after treatment, have demonstrated that beta-endorphins and serotonin levels are modulated during treatment and continue to be modulated for periods of at least 24 hours after treatment, relative to pre-treatment levels (Silverstone, 1996).

All subjects showed excellent results with respect to tremor control when using either of the two Synaptic devices. A mean tremor reduction from 10 to 3.9 was achieved with hand tremor subjects, and from 10 to 3.8 with head tremor subjects. Unlike the results obtained with the thalamus implant, results with the Synaptic device showed bilateral control of hand tremor as well as control of head tremor. These results were of a higher level of efficacy than drug therapy for tremor control for all subjects in this study. Subjects preferred the use of the automatic treatment programs relative to using the hand-held remote controller. Many subjects showed additional benefits since their chronic pain problems were controlled in addition to their tremors, which contributing significantly to an overall increase in their quality of life. Previous results relating to neuromodulation with the Synaptic device points to a possible mechanism of action for these successful clinical results.

References

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