Deep Brain Stimulation

Lisa Rosenberg, *Biomedical Engineering, University of Rhode Island*
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***Abstract*—Deep Brain Stimulation (DBS) occurs when an electrode is implanted inside an individual's brain and electronic pulses are emitted from this probe at certain areas and rates in the brain which can diminish the symptoms of many motor and functional disorders.**

I. Introduction

DEEP Brain Stimulation is an amazing process of safely sending electrical currents in to the brain to recreate functions that have deteriorated or have been interrupted. A lead, also known as an electrical probe, is implanted inside the brain. A pulse generator is connected through a wire placed under the skin. This device stays inside the patient's brain throughout the duration of the need to reduce symptoms. Deep brain stimulation can relieve symptoms for individuals with many types of ailments. The most well-known ailment deep brain stimulation is used for is Parkinson's disease. DBS can also be used in treating essential tremors, dystonia and obsessive compulsive disorder. This process is saving healthy brain tissue while providing patients the ability to function regularly again on a day to day basis.

II. Methods

Before the surgery for the device implantation can take place, CT scans, MRI scans, angiographies and ventriculographies are done on the patient. These scans allow the surgical team to plan for the placement of the probe. A frame is set up using the 3D coordinate information gathered from the scans to help guide the implantation of the probe during surgery. The hair is shaved where the hole is to be drilled and a sedative is given to the patient before the drilling begins. Once the drilling is finished, the patient is then awakened for the implantation of the probe to report any sensory changes that may occur from the probe being placed too close to a vital area of the brain. No further anesthetic is necessary due to the lack of pain receptors in the brain. This surgery can take three to four hours and will require more time if the surgery team decides to implant the pulse generator in the same procedure. Often the pulse generator and the electrode are implanted during two different surgeries. This decision is made by the surgical team. There is a wire connected to the probe that will be implanted under the skin behind the ear leading down to the collarbone where the pulse generator will be implanted. The electrical probe is about a millimeter wide and is placed in a location determined by which disorder is being treated. The probe is implanted in the thalamus, subthalamic nucleus (STN) or the globus pallidus for treatment of Parkinson's disease. These areas of the brain are related to movement and stimulating these areas will not only reduce tremors but will also relieve muscle stiffness and slow movement as well. Dystonia is also treated by placing a probe in the globus pallidus due to the fact that dystonia also involves degradation of movement. Essential tremors are treated by placing the probe inside the thalamus. For OCD, the probe is located in the ventral capsule. Many movement disorders affect both sides of the body and each side of the brain controls a side of the body. Therefore, this surgery is usually done on both the left and right side of the brain unless the individual is only experiencing symptoms on one side. The signals sent from the electrode will help calm an overactive brain which lessens the symptoms experienced by individuals with these disorders. The pulse generator controls the level of electric current supplied and it also holds the battery. This battery will need to be replaced every 3 to 5 years and can be done so with a simple surgery by opening the incision where the pulse generator is located. The next step in this process is the programming of the pulse generator. During this session a wand that can program the generator is held in front of the collarbone where the pulse generator is implanted and the pulse generator is then programmed by the attending surgeon.

III. Results

The risks associated with the implantation of the device consist of intracranial bleeds (12%), seizures (3%), headaches (25%), and infection (6%). The device related complications include lead (electric probe) replacements (9%), repositioning of the lead (8%), replacement of the wire (6%) and replacement of the pulse generator device, which is mostly due to malfunction of the device (17%). The risk of death is less than 1 percent. Even though these risks are present, this surgery does not require the destruction of brain tissue or creating lesions to acquire results which makes it a viable option for many individuals with Parkinson's or other destructive ailments.

IV. Discussion

Overall, deep brain stimulation can help many individuals maintain a normal lifestyle when otherwise their ailments would prevent them from functioning. Movement disorders can be completely impairing and deep brain stimulation recreates the effect of the areas of the brain that have degenerated or are malfunctioning. The progress of technology has created a way to perform this surgery while the patient is asleep with a MRI machine instead of the patient needing to endure this surgery while awake and this process is still being tested. Overall, deep brain stimulation is a great alterative to creating lesions or destroying the brain which has been done for several years. With this procedure, individuals are able to return to a manageable lifestyle while living with an extremely torturous disease.

References

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