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Case Report

Technical Case Report of Deep Brain Stimulation: Is it Possible Single Electrode Reach to Both of Subthalamic Nucleus and Ventral Intermediate Nucleus in One Stage?

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Abstract

BACKGROUND: The primary target of this operation is Ventral Intermediate Nucleus (VIM); however VIM - Subthalamic Nucleus (STN) were tried to be reached with one electrode, adjusting the angle well, the coronal section; medial of VIM can partially reach the STN. Using the properties of the electrode; we believe we could act on a wide area.

METHODS: An analysis was performed on one patient who underwent VIM Deep Brain Stimulation (DBS) in 3 periods (pre – peri - post-operation).

RESULTS: A 53 – year - old woman diagnosed with Parkinson's disease 8 years earlier including symptoms of severe tremor on the right than left underwent bilateral DBS VIM. Obtaining a satisfactory improvement of tremor, the patient did well, and postoperative complications were not observed. The patient was discharged from hospital on postoperative thirty day

CONCLUSIONS: It is certain that more research and experience are needed. However, we believe that the two targets can reach the same point and the second operations for another target can be avoided.We believe that this initiative is advantageous and promising regarding patient and cost.

Introduction

Surgery treatment is lesioning (Thalamotomy) or DBS (Deep Brain Stimulation) for PD and ET (Parkinson's disease and essential tremor). In this particular case, DBS has been preferred over lesioning because it is safer: for two reasons; no permanent brain tissue damage and controllable side effects from stimulation [1] [2].

In recent years; DBS has had an important place in the treatment of Parkinson's disease (PD), tremor, dystonia and some psychiatric diseases. Subthalamic nucleus (STN) is one of the main targets for DBS in PD. Clinical signs are improved by STN stimulation; thus reducing dopaminergic drug requirements by about 50% [1] [3] [4] [5]. DBS of the ventral intermediate nucleus (VIM) of the thalamus is highly effective for the treatment of tremor. Patients with tremor associated with Parkinson's disease and essential tremor appear to respond best but without benefit on other the cardinal PD symptoms and motor complications [1] [5].

We aim to determine the single electrode reach to both of STN and VIM in one stage. All aspects of the subject have been demonstrated in this article. The closeness of STN and VIM has led us to evaluate the possibility of paving a path to the development of new technologies.

Case Report

A 53 – year - old woman followed with PD for 8 years had tremor mainly over the right side & slightly dyskinesia. Trials of more than four medications and other therapies failed to relieve the tremor.

The medical history of the patient was unremarkable. Preoperative laboratory values were within normal limits. Standard oral medication failed to prove significant tremor control.

The patient was evaluated by a multidisciplinary team of neurosurgeons, neurologists and psychiatrists; she underwent surgery for implantation of DBS - VIM.

Antiparkinsonian drugs were withdrawn 24 hours before the surgery. The patient has fitted a stereotactic frame (Radionics™ CRW Precision™ Arc Stereotactic System, Integra Radionics Burlington - USA**)** with local anaesthesia. A one – mm - thick section of CT image and a two – mm - thick section of MR Image (1, 5 Tesla) was used to identify the coordinates of the target. The target was determined from fused images. MR imaging (T1 - weighted Gd-enhanced) data was used to avoid the puncture of vascular structures and the lateral ventriculus. Brain mapping, direct method and indirect method (anterior-posterior commissure) were used to determined target.

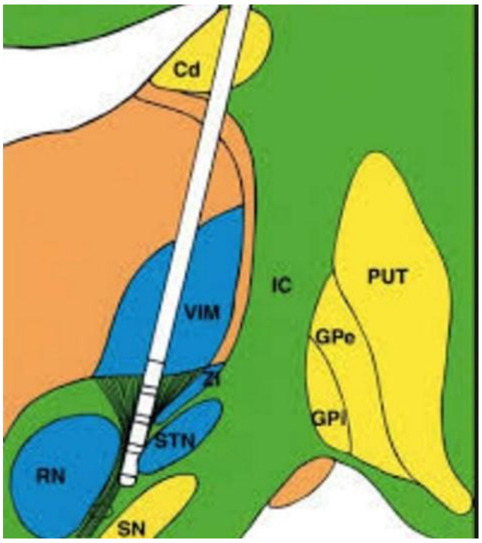

Figure 1: Schematic view of DBS targets (Especially STN and VIM)

A burr hole was made on the frontal skull the singe-track microelectro-recording, macrostimulation were carried out to confirm the effect of stimulation. Boston Scientific DBS 8 contact Lead implantation was decided to adjust each contact from all total 8 contacts, different amplitude and frequency. X-ray system was also used to identify the actual electrode malposition. The electrode has multiple Independent Current Control and Interleaving feature.

During macro stimulation tremor decreased was observed and VIM - STN were detected during MER.

Following implantation of the DBS; generator (The Vercise, Boston Scientific) was placed in a subcutaneous pocket in the infraclavicular region under general anaesthesia.

Figure 2: The sagittal an axial sectional view of the target in postoperative CT

Thanks to Postoperative CT images showing any intracranial haemorrhage and we believed that the DBS lead was implanted at the appropriate position. There was no complication in our case. Thus, the patient was discharged from hospital on the postoperative third day. The battery was activated 15 days after the surgery; we received a response at all the contacts.

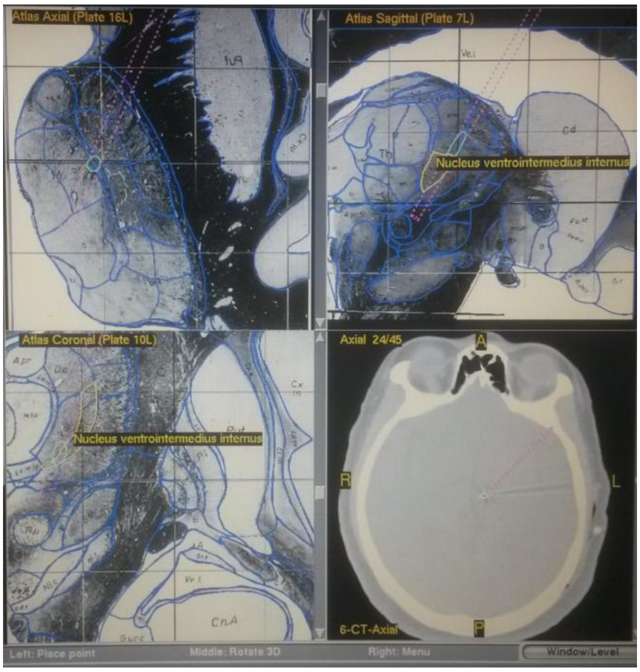

Figure 3: Anatomical relationship of STN and VIM according to Postoperative Brain Mapping

VIM and STN have been reached with one electrode. The primary target was VIM. Adjusting the angle well in Neurosighr Arc with Atlas Plan Module (Integra); the STN from the medial of the VIM could be partially reached. The properties of the electrode made it possible to affect a wide area. We aimed to place the Lead's Caudal contact points into the STN. We worked in the coronal and axial slices on MRI. The side was found on the brain map; we believed the targets were reachable, STN&VIM were observed with MER during the operation. Clinical response in all our target point was achieved with Macrostimulation. We checked the situation with postop CT that it could affect a wide area. Although the main target VIM, We tried to place. We've worked in. We found our site on the brain map. We thought that the targets were reachable. We observed STN and VIM waves during operation with MER We have a clinical response in all our target point with macro stimulation. We checked the situation with postop CT.

The condition was repeatedly checked with MER, macro stimulation postoperative brain mapping and CT (Figure 1, 2, 3 and 4).

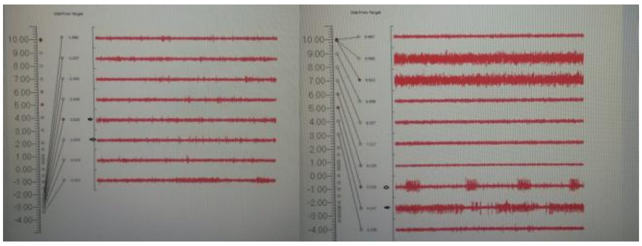

Figure 4: Perioperative MER mapping of the STN and VIM

Stimulation Parameters

During the post-operative process, the stimulation was optimised by utilising the various combinations of frequency, voltage and pulse width. Intraoperatively, system parameters consisted of a frequency of 60 to 130 Hz, the pulse width of 60 Ìs, and amplitude of 1.0 - 4.0 mA. Optimal tremor suppression was seen with a voltage of 4 – 5.2 mA, a pulse width of 80 - 150 is and a frequency of 100 - 130 Hz.

Discussion

During target determination process electrophysiological and clinical evaluation have been observed as the most reliable methods. VIM - DBS of the thalamus is highly effective for the treatment of tremor. In addition to VIM - DBS patient suffering from tremor associated with PD appear to respond best but without benefit on other the cardinal PD symptoms and motor complications [6].

VIM can be recognised either by MRI (3 Tesla) or the indirect method.In our case, the letter one was chosen [7] [8].

Two electrodes with different angles have been placed for STN and VIM. Arranging this, not only anatomy but also preoperative clinical and electrophysiological assessment has been precedence in our case. We believe that the two main targets have been affected by one single electrode. In consequence, not only the primary tremor but also the possible other PD symptoms may benefit from STN.

Clinical trials studies Show that STN is a good target for ET and Parkinsonian tremor. STN can be accessed directly or indirectly via AC - PC. The relationship between RN (Red Nucleus) and STN has also been a guide for us [1] [9] [10].

RN is easier to recognise in MR than STN. The STN is recognised as a hypointense structure located lateral to the anterior portion of the RN on a coronal section MRI [9].

In Parkinson tremors, STN can be selected because it will contribute to the treatment of other motor symptoms [1] [11]. In our case, the tremor was dominant. VIM - DBS was chosen for the tremor. However, we believed that other cardinal findings of PD would develop over time. At this point, we believed that STN - DBS would increase the clinical utility.

In Literature we have seen that two targets have been reached by two electrodes [1][11][12].

Clinical studies in literature were taken into consideration. The features of new lead were reviewed with 8 contacts. The target has not been evaluated radiological electrophysiological even clinical assessment are of at most importance. The angle was arranged with one electrode in VIM and STN. STN was placed in medial; not only were side effects recognised; which is believed to be the outcome of the effect of the lead. It is possible to activate various contacts through different parameters. For instance, contact point 1, 2, 3, 4 can be activated through different frequencies and voltage. It was observed that this was an advantage. The possibility of stimulation to STN and VIM (together or separately) with this lead, which may be important for the future progress.

It is certain that more studies and clinical trials are needed. However, we belive that reaching the same point with two targets can prevent succeeding operations for another target. We believe that this initiative is advantageous and promising in term of cost and patient benefit.

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