



NEUROLOGICAL DISEASE UPDATES

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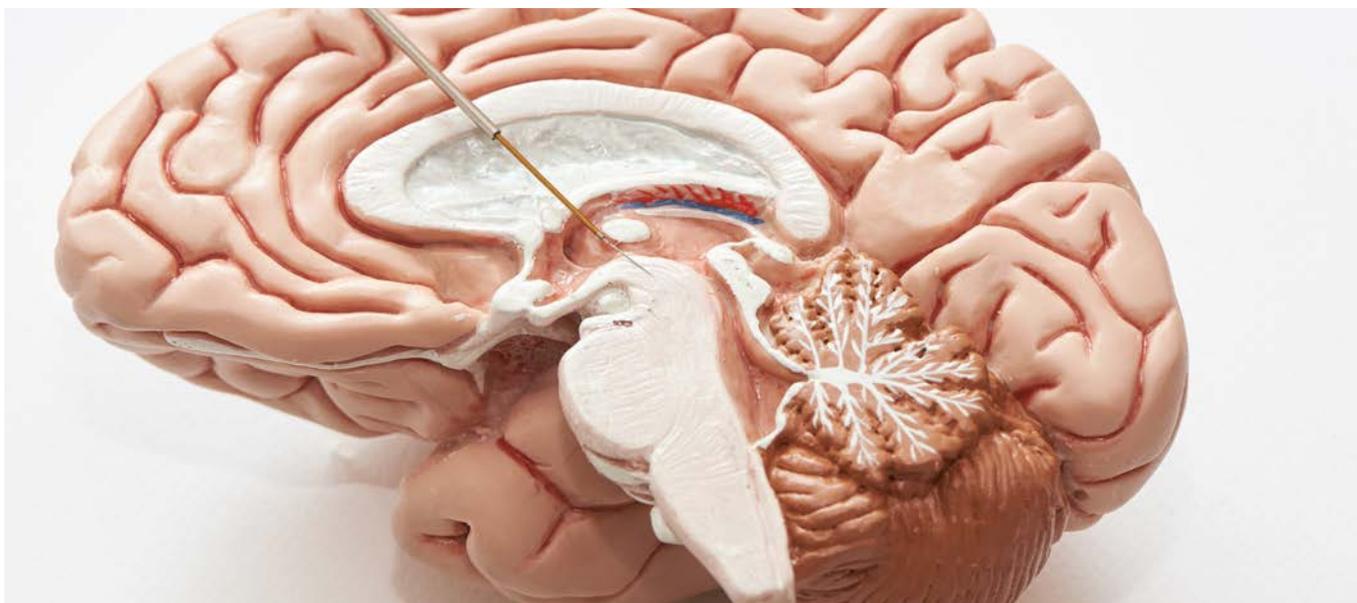
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## A Team Approach to Asleep Deep Brain Stimulation

*Henry Ford Health System's investment in advanced DBS technology and its commitment to multidisciplinary care has helped them become a leading treatment center for Parkinson disease and related movement disorders.*

By: Jason M. Schwalb, MD; Ellen L. Air, MD, PhD; Neepa J. Patel, MD; and Julia A. Wall

**TREATMENT OF MOVEMENT DISORDERS**, such as Parkinson disease (PD), essential tremor (ET), and dystonia, requires a multidisciplinary, patient-focused approach consisting of nonpharmacologic therapy, medications, and surgical treatments or combinations thereof.

Currently, high frequency deep brain stimulation (DBS) is the standard of care when response to medication is inadequate.<sup>1,2</sup> For PD, the goal of this surgical therapy is to “level out” the patient’s symptom control and help prevent neuronal cell death<sup>3,4</sup> so they experience fewer fluctuations associated with medications. For ET and dystonia, the benefits of DBS can exceed what patients ever experienced with medication.

DBS consists of an implantable neurostimulation system that creates a nondestructive and reversible disruption of the abnormal activity in specific areas of the brain to improve motor symptoms.<sup>5,6</sup> The customary method of DBS lead implantation involves the use of preoperative brain images registered in a stereotactic coordinate system and physiological localization using microelectrode-guided mapping of the target regions while patients are awake.<sup>7</sup> Selection of the target is based on

disease-specific considerations, including prioritization of the most disabling symptoms. Once implanted, the system is programmed to deliver a low-dose electrical current to the targeted area and disrupt abnormal movements.<sup>8</sup>

### Asleep DBS: A Treatment on the Rise

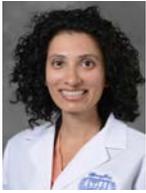
Awake DBS poses challenges for many patients who are claustrophobic, experience severe off-medication symptoms, or have a general fear of being awake and providing critical feedback to the surgeon during the brain surgery.<sup>9</sup> To accommodate patients who have severe reservations to this type of procedure, there is an alternative approach, refined over the last 10 years, called asleep DBS.<sup>10</sup> The asleep version of DBS enables implantation of the leads using real-time computed tomography (CT) or interoperative magnetic resonance imaging MRI (iMRI) guidance rather than the more cumbersome process utilized in awake DBS. Asleep DBS is a real-time, image-guided surgical procedure for placement of electrodes while the patient is under general anesthesia. At Henry Ford Health System (HFHS), the ClearPoint surgical navigation system is used in



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conjunction with iMRI guidance during surgery to ensure accurate placement of the DBS electrodes at the target location. Unlike CT scans or fluoroscopy, iMRI does not involve exposure to radiation, enabling continual magnetic resonance imaging (MRI) scans of the brain throughout the entire procedure to guide the surgery.<sup>11</sup> Clinical outcomes of asleep DBS in patients with PD using the iMRI technique with the ClearPoint system confer at

least equal efficacy in comparison to those with frame-based, microelectrode-guided surgery, and with a similar safety profile.<sup>7</sup>

### Establishing a Leading Asleep DBS Program

HFHS was the third facility in the United States to perform iMRI-guided asleep DBS procedures. They recognized an opportunity to excel in their region's highly competitive neurosurgery market when they established their asleep DBS practice over 10 years ago in Detroit, Michigan. Investing in a state-of-the-art MRI suite connected to an existing operating room, HFHS is now a national leader in brain surgery, garnering referrals from throughout the region and across the United States (FIGURE 1).

FIGURE 1. Image of DBS Suite



Courtesy of Henry Ford Health System

This new offering, combined with a strong outreach program, enabled the health system to reach neurologists and patients who previously opted out of awake DBS as a treatment option for PD. In the early stages of the asleep DBS program, education was key. HFHS proactively contacted other regional medical centers, support groups, and the Michigan Parkinson Foundation, to provide presentations, educational materials, and content for newsletters and other communications. These activities helped reach a previously untapped patient cohort and neurologists who could now refer patients to a more comfortable option for DBS surgery.

Today, 80% of the DBS procedures performed at HFHS are conducted while the patient is asleep, and that number continues

to rise. Typically, this is the patients' preference. Throughout the United States, approximately 50 other hospitals perform asleep implantation of DBS. Although the current percentage of asleep iMRI DBS procedures among total DBS procedures is approximately 8%, it has been climbing as more neurologists (and their patients) become educated on the benefits of asleep DBS. Furthermore, many physicians at HFHS attribute much of the dramatic rise in asleep DBS procedures to a relatively novel method of evaluating, preparing, treating, and monitoring patients undergoing asleep DBS.

### The Team Approach

A key ingredient to the success of the HFHS asleep DBS program is a multidisciplinary team approach. Recognized as a best practice in academic centers for years, the team approach has permeated into specialties (eg, cardiology, cancer, and diabetes) outside the academic centers over the past 20 years. Health care systems are finding that the team approach is particularly suitable in advanced and aging countries like the United States, where many elderly patients have comorbidities. Accordingly, treatment plans are becoming more technical and complex; they often exceed the abilities of the single physician. The focus of treatment is shifting from disease or disorder management to a more patient-centered, patient-empowered approach, with increasing emphasis on the psychosocial and quality of life-related aspects.<sup>12</sup> For health care providers, researchers are finding that working together as a team reduces the number of medical errors, increases patient safety, and can reduce issues that lead to physician fatigue and burnout.<sup>13</sup> A typical team for a patient with PD at HFHS might include a neurologist/movement disorder specialist, neuropsychologist, neurosurgeon, coordinator, and other specialists, as required.



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### The Neurologist

Neurologists, typically movement disorders specialists, play an integral role on the asleep DBS team. They are on the front line and normally the first team member to initiate care for the patient with PD. Depending on the severity or stage of the disease, the neurologist may care for the patient for several years with a regimen of pharmacologic therapies. As the disease progresses, medications may no longer be effective or patients may begin experiencing complications from their treatment, with motor complications becoming a major source of disability.<sup>14</sup> At this phase, it is largely the neurologist's responsibility to identify a patient with PD as a potential candidate for DBS.

Many patients with PD that came to HFHS were previously given the option of awake surgery but often declined it out of fear of being awake during brain surgery, or other factors, such as claustrophobia or severe off-medication symptoms. However, with the advent of asleep DBS, coupled with referring neurologists and patients becoming more educated on the benefits of asleep DBS, patients with PD are reconsidering brain surgery as a realistic option. ■

Neurologists are also starting to recognize that earlier DBS intervention offers the opportunity to impact patients' quality of life and functional ability, providing potentially significant symptomatic relief over a longer period.<sup>15</sup> A discernable trend has emerged where patients are pursuing therapy earlier—before they are more severely disabled.<sup>15</sup> The neurologist discusses the patient's goals for the surgery to establish a patient-centered and symptom-specific outcome for each potential DBS candidate.

The neurologist, who has the relationship and historical knowledge of the patient, is a key contributor in the team decision on whether to move forward with asleep DBS. The neurologist presents potential risks, anticipated adverse effects, and potential electrode target areas based on the current medication regimen and an understanding of the patient's postoperative goals. He or she remains an active member of the team throughout the entire process, from planning to post-surgery.

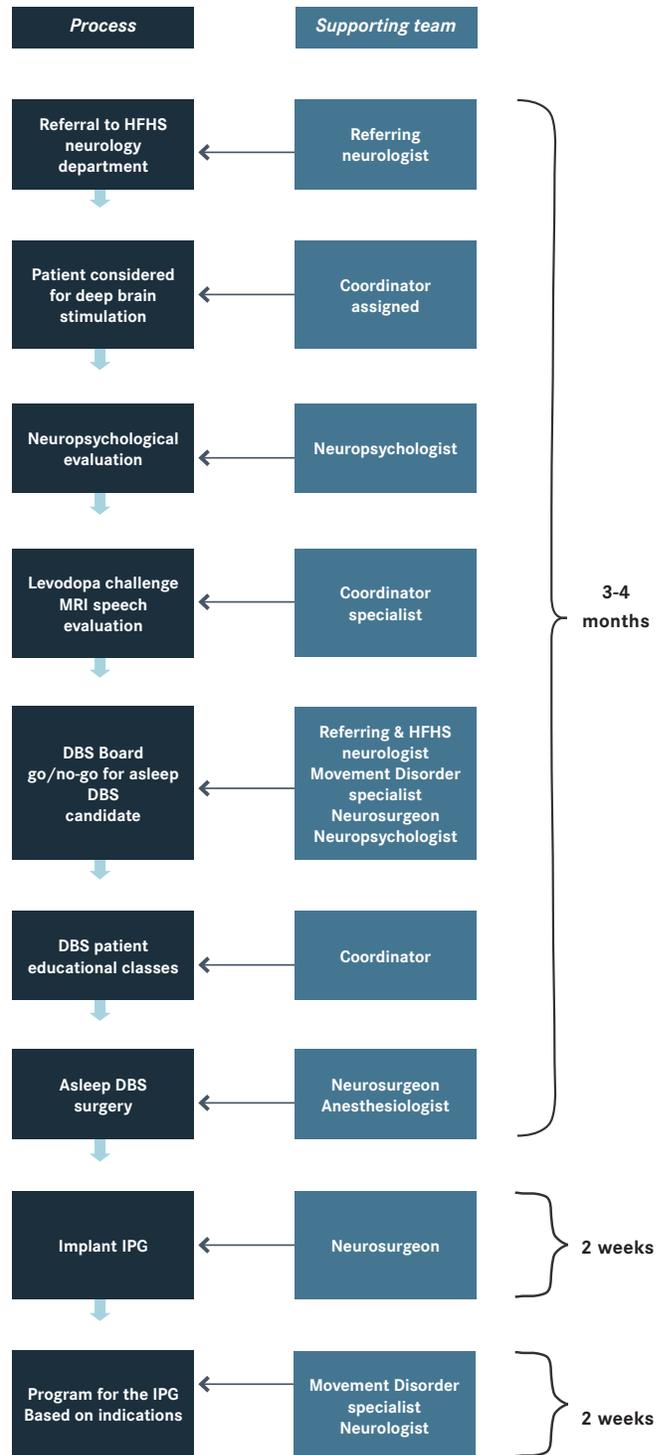
At approximately 1-month after surgery, the patient returns to have the system programmed and customized to the patient's individual indications. The neurologist or movement disorder specialist is typically responsible for programming the device, monitoring the patient and fine tuning as appropriate, but team input is always available. For example, the movement disorder specialist may join the neurologist during the programming sessions and the surgeon might provide images of where the electrodes are placed and remains another resource for the neurologist. Follow-ups for fine-tuning can occur for 3 to 6 months thereafter.<sup>8</sup> Programming can be updated and modified throughout the course of disease progression to optimize therapy.

**Coordinator**

The focal point of the team concept is the DBS coordinator. The coordinator is the primary contact for the patient and their family/caregiver as they maneuver the entire process, which can be quite daunting within a large hospital. Once the patient decides to undergo asleep DBS, a coordinator is assigned to the case and detailed planning ensues (FIGURE 2). Approximately 50% of the DBS volume at HFHS comes from the internal movement disorders group of specialists. HFHS also has a large neurologist referral network in the community and throughout the region. The coordinator plays a key role collaborating with PD support groups and hosting educational events for referring neurologists and their patients.

Throughout the patient journey, the coordinator manages the schedule, collaborates with team members, and builds a rapport with the patient and their caregivers. He or she schedules preoperative surgical evaluations, confirms that forms are complete and signed, schedules facilities, team meetings, and appointments, and keeps all team members apprised. When possible, patients are scheduled to be seen on the same day for certain procedures, including the levodopa challenge, MRI, and speech evaluation. This process is more time efficient for the patient, engendering improved patient satisfaction. During this phase, the coordinator serves as the primary liaison between the DBS team and the patient. The coordinator ensures that team members have the

FIGURE 2. Asleep Deep Brain Stimulation Process Flow Chart



IPG: internal pulse generator

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case information in time to carefully consider and reach tentative conclusions and that patients have all of the information and support they need to move forward with the surgery. At HFHS, the best clinical decisions are made through thoughtful, collegial discussion. From a professional standpoint, these decisional team meetings not only improve the knowledge base and skill sets of all participants, but also elevate the exchange of ideas and options in a synergistic manner. Equally important is the role the coordinator plays in managing the patients' and caregivers' expectations.

### Neuropsychologist

The neuropsychologist has a vital role in the preoperative screening process because they help distinguish if the patient has PD or a Parkinson-plus syndrome, as the latter tends not to respond to DBS. There is also evidence that patients with significant cognitive disorders are at higher risk of poor outcomes with surgery than medical management. In some cases, the surgery improves their motor symptoms, but it may induce adverse effects such as mood, cognitive, or behavioral problems.<sup>16</sup> The neuropsychologist uses preoperative neuropsychological testing to determine risk of major cognitive impairment or dementia and to establish a baseline for later comparison to assess change related to disease progression or surgical factors.

Neuropsychological testing involves an in-depth assessment of skills and abilities linked to brain function, such as attention, problem solving, memory, language, intelligence quotient, visual-spatial skills, academic skills, and social-emotional functioning.<sup>17</sup> The neuropsychologist interprets the test results, participates in the multidisciplinary team meetings to discuss the pros and cons for a DBS solution, and provides input on target selection.

### Neurosurgeon

Neurosurgeons at HFHS who have been performing asleep DBS for the past decade possess significant, valuable experiences with a variety of PD, ET, and other movement disorders; they assert the team concept as an ideal *modus operandi* in treating these conditions. Surgeons recognize that the other team specialists approach these situations differently, and at times, identify issues that the rest of the team did not see. Taking a multidisciplinary, 360-degree approach may produce some redundancy, but it also reduces risks and gives the patient (and family) greater confidence knowing that the entire team is focused on their well-being and the best outcome.

The DBS team at HFHS is a close-knit group who physically works in a central location on the same floor. This arrangement fosters informal, enhanced communications outside of the structured patient management communications between the specialists who actively participate in evaluating patients prior to and following surgery. The neurosurgeon, for example, relies heavily on perspectives of the neurologist and neuropsychologist to determine the anatomical target for the electrodes that will result in the best patient outcome.

Employing the ClearPoint system for asleep DBS, HFHS neurosurgeons are routinely expected to achieve submillimetric

accuracy in lead placement procedures. To facilitate this accuracy, ClearPoint's aiming device and software were developed specifically for iMRI interventions. Although the workflow of both awake and asleep DBS is similar, many of the asleep DBS guidance measures are automated, potentially saving time while maintaining flexibility and increased control over the procedure. In addition, the surgeon does not encounter a time limitation when the patient can no longer physically endure the procedure, which can occur during awake DBS. Finally, the asleep procedure eliminates the need for microelectrode or physiologic mapping, reducing brain penetrations and enabling bilateral intraoperative visualization of the subthalamic nucleus (or globus pallidus pars interna) and the DBS electrode simultaneously, detecting potential complications immediately. This technique increases patient comfort by eliminating the need for stereotactic frame or bone fiducials placement and enables the procedure to be done under general anesthesia.<sup>18</sup>

Following recovery, the patient returns and the neurosurgeon implants an internal pulse generator (IPG) under their respective clavicle and connects the electrical probes. Typically, 1 IPG is used for 2 DBS electrodes.

### Clinical and Economic Benefits

Clinically, perhaps the greatest benefit of the team approach is having multiple perspectives in the evaluation, planning, surgery, and aftercare phases. Each discipline imparts a slightly different, yet valuable perspective on how they view the patient's history, data, clinical evaluations, and goals. This results in improved outcomes for the patient undergoing DBS. Additionally, the adoption of the team approach for DBS could result in fewer errors and readmissions; however, this theory needs to be validated in studies.

The option of asleep DBS can provide a competitive advantage by attracting more patients who may have opted out of the awake DBS surgical procedure. Further, the asleep version combines much of the planning phase with the actual surgery, streamlining the overall process and, according to HFHS neurosurgeons, results in a more focused, less stressful surgery. In addition, the Affordable Care Act and the Centers for Medicare & Medicaid link Medicare reimbursement to patient satisfaction scores.<sup>19</sup> With the asleep option gaining favor with many patients, hospitals who offer asleep DBS may benefit from a positive patient experience assessment.

### Conclusions

As evidenced at HFHS, the team approach to asleep DBS surgery is a model that is critical to providing the best care for patients and results in optimal patient outcomes. Collaboration from a broad range of related specialists also results in greater patient and clinician satisfaction. The circumstances in any individual hospital will be unique, but the collaborative process described here can help other asleep DBS programs achieve and demonstrate the best outcomes possible. ■

For a full list of references, see the article on [NeurologyLive.com](https://www.neurology.com).