Synapse
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Deep Brain Stimulation: Multidisciplinary Team, Full Continuum of Care

Ehsan Hadi, MD

Deep brain stimulation has gradually evolved as a highly effective, safe, and reversible treatment for a variety of movement disorders. The long course of the eventual DBS discovery is full of serendipitous discoveries and resurgences brought about by very astute neurosurgeons, including Irving Cooper (1952), who first discovered that ligation of the anterior choroidal artery with resultant infarction of the medial globus pallidus leads to improvement in motor symptoms, and later by Alim Louis Benabid (1987), who discovered that high frequency stimulation of the thalamus leads to abatement of tremor, mimicking the effects of lesioning in a reversible and safe manner.

The exact mechanism of benefit of DBS simulation is not clear. However, DBS is thought to be a brain pacemaker which delivers electrical current, modulating specific targets in the brain, resulting in symptomatic improvement. DBS is preferred over surgical lesioning due to reversibility, adjustability, and a good safety profile. DBS received its FDA approval for essential tremor in 1997, for Parkinson disease (PD) in 2002, and for dystonia in 2003. DBS hardware includes a surgically-implanted DBS lead with four electrodes placed in desired targets such as the subthalamic nucleus (STN) or globus pallidus pars interna (GPi), an extension wire that passes from the scalp area under the skin to the chest, and an implantable pulse generator over the chest wall. Since 1997, more than 140,000 patients worldwide have received DBS therapy, and it is estimated that 700 centers throughout the world are performing approximately 8,000-10,000 DBS surgeries per year.

DBS surgery requires a multidisciplinary team, typically comprising of a movement disorder neurologist, a neurosurgeon and a neuropsychologist.

Pre-surgical evaluation is of critical value in ideal patient selection and successful surgical outcome. DBS surgery requires a multidisciplinary team, typically comprised of a movement disorder neurologist, a neurosurgeon, and a neuropsychologist. Factors that should be considered in the screening process include assessment of motor symptoms, evaluation of atypical features, medication ON/OFF testing to determine response, establishing realistic expectations, timing/target selection for surgery, performing a detailed neuropsychological evaluation to assess cognitive/psychiatric status, and brain imaging to rule out any secondary etiologies. Overall, serious complication rates from DBS surgery remain very low. Intracerebral hemorrhage occurs in 1 to 2%, and other adverse effects may include infection and surgical hardware malfunction. Post-surgically, DBS programming is initiated after placement of the pulse generator. Settings are adjusted gradually over time as tolerated by patients, while slowly lowering dopaminergic medications. Once settings are optimized, further programming adjustments are made as needed.


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Important Updates from the 2018 International Stroke Conference

Lucian Maidan, MD

January 2018 marked a major change in the stroke treatment guidelines released by the American Heart Association and American Stroke Association (AHA/ASA). These changes followed the release at the International Stroke Conference in Los Angeles of the Diffusion and Perfusion Imaging Evaluation for Understanding Stroke Evolution Study 3 (DEFUSE-3) trial results. The paradigm changing aspect of this study is the differentiation of tissue permanently damaged by the ischemic event from the tissue which is not functioning properly but is not yet fully infarcted. In addition, the results of the Diffusion Weighted Imaging (DWI) or CT Perfusion (CTP) Assessment With Clinical Mismatch in the Triage of Wakeup and Late Presenting Strokes Undergoing Neurointervention with Trevo (DAWN) trial led to a level Ia recommendation for mechanical thrombectomy (MT) in addition to medical treatment for patients who have a stroke due to an anterior circulation, large vessel occlusion (LVO) within 24 hours from last known normal.

For a select group of patients who demonstrate a mismatch between severe neurological deficit with a small core infarction, indicating that complete infarction has not yet occurred, MT benefits were shown to extend well beyond the previous six hours recommendation. The patients that were included in these trials were carefully selected using advanced multimodal imaging CTA or MRA in addition to CT or MR perfusion. For every two patients that are treated with mechanical thrombectomy, one patient will have a better chance of having no disability at 90 days.

While for the last 20 years, treatment of acute ischemic stroke has been offered only to those patients presenting for treatment with known onset of deficit less than within 3, or in some cases 4.5, hours prior to presentation. These recent trials indicate that time from onset of the symptoms is no longer the main selection criteria for treatment of strokes due to large vessel occlusion. The concept of a physiological "tissue window," rather than a "time window," is truly revolutionary, because it suggests that the presence of good collateral blood flow may protect ischemic brain tissue from complete infarction, extending the treatment window in appropriate candidates.

A major challenge for the current stroke systems of care is quickly identifying the patients who will benefit from treatment at a Comprehensive Stroke Center where mechanical thrombectomy is available and where postoperative care is offered by highly trained physicians in the neurocritical care setting. The AHA/ASA recently released a triage algorithm for EMS providers with the goal of directing these patients to the centers where MT can be provided immediately and efficiently, without compromising rapid access to intra-venous t-PA. More than half of the patients transferred to a Comprehensive Stroke Center by this algorithm will qualify for MT. Therefore accurate, pre-hospital selection of the patients is critically important.

Mercy San Juan Medical Center's Comprehensive Stroke Center has developed policies and trained nursing staff, interventional radiology technicians, and neurointerventionalists in anticipation of these major changes in the treatment of acute stroke. ■

Lucian Maidan, MD

The Role of MRI Scan in the Diagnosis and Management of Multiple Sclerosis

John Schafer, MD

Although MRI scans are considered to be indispensable in the diagnosis and management of multiple sclerosis, they are not actually required for the diagnosis. After all, MS was recognized and diagnosed for more than a hundred years prior to the arrival of the MRI scan, which was the first and remains the only imaging modality which shows MS plaques in detail. The diagnosis of MS has always been based on the recurring appearance of neurological events at different points in time and in different areas of the brain, optic nerves and spinal cord. Prior to the MRI, an attack of optic neuritis followed at a later time by an attack of myelitis, for example, would have been sufficient to strongly suspect if not definitively establish the diagnosis of MS.

Perhaps the most important thing to understand about the use of MRI scanning in MS is that the diagnosis of MS begins with the signs and symptoms, and the MRI scans may support or refute the clinical suspicion.

MRI scanning has greatly accelerated the diagnosis and management in several ways. MRI scans of the brain, optic nerve and spinal cord show MS lesions in a way that is relatively specific and usually different in appearance from infarcts and most tumors. The criteria for recurrence in space can be met by appearance of characteristic lesions in different areas of the brain, spinal cord or optic nerves. The criteria for dissemination in time can be met by the appearance of new lesions on scans taken at different points in time. With a later revision of the McDonald Criteria, which are accepted as the "rules" for using the MRI to diagnose MS, dissemination in time can also be established when a lesion which enhances with gadolinium, which implies current inflammation, is seen on the same scan with typical lesions which do not enhance, implying that they have been present for a longer time.

MRI scanning is a critical part of monitoring the course of a patient with multiple sclerosis. Appearance of enlarging or new lesions, including gadolinium enhancing lesions, indicate that MS is active. This information may add to urgency of starting treatment or of changing treatment in those already on immune modulating medication. How often MRI scans should be repeated depends on many factors, including the duration of MS, its stability and how long they have been on a treatment. Repeating scans six months after starting or switching treatment is recommended, and various guidelines suggest repeating scans every year or two years in patients on treatment.

There are pitfalls in the use of MRI scans to diagnose MS. T2 hyperintensities in the brain have a wide variety of possible causes. People with migraine syndrome have T2 lesions which can be mistaken for MS, and the lesions which occur with increasing age are believed to be due to small vessel disease. Fewer causes other than MS are responsible for lesions in the spinal cord. In some instances, the cause of the hyperintensities in the brain may never be determined. Nevertheless, the radiologist is obliged to include multiple sclerosis, or demyelinating disorder, in the radiological differential diagnosis.

Perhaps the most important thing to understand about the use of MRI scanning in MS is that the diagnosis of MS begins with the signs and symptoms, and the MRI scans may support or refute the clinical suspicion. An important item in the McDonald Criteria is that there be no other explanation for the clinical and radiological picture. Some patients referred to the MS Clinic on the basis of MRI findings do not have clinical signs or symptoms of MS or may even have other non-MS neurological disorders. Several studies are underway of Radiologically Isolated Syndrome (RIS) in which a highly characteristic MRI scan is found in a patient with no history or findings consistent with MS. Some, indeed, do progress either radiologically or clinically, but most neurologists do not prescribe treatment until a clinical diagnosis is established.

John Schafer, MD

Like many tools in medicine, the MRI scan is highly valuable but has limitations which must be recognized. ■

Mandatory Reporting of Impaired Drivers

Peter T. Skaff, MD, FAAN

Driving is considered to be a privilege but is nearly universal among adults and is tightly intertwined with social and occupational functioning. Loss of driving privilege or ability results in loss of independence, difficulty maintaining work responsibilities, impaired social connectedness, and increased burden on family. Physicians regularly encounter patients with physical or mental disabilities that could interfere with safe driving, and in addition to our primary responsibility to care for the health and well being of our patients, we also have a duty to protect public safety.

So, when should a patient's medical condition be reported? Medical disabilities are multidimensional and complex, may result from multiple conditions or their treatment, and typically produce impairment along a continuum. As such, clinical judgment is required when assessing degree of disability, incidence of episodic disorders, and overall driving risk. When making this clinical assessment, the duty to report should be commensurate with both actual and relative risk. For example, motor vehicle collision rates are approximately six times higher for drivers under 18 years old when compared to the safest age group, those in their 60's.

The table below shows the relative risk of having a motor vehicle accident for those with various medical conditions. Consider how this compares to the relative risk by age described above. Interestingly, only dementia has a higher relative risk than that of the youngest drivers.

Dementia	7.9
Sleep Apnea	2–6
Substance Abuse	2.8
Mental Illness	2.1
Epilepsy	2.0
Diabetes	1.8
Cardiovascular Disease	1.6

California Health & Safety Code §103900 stipulates that "every physicians and surgeon shall report immediately to the local health officer . . . every patient at least 14 years of age or older. . . diagnosed as having a case of a disorder characterized by lapses of consciousness," which is defined by three criteria: (1) A loss of consciousness or marked reduction of alertness or responsiveness to external stimuli, (2) The inability to perform one or more activities of daily living, and (3) Impairment of the sensory motor functions used to operate a motor vehicle. This definition includes dementia and other cognitive disorders "that are severe enough to be likely to impair a person's ability to operate a motor vehicle." Moreover, "if a physician or surgeon reasonably and in good faith believes that the reporting of a patient will serve the public interest, he or she may report a patient's condition even if it may not be required" without risk of civil or criminal liability.

There are several methods for reporting impaired drivers including sending a Confidential Morbidity Report to the Department of Public Health, sending a written letter to the DPH, or reporting via the Online California Reportable Disease Information Exchange, known as CalREDIE. New users can sign up at the following web address: https://calredie.cdph.ca.gov. Reports are confidential, but disclosure of personal health information should be limited to what is necessary. Reporting is not required for patients who are impaired to the degree they are unable to operate a motor vehicle, who do not drive, or who have been previously reported and have not driven since.

Peter T. Skaff, MD

If a physician or surgeon reasonably and in good faith believes that the reporting of a patient will serve the public interest, he or she may report a patient's condition even if it may not be required" without risk of civil or criminal liability.

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Service Dogs Can Go Above and Beyond and Assist Individuals with Disability

Linda Zisko

What is a service dog and what do they do? A fully trained service dog serves many roles. Besides being a trusted companion and alleviating a life of social isolation, depression and dependence, a dog may improve patient safety by assisting with a variety of tasks. Falls are reduced by the dog's ability to retrieve items, including dropped objects, open doors and turn on lights. This includes retrieving a phone to call for help or to alert another person after a fall.

Many types of trained dogs are recognized and protected by the Americans with Disabilities Act. These include service dog; hearing dogs; diabetic, seizure and allergy alert dogs; PTSD dogs as well as the more familiar guide dogs for the blind. These categories are ADA covered, allowing the animals to be brought into public establishments. Service dogs are specifically trained to assist just one person but need to tolerate a wide variety of experiences, environments and people.

Numerous national organizations provide fully trained service dogs; however, researching the provider for accreditation by Assistance Dogs International will avoid scammers.

Facility and therapy dogs may work in medical, educational and law enforcement settings and provide emotional support and comfort to many people. Therapy dogs provide comfort in nursing homes and hospitals. They need to tolerate a wide variety of experiences, environments and people. Facility and therapy dogs are not ADA covered for public access.

Emotional comfort dogs function to provide emotional support through companionship. They may live with owners even if a "no pets" policy is in place, though they do not have public access except to fly if the need is documented by a medical doctor.

There is no "national registry or national certification" for service dogs, and many "fake" sources do a disservice to properly trained dogs. Anyone can access a service dog vest online, but a vest does not make a service dog.

Since 1975, Canine Companions for Independence has provided assistance dogs free of charge for recipients. Learn more at cci.org.

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The process to acquire a service dog can take as long as two years from application to partnering with a trained service dog. Some organizations will match a 12-week-old puppy with a person to work through the puppy raising process. This puts a responsibility on the person with a disability to raise a puppy to adulthood. Other service dog organizations raise and train the puppies and provide fully trained service dogs at no charge to the recipient, while some organizations may charge as much as $20,000.

The Multiple Sclerosis Achievement Center in Citrus Heights is delighted to have a Canine Companions for Independence Facility Dog, Summer, working with clients. Summer encourages and is a great comfort to all who meet her. In addition, many MS Achievement Center members have service dogs who provide assistance as well as comfort and accompany them to the weekly sessions.

For additional information on service dogs please visit cci.org or asssitancedogsinternational.org. ■

Brain Waves

DHNI Welcomes New Talent

Hemant S. Kudrimoti, MD, PhD joins Mercy Medical Group as a neurologist with special expertise in epilepsy. Having completed his internship, residency and fellowship at University of Arizona in Tucson, Dr. Kudrimoti sees patients at Mercy Medical Group's Carmichael location. Dr. Kudrimoti says he became a medical provider given his intrigue with the nervous system, noting that the idea the brain controls so much in the body and defines our thoughts and actions—and ultimately who we are—is simply fascinating.

Rodica Petrea, MD is a stroke neurologist, practicing at Mercy Medical Groups' Folsom, Carmichael and Sacramento locations. She completed her internship at Fairview Hospital/ Cleveland Clinic Health System. Dr. Petrea went on to Boston University at Boston Medical Center to complete her residency in neurology, followed by a fellowship in vascular neurology. In addition to her expertise in acute stroke care and prevention, Dr. Petrea has special clinical interests in treating patients with headaches, dementia, vasculitis and systemic disorders with neurological complications.

Multiple Sclerosis Program Updates

Now in its fourth year, the **Mercy Multiple Sclerosis (MS) Achievement Center** has expanded programs from three to four days per week. The MS Achievement Center provides two core day programs, *Empowered to Achieve* and *Achieving Wellness*, where participants attend one day per week to maximize different aspects of their physical, cognitive, and emotional wellness. Since the program's inception, the MS Achievement Center has seen a total of 12,096 participant contacts with 41,406 contact hours. The program is sustained by generous philanthropic support from numerous donors, including two generous grants from the Conrad N. Hilton Foundation. For more information, visit DignityHealth.org/Neuro.

The Mercy MS Center continues to partner with the **National MS Society** to offer patients and their loved ones to learn more through their MS Lecture Series. Patients may register at nationalmssociety.org.

Wednesday, May 9 at 6:30 p.m.—Treatment of Spasticity in MS: What Are My Options?
Mercy Medical Group—Midtown, 3000 Q Street, Sacramento, McKinley Room

Wednesday, July 11 at 6:30 p.m.—Cannabis and MS: An Objective Review of Effectiveness and Safety
Mercy San Juan Medical Center, 6555 Coyle Avenue, Carmichael, Lukens Auditorium

Wednesday, September 12 at 6:30 p.m.—Done Being Tired: Tools to Manage Fatigue in MS
Mercy Medical Group—Midtown, 3000 Q Street, Sacramento, McKinley Room

Wednesday, November 14 at 6:30 p.m.—What's New in MS: Research Update
Mercy San Juan Medical Center, 6555 Coyle Avenue, Carmichael, Lukens Auditorium

Deep Brain Stimulation: Multidisciplinary Team, Full Continuum of Care—continued from page 1

Several studies have shown beneficial effects of DBS for movement disorders with sustained benefits over the years. In PD, DBS has been shown to improve overall motor scores by up to 56-71% (GPi/ STN) allowing reduction in L-dopa by up to 65% (STN) and reduction in dyskinesia by up to 89% (GPi). Both GPi and STN targets have significantly improved quality of life scores (PDQ 39) with a sustained benefit reported up to ten years after implantation. For essential tremor, DBS has shown tremor suppression scores varying from 40% to complete abatement. Bilateral GPi DBS for primary dystonia has demonstrated a response rate of 30-47% with sustained benefit reported in follow-up studies for up to ten years. In addition to DBS being superior to best medical therapy in the ideal candidate, it has also been shown to be a cost-effective treatment by reducing the need for medication and likely by increasing the number of productive days.

DBS surgery technology has advanced rapidly in recent years. Interventional MRI (iMRI) in conjunction with frameless stereotaxy systems, performed under general anesthesia, allow real-time assessment and positioning of intracranial leads; rechargeable batteries allow smaller sized implanted pulse generators; directional electrodes allow current steering, thus optimizing clinical benefits and avoiding side effects; adaptive/ closed loop stimulation can detect a physiologic signal and then trigger a stimulation pulse. Success of DBS as a treatment for movement disorders has also prompted the exploration of its use for other possible indications such as epilepsy, obsessive compulsive disorder (OCD), Tourette syndrome, depression, and Alzheimer's disease.

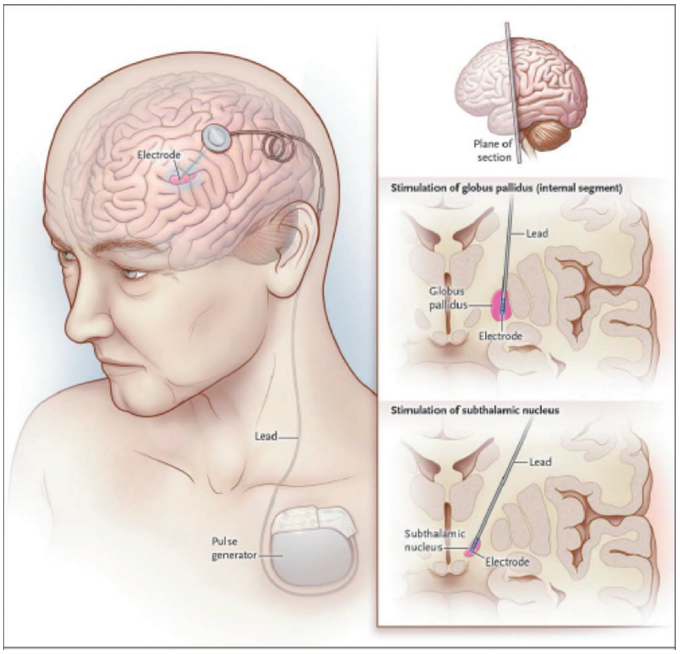

Figure 1. Electrode Implantion for Deep-Brain Stimulation.
The lead for deep-brain stimulation is implanted in either the subthalamic nucleus or the internal segment of the globus pallidus. The lead passes through a burr hole in the skull. Attached to the lead is a connecting wire, which is tunneled under the skin of the scalp and neck to the anterior chest wall, where it is connected to an impulse generator. (Okun,2012)

DBS surgery remains an adjunctive treatment, and though it has not been shown to be curative or disease modifying, it does advance the overall goal of management of movement disorders; improving quality of life. Availability of DBS at Mercy General Hospital, using a multidisciplinary approach, has provided a valuable tool in the armamentarium of movement disorders management. ■

Mandatory Reporting of Impaired Drivers—continued from page 4

Patients are often unhappy about a loss of driving privilege, so it is essential to guide the patient and their family as their advocate. Advise the patient that their condition may affect safe driving and that it is a legal obligation for physicians to report such conditions. Explain the process that will follow reporting, which may result in the patient receiving a letter of suspension. Also advise them of their right to appeal an adverse decision by the DMV. It may be helpful to emphasize that in California, the physician makes recommendations to the DMV, but does not determine license status. Finally, document the discussion in the medical record.

This article was adapted from a presentation delivered by Dr. Skaff at the Mercy San Juan Medical Center, Friday CME Conference on November 3, 2017. The audio file for this lecture can be found at: https://vimeo.com/249565297/e4bac3c62d. ■

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CONTINUING MEDICAL EDUCATION 2018

Save the Date: Insights and Innovations
Stroke Update
North Ridge Sacramento
November 8, 2018

Stroke & Vascular Neurology Conference
Mercy San Juan Medical Center
6555 Coyle Ave., Suite 145
4th Thursday of the month at 7 a.m.

Epilepsy & Subspecialty Neurology Case Conference
Mercy General Hospital
North Auditorium
4th Tuesday of the month at 6 p.m.

Multiple Sclerosis Clinical and Neuro-Radiology CME Case Conference
Mercy San Juan Medical Center
6555 Coyle Ave., Suite 145
First Wednesday of the month at 5:30 p.m.

Neurocritical Care & Neurosurgery Conference
Mercy San Juan Medical Center
CC3
1st Thursday of the month at 12:30 p.m.
For WebEx dial-in call 916.864.5613
No CME available

Neuro Radiosurgery Case Conference
Mercy Cancer Center, C Street
1st and 3rd Thursday of the month at 7:30 a.m.

If you have any questions about upcoming opportunities, contact DignityHealthNeuro@DignityHealth.org or call 916.962.8751.