Modern Concepts in Psychiatric Surgery
E.R. Hitchcock, H.T. Ballantine, Jr. and B.A. Meyerson, eds.

CHRONIC MEDIOTHALAMIC STIMULATION FOR CONTROL OF PHOBIAS

GERT DIECKMANN
Division of Stereotactic Neurosurgery, Department of Neurosurgery, Universität des Saarlandes, Homburg-Saar (West Germany)

ABSTRACT

This preliminary report deals with the clinical and electrophysiological data of a patient suffering from phobias successfully treated for 1 year by chronic stimulation within the subdominant medial thalamus.

INTRODUCTION

In 1967 together with Hassler[1] we reported stereotactic thalamotomy as a method for the surgical treatment of obsessive and compulsive disorder. Circumscribed lesions in the rostral intralaminar and dorsomedial thalamic nuclei were followed by an improvement or relief from obsessive-compulsive and phobic symptoms. Since that time we have used this treatment on patients with intractable mental illness, most of whom suffered from obsessive-compulsive neuroses, tics, erethisms and phobias[2]. Up till now patients with phobias always required a bilateral thalamic intervention to obtain sufficient results but because a bilateral procedure produces undesirable side-effects, a new technique seemed necessary.

We reasoned that a new, non ablative technique might prevent the complications that occurred after bilateral thalamic lesioning. The therapeutic concept was that repeated stimulation of the non-specific thalamic activating system could modify its disinhibited, enhanced activity and thereby change the compulsive character of the disease. In animals it is known that low frequency stimulation of different parts of the unspecific thalamic system induces an inhibitory effect clinically and electrophysiologically. Since the pathways of this system converge in the rostral intralaminar nuclei as well as in the basal part of VA, this region was chosen as the target point for stimulation.

MATERIALS AND METHODS

The technique of electrical selfstimulation by an implantable pacemaker was used in the treatment of a female patient suffering from necrophobia and phobic ideas of injuring children.

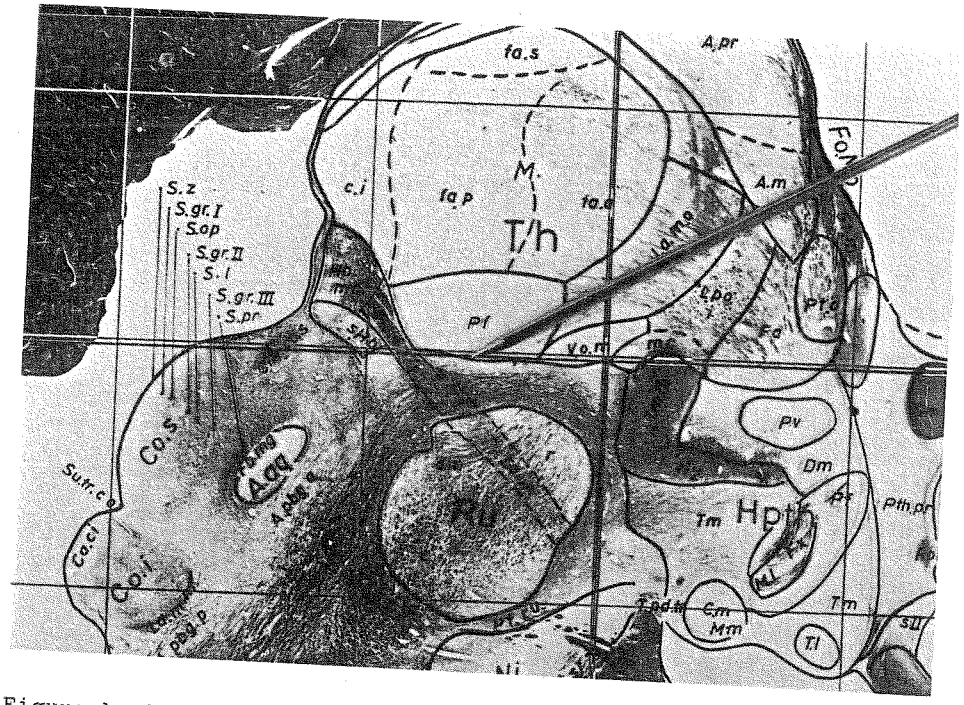
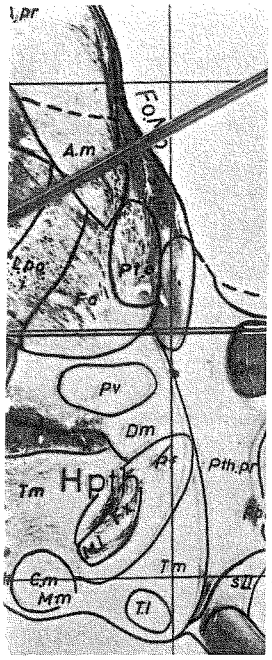


Figure 1. Sagittal section through human diencephalon, 5 mm lateral of the midline. The needle indicates site and approach of the stimulating permanently implanted electrode. The upper 2 poles of the electrode are estimated lying within the 2 intralaminar nuclei (La.m.o.). The length of one site of the grid is 10 mm. (Using a picture of Schaltenbrand and Bailey[3], anatomical labelation by Hassler).

A deep brain stimulation electrode used in permanent self-stimulation in patients with chronic pain (Medtronic^{R}), was implanted stereotactically in the medial thalamus of the sub-dominant hemisphere. A description of electrode position is given in Figure 1. The figure shows a sagittal section through

y an implantable
patient suffering
nildren.



phalon, 5 mm lateral
site and approach
ted electrode.
e estimated lying
m.o.). The length
ing a picture of
labelation by

ermanent self-
ronic^{R}), was
us of the sub-
e position is
section through

the human diencephalon in which site and approach of the electrode is indicated by a needle. The tip of the electrode reaches the parafascicular nucleus, 5mm lateral the midline. The active surface of the electrode consists of 4 poles over a total length of 12 mm. This arrangement permits bipolar stimulations of different sites involving both parafascicular nucleus as well as rostral intralaminar nuclei.

Figure 2 represents an X-ray of the patient today. Besides the permanent implanted electrode itself one sees the extracranially, subcutaneously implanted chronic extension which leads to a radio frequency receiver implanted in a subcutaneous subclavian pocket. Chronic stimulation is performed by the patient herself with a radio frequency transmitter giving the current by an antenna through the skin to the receiver by way of induction.

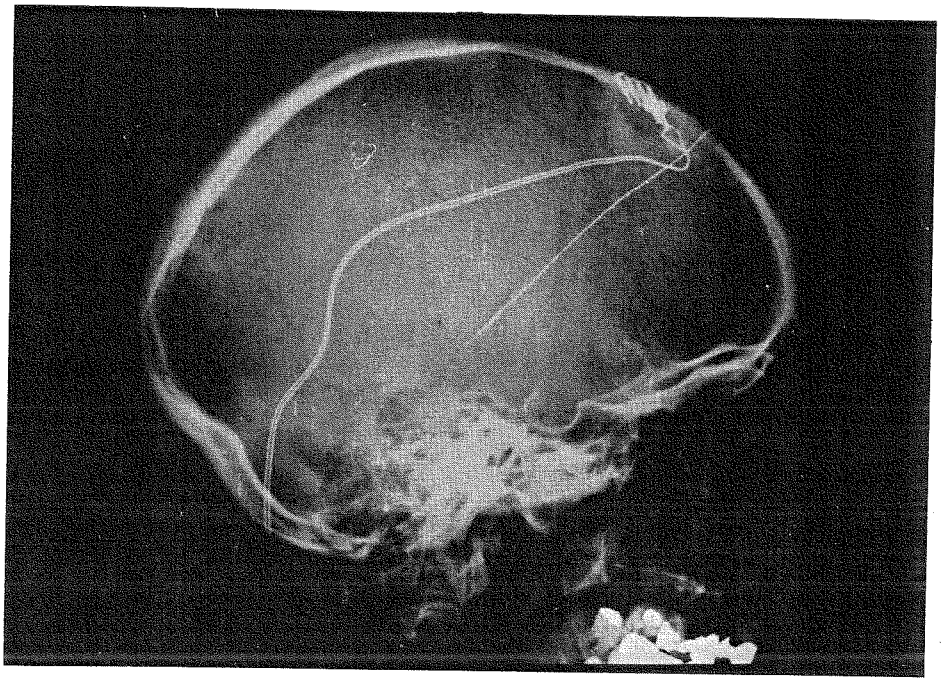


Figure 2 Sagittal X-ray of the patient. In the centre the implanted deep brain stimulating electrode, at the left the extracranial, subcutaneously implanted chronic extension to a subclavian radio frequency receiver.

During the intraoperative as well as the postoperative trial period low frequency stimulation of the upper 2 poles situated within the intralaminar nuclei gave the most curative effect for the patient. Therefore the internalization of the whole system was performed over these 2 poles.

RESULTS

First results in the EEG during stimulation were obtained 3 weeks after the test implantation. Evoked potentials were found over both frontal poles, ipsilateral more pronounced than contralateral (see Figure 3, 5th row) and the recruiting character of the effect was evident. During this period, the patient reported a sedative effect after 10 minutes of stimulation.

2 months later, typical records resulting from repetitive 1/second, 3/second and 5/second stimulation were obtained. The

Figure 3 Monopolar EEG recording during trial period, 3 weeks after electrode implantation. The first 4 rows indicate the contralateral derivations, the other 4 ipsilateral to the stimulated hemisphere. A recruiting answer appears over the ipsilateral frontal region.

records in Figure 4 provide in all respects the standard surface potentials of thalamic-induced recruiting responses. The 1/second stimulation in the upper third of the figure produced slow negative waves at a latency of about 50 milliseconds which are followed by a large negative wave after 125 milliseconds. Particularly the

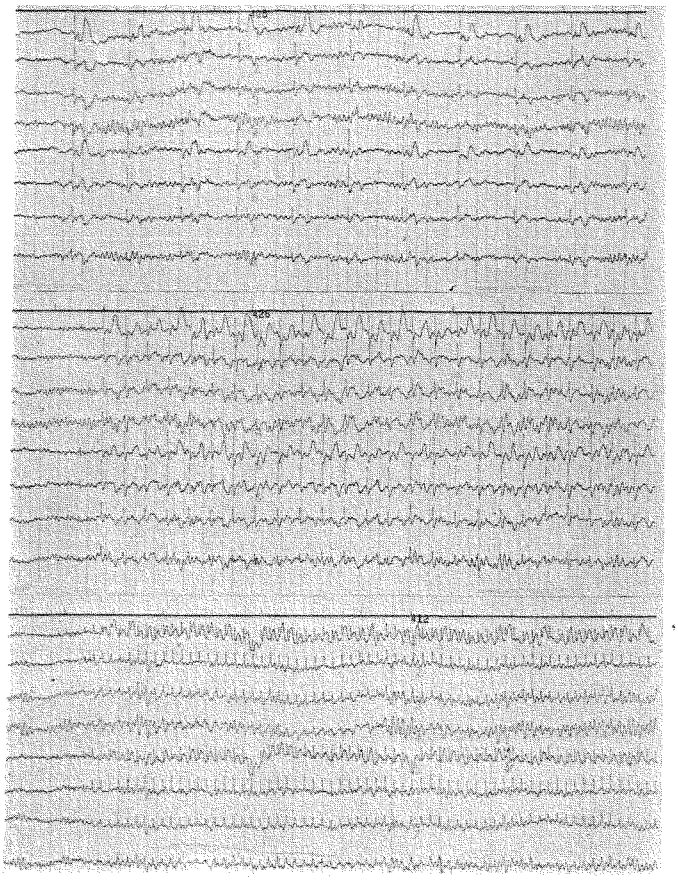


Figure 4 Monopolar EEG recording over both hemispheres during unilateral (right) mediothalamic stimulation with different frequencies. Upper third of the picture: 1/second stimulation; middle third: 3/second stimulation; lower third: 5/second stimulation.

latter showed waxing and waning features, thus varying their voltage between 80 and 120 microvolts. The recruiting phenomenon is better obtainable with 5/second stimulation, the record of which is shown in the lower third of the figure. The stimulation effects were found over the frontal, precentral and parietal areas of both hemispheres particularly ipsilaterally, while the occipital region does not regularly show an influence. The 3/second stimulation shows the tendency to set up a general synchronization. Such a general synchronization induced by 5/second stimulation

replacing the spontaneous bioelectrical activity occurred 3 months after implantation of the deep brain stimulation electrode and is now the general effect of the 2 times per day stimulation of the patient.

The upper third of Figure 5 shows the beginning of the stimulation, the middle part represents the recording after 5 minutes stimulation while the lower part demonstrates the end of the stimulation after 10 minutes. Immediately after stopping the stimulation the usual bioelectrical activity recurred, with the exception of a tendency to more desynchronized activity in both frontal and precentral regions, as indicated by occasional faster activity of lower voltage.

During the 5/second stimulation the patients phobias disappear. She is then able to walk to a cemetery, to see hearses or to play with children without fearing injuring them. All of this was, and is not, possible without the stimulation. Furthermore, she reported that she became quiet during the stimulation and 3 to 4 hours after it.

After this encouraging result during the trial period, the final implantation of the device was performed 3 months after the test implantation of the deep brain-stimulation electrode. From that time the device failed. Clinical sedation was not reported by the patient nor did electrophysiological features of regular low-frequency stimulation occur. The EEG records seemed not to be influenced. After several other trials, we saw that a somewhat different kind of current reached the patient's deep brain-stimulating electrode by way of the radio frequency receiver belonging to the usual stimulating device used in patients with chronic pain states. Since an interposition of a condenser could not correct this failure sufficiently, we continued to stimulate directly over transcutaneous wires which are connected with the implanted device by-passing the radio frequency receiver. In that way a good clinical result concerning the phobias was again achieved, remaining so until the present day.

A direct relation between correct current application and the blood supply of the brain estimated by the measurement of the peripheral blood pressure was observed, although the

occurred 3
lation electrode
day stimulation

ng of the stimu-
after 5 minutes
e end of the
stopping the
urred, with the
ctivity in both
occasional faster

phobias disappear.
nearses or to play
ll of this was,
Furthermore, she
lation and 3 to

al period, the
3 months after
tion electrode.
ation was not
gical features
ne EEG records
ner trials, we
reached the
way of the radio
ulating device
nce an interposition
sufficiently, we
neous wires which
sing the radio
al result concerning
ntil the present

pplication and
measurement of
though the

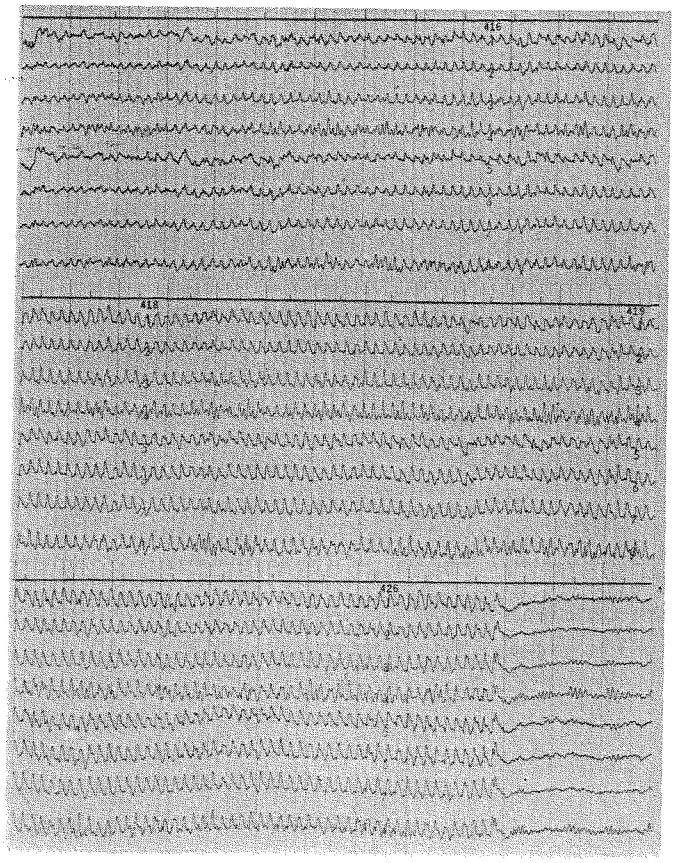


Figure 5 General synchronization of the EEG during permanent unilateral mediothalamic 5/second stimulation. Upper part: at the beginning of the stimulation; middle part: after 5 minutes stimulation time; lower part: at the end of stimulation period, 10 minutes after the beginning.

influence of these variables is complicated by a lot of unknown factors. Several times when low frequence stimulation was used, it was not possible to obtain a sufficient clinical effect as well as a typical EEG-recording.

As an example, Figure 6 shows 2 surface recordings from different days, but in the arrangement as before. In the days

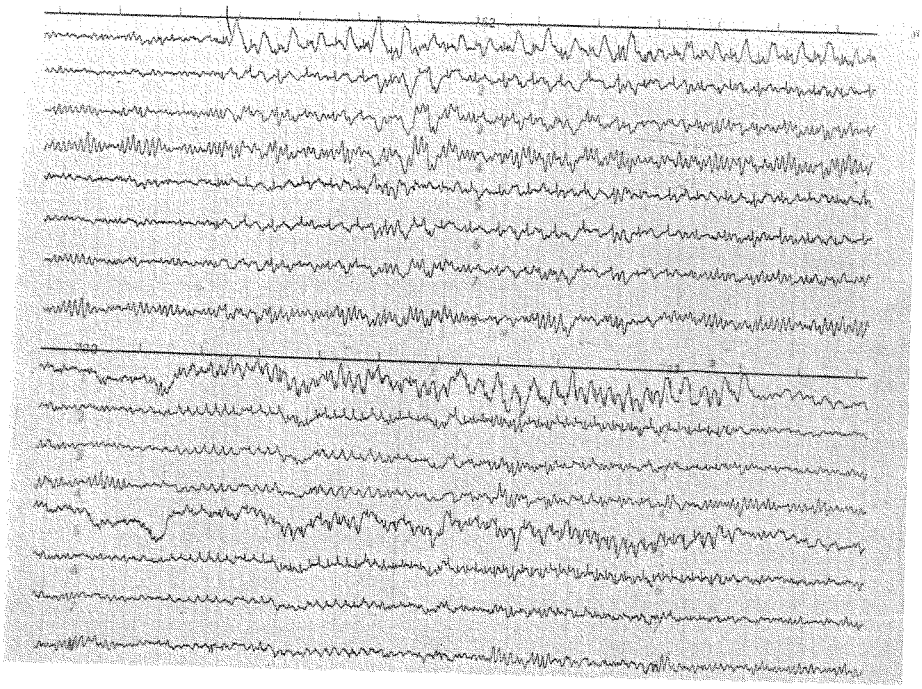
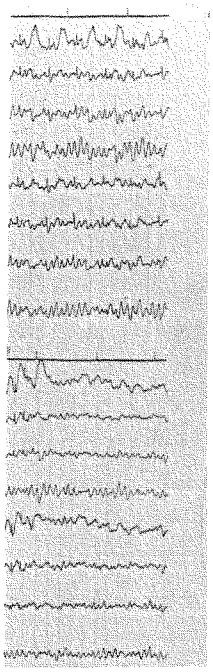


Figure 6 Monopolar EEG recording during 3/second stimulation (upper part) and 5/second stimulation (lower part) of the right medial thalamus during states of blood hypotension. The usual general synchronization does not occur.

when the blood pressure of the patient was low, figures of 90 to 50 mm mercury were measured. The electrophysiological effect was remarkably restricted, practically only to the prefrontal regions as shown in rows 1 and 5 of both parts. In both examples, showing a 3/second stimulation in the upper part and a 5/second stimulation in the lower part of Figure 6, no clear general synchronization occurred. Only sometimes a tendcney to synchronization was recognised. The same happened when a medical tranquilizer was given before the stimulation period.

As far as the clinical result is concerned, the patient became quiet during 5/second stimulation, she was free of phobic ideas and had a satisfied expression on her face. Recently she used to stimulate herself 3 times per day and gained a state free of



phobic ideas by these stimulations. On the contrary, a 50/second stimulation was experienced as being very disagreeable. In that case one sees in the face of the patient that the stimulus obviously induces unpleasant feelings. She herself reported anxiety and some strange, inexplicable, unpleasant feelings depending on stimulation with this frequency.

CONCLUSION

Using a commercial deep brain stimulating electrode device, phobic symptoms of different kind and strength could be improved or relieved by repetitive, low frequency self-stimulation within the rostral intralaminar nuclei of the subdominant thalamus. The patient reported here and followed over 1 year is able to supress her phobic symptoms by self-stimulation on demand like pain patients who can relieve their pain by such a deep brain stimulation. Recordings of EEG surface potentials during stimulation periods showed typical effects known to be induced by stimulation of non-specific thalamic structures in animal experiments. The aim of the intervention, to relieve the patient of her phobic ideas, was obtained, although several technical problems still exist.

REFERENCES

1. Hassler, R. and Dieckmann, G. (1967) Confin. Neurol. 29, 153-158.

2. Hassler, R. and Dieckmann, G. (1973) in Surgical Approaches in Psychiatry, Laitinen, L.V. and Livingston, K.E. eds., Medical and Technical Publishing Co. Ltd., Lancaster, pp. 206-212.

3. Schaltenbrand, G. and Bailey, P. (1959) Introduction to Stereotaxis with an Atlas of the Human Brain, Thieme, Stuttgart, pp. 230-290.