Thomas Jefferson University Hospital

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Contemporary Medicine

NEUROSURGERY

New Hope for Those with Late-Stage Parkinson's Disease

The pacemaker's electrical signals are delivered to the brain through a thin, implanted wire with electrodes attached at the tip.

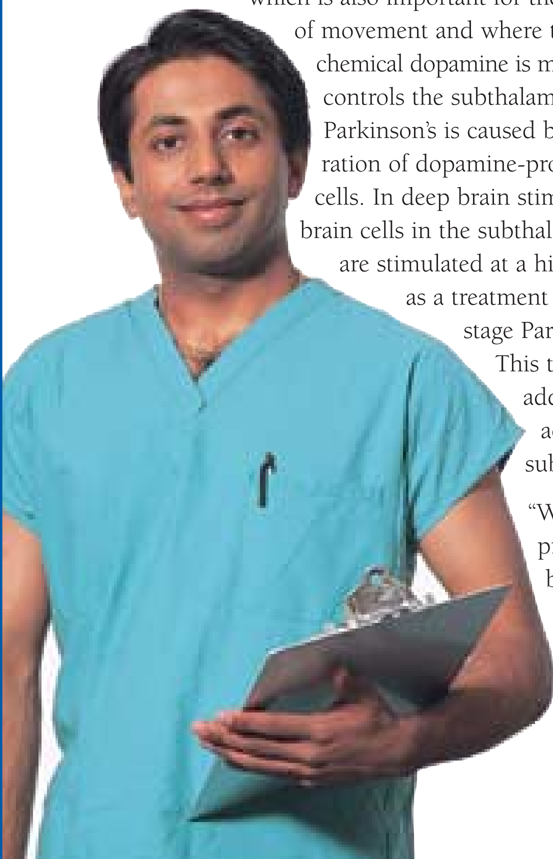
Neurosurgeons at Thomas Jefferson University Hospital now can also treat Parkinson's disease by supplying controlled electrical signals through electrodes implanted deep within the brain. The surgical procedure, called Deep Brain Stimulation (DBS), is for those patients whose disease has stopped responding to drug treatment.

"We're essentially putting electrodes inside different areas of the brain and trying to re-establish the brain's disordered circuitry in Parkinson's disease," says Jefferson Hospital neurosurgeon Ashwini D. Sharan, MD, Assistant Professor of Neurosurgery at Jefferson Medical College of Thomas Jefferson University, who leads the new program. Dr. Sharan performed approximately 50 DBS surgeries when he was at the Cleveland Clinic prior to coming to Jefferson in 2001.

According to Dr. Sharan, Parkinson's disease, which is a progressive, neurodegenerative disorder, is an ideal candidate for this treatment because it involves a single area of the brain.

In Parkinson's, the brain's circuitry has gone awry. A portion of the brain called the subthalamic nucleus is overactive. These cells produce glutamate, an excitatory neurotransmitter, or chemical message carrier. Another region called the substantia nigra, which is also important for the coordination of movement and where the brain chemical dopamine is made, indirectly controls the subthalamic nucleus. Parkinson's is caused by the deterioration of dopamine-producing nerve cells. In deep brain stimulation, brain cells in the subthalamic nucleus are stimulated at a high frequency as a treatment for late-stage Parkinson's. This treatment addresses over-activity in the substantia nigra.

"We have proven that by putting electrodes in the subthalamic nucleus, we can shut off the hyperactivity," he says. "The mechanism is not precisely understood right now."


Ashwini D. Sharan, MD, Assistant Professor of Neurosurgery, Jefferson Medical College, Thomas Jefferson University

Advantages of DBS

DBS, says Dr. Sharan, may have several advantages over other treatments. Its effects are very precise and controlled, and what's more, it's reversible. In addition to electrodes, doctors implant a pacemaker into the chest to regulate the electrical signals in the brain. "If we take the electrode out of the brain, there is no scarring within the brain or alternatively, the electrode may be inactivated and the patient will still be a candidate for developing therapies."

Patients can control their own daily treatment simply by turning the device on or off. "Additionally, the doctors can prescribe more current, more voltage, or different frequencies," he says.

Some 1.5 million people in this country have Parkinson's disease. Less than 1 percent are operated on; about 15 percent need surgery, according to Dr. Sharan. In the next decade, 80 percent of people with Parkinson's will not respond to medications (usually the drug L-dopa) and have untreatable side effects, he adds. DBS has been approved by the FDA as of February 2002 for patients with Parkinson's for those whose medical treatment has failed.

"You should always try medication first," says Dr. Sharan. Surgery to implant the DBS electrodes typically lasts six to eight hours. Older patients tend to remain in the hospital for an additional 48 to 72 hours, while younger patients may be able to go home the next day. After a week, they return as outpatients for a second day, and have a pacemaker put in. Finally, a month later, patients are seen in the office and the pacemaker is turned on.

"Patients with a lot of tremor, dyskinesia (involuntary movements) and bradykinesia (extreme slowness of movement) are the ones who respond the best to DBS surgery," he says. "Most patients' brains are working well early in their disease, so this is a major quality-of-life issue, because they know their body is not keeping up with them."

How long do the effects of DBS implants last?

It's variable, Dr. Sharan says, depending on how fast the Parkinson's disease is progressing. The first patients were implanted in 1987 and many haven't lost the effects of the treatment as yet, he notes. If the treatment becomes ineffective, it's probably because the disease is progressing.

According to Dr. Sharan, DBS controls about 70 to 80 percent of tremor, 60 to 70 percent of rigidity and 50 to 60 percent of akinesia, or abnormally slow gait. Approximately one-half of individuals can cut their medications (L-dopa) by half. And 10 to 20 percent stop taking their medications completely.

While Parkinson's is by far the disease for which DBS surgery is most often used, it also has applications for treating both essential tremor and dystonia, an inherited disease in which victims suffer from spasmodic, twisting body movements.

In speaking about the future of DBS, Dr. Sharan predicts that, within three to five years, rechargeable batteries will be available to implant in a patient's head, eliminating the second part of the surgery. Instead, he says, the patient will be able to wear a cap that will recharge implants while he or she sleeps. Rechargeable electrodes will be planted on top of the patient's head. Pacemakers will be able to be programmed by phone (telemetry) for those patients who live in remote areas.

For more information about deep brain stimulation and to reach Dr. Sharan, please call the Department of Neurosurgery at **215-955-7000.** To schedule an appointment, call **1-800-JEFF-NOW.**

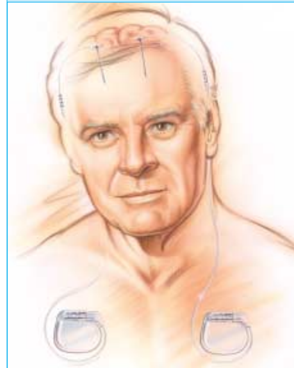
The Surgical Procedure

Patients are admitted the day before surgery and are taken off medications. As a result, the patient wakes up in the morning rigid and unable to move. They are placed in a stereotactic head frame and given a CT scan and an MRI to help target the location for surgery. Robotic tools may also be used to speed the process and better enable surgeons to avoid blood vessels or other obstacles.

In the operating room, the surgeons need the patient to respond during the procedure. The patient is awake during surgery and is asked questions so doctors can confirm they are in the right location in the brain. "We know when we're in the right spot because the tremor stops and the rigidity melts away," Dr. Sharan says.

Different apparatuses are used to get the electrodes to the right spot. To make things more precise, surgeons attach a microdrive. "We actually listen to the sound of the cells on the approach to the subthalamic nucleus because each cell along that route has a different signature," Dr. Sharan explains. "Based on that, we can tell if we're too far forward or backwards. The MRI is accurate only up to a millimeter. The microdrive can move the electrode at the micrometer level."

The surgery may have some small risks of complications, including infection, bleeding and perhaps some transient confusion.


Surgically implanted pacemakers deliver electrical stimulation to precisely targeted areas on each side of the brain.

After surgery, older patients may need two to three days in the hospital to recuperate. Younger patients may be able to go home the next day. After a week, patients return to the hospital to have a pacemaker put in, which is done under general anesthesia as an outpatient. Patients return in a month, after the swelling goes down, to have the pacemaker turned on.

"Patients are so happy to regain some quality of life," Dr. Sharan says.

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