BRAIN SPECIAL

Dive into deep brain stimulation

This technique provides new hope for patients with movement disorders.

By Kathryn Murphy, DNSc, NP

Historically, electrical stimulation has been used to modulate the nervous system and treat neurologic conditions. In fact, electric fish were first placed on the scalp to treat headaches as far back as 46 A.D., and later used for the treatment of seizures. As medical techniques advanced, the use of a stereotactic frame allowed surgeons to more precisely identify the parts of the brain to stimulate related to the patient's symptoms. Currently, electrical stimulation is a recommended intervention for patients with movement disorders, such as Parkinson disease, essential tremor, and severe dystonia. There are two U.S. FDA-approved implantable deep brain stimulation (DBS) devices available to help reduce the symptoms of these disorders when medications are no longer effective.

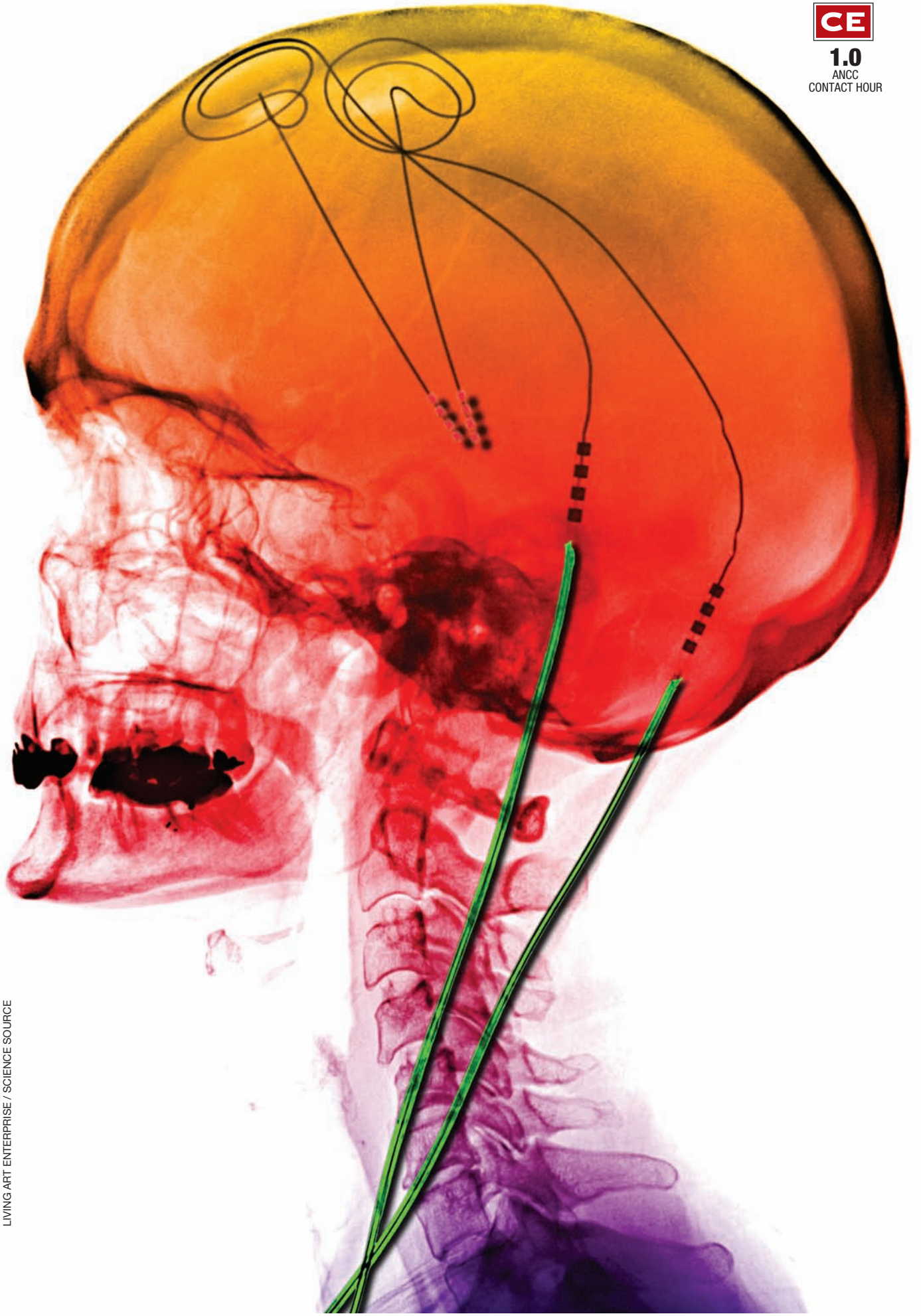
Refresher course

Parkinson disease is a chronic, degenerative neurologic disorder that affects over 1 million Americans. Incidence of the disease increases with age, but it can also occur before age 40. This movement disorder progressively affects a person's quality of life; in fact, more than one-third of patients with Parkinson disease lose some employment after a year of diagnosis and, within 5 years, are no longer employed full time.

Parkinson disease occurs when the nerve cells that produce dopamine (a substance that helps

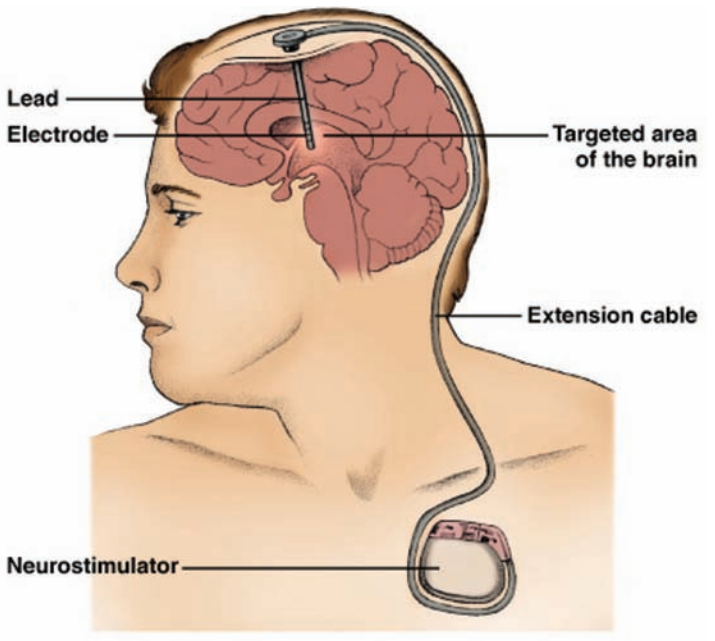
CE

1.0
ANCC
CONTACT HOUR



LIVING ART ENTERPRISE / SCIENCE SOURCE

Picturing DBS



Lippincott's Nursing Advisor

transmit signals between different parts of the brain that are involved in the production of smooth, purposeful movement) become impaired or die, presenting with both motor and nonmotor symptoms with individual variations. Motor symptoms include a resting tremor, stiffness or rigidity, bradykinesia or slowness of movement, shuffling gait, small handwriting (micrographia), and difficulties with balance. Nonmotor symptoms include mood disturbances, such as depression, anxiety, or apathy, and cognition problems, such as memory difficulties or frontal lobe dysfunction.

Essential tremor is an involuntary rhythmic movement of the hands and arms occurring at rest and during purposeful movement. It's often misdiagnosed as Parkinson disease, although it's eight times more common, affecting an estimated 10 million Americans. Essential tremor can cause the head, arms, and voice to shake uncontrollably. This can be so severe that normal activities, such as eating with utensils, are compromised.

Dystonia is a movement disorder resulting in involuntary movements and prolonged muscle contractions, causing writhing body movement, tremors, and abnormal posture. It may involve an isolated area or the entire body. Some older neuroleptic medications can cause dystonia. Again, when the movements are so severe that the patient's quality of life is compromised, intervention is needed and DBS may be recommended.

The device

DBS surgery can take place while the patient is awake or under general anesthesia. With asleep or image-guided DBS, the patient doesn't remember the procedure and high-resolution scans are used to place the electrodes. If awake or microelectrode-guided DBS is chosen, the patient has medication for comfort but is aware of the procedure, responding to questions and moving to help electrode placement in the correct part of the brain.

Electrodes are positioned deep in both the left and right side of the brain, and connected to a stimulator device similar to a pacemaker. Location of the electrodes depends on the patient's primary symptoms. These electrodes are advanced through small openings called burr holes at the top of the skull and connected by extension wires passing under the skin and down the neck to a battery-operated stimulator under the chest skin. When the device is activated, the stimulator sends electrical pulses to block the faulty nerve signals that cause the symptoms.

There are three parts to the DBS device: the neurostimulator, the lead, and the extension (see *Picturing DBS*).

The neurostimulator is a programmable, battery-operated device that creates electrical pulses. It's placed under the

chest skin below the collarbone or, alternatively, in the abdomen.

The lead refers to the electrodes that deliver the electrical pulses. Linked to an extension wire through a burr hole in the skull, the lead is placed inside the brain's subthalamic nucleus, thalamus, or globus pallidus. Placement in the subthalamic nucleus area is most effective for symptoms of Parkinson disease, such as tremors, rigidity, bradykinesia, dystonia, and dyskinesia. Placement in the thalamus is most effective for tremors and is used to treat essential tremor. Placement in the globus pallidus is effective for tremors, bradykinesia, rigidity, dystonia, and dyskinesia, and is used to treat both Parkinson disease and dystonia.

The extension connects the lead to the neurostimulator. It's placed under the skin and runs from the scalp behind the ear, along the neck, and to the chest.

The procedure

The patient first meets with a neurosurgeon, who collects a comprehensive medical history, including allergies, current medications, and reactions to previous surgeries, to avoid any risks. Then the patient completes typical preoperative tests, such as an ECG, blood tests, and a chest X-ray. Before the surgery, magnetic resonance imaging (MRI) is used to scan the brain to locate the specific target for the intervention. A microelectrode recording may be done, which involves a small wire that monitors nerve cell activity in the targeted area to better identify the precise part of the brain that needs to be stimulated.

The patient is instructed to stop taking nonsteroidal anti-inflammatory medications (such as ibuprofen, naproxen, celecoxib, and indomethacin), anticoagulants (such as clopidogrel and warfarin), and antiplatelet medications (such as aspirin) at least 7 days before surgery to decrease the risk of bleeding. All medication for Parkinson disease, such as levodopa, is stopped 12 hours before the surgery. In addition, the patient should stop smoking, chewing tobacco, and drinking alcohol 1 week before surgery because these activities may increase bleeding risk. At midnight on the day of the surgery, all medications, food, and drink should be stopped. All valuables should be left at home for safekeeping.

On the morning of the surgery, the patient washes with antibacterial soap and puts on a hospital gown. Any hairpins, makeup, contacts, body piercings, and nail polish should be removed just as before any kind of surgery. Lastly, an anesthesiologist will talk to the patient about the risks and effects of anesthesia, and an I.V. line will be placed.

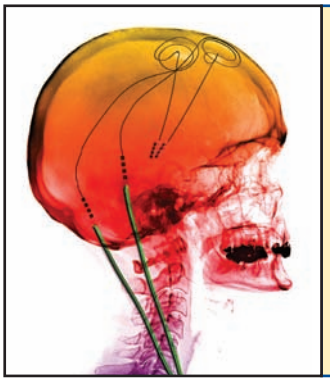
Electrode placement lasts 5 to 7 hours. A stereotactic frame is attached to the patient's head with four pins. Some pressure can be felt as the pins are tightened. This frame prevents any small movement of the head while the electrodes are being placed. The MRI helps the surgeon plan the path of the electrodes. Then a microelectrode is inserted to obtain electrophysiologic recordings of nerve signals to assist with effective placement. Once the exact position in the brain is located, the recording electrode is replaced with a permanent DBS lead. A test is then done to see if the patient feels any reduction in symptoms. Once complete, a plastic cap is placed over the burr hole to hold

key points

DBS:

- can improve the symptoms of Parkinson disease, essential tremors, and dystonia
- isn't a substitute for medication; rather, it augments medications to control symptoms
- consists of a neurostimulator, lead, and extension
- may involve one of three brain regions: the subthalamic nucleus, the thalamus, or the globus pallidus.

the lead in place. In a separate surgery 2 to 7 days after the first one, a small coil of wire is left under the scalp for later attachment to the extension and neurostimulator.



DBS for essential tremors can reduce hand tremors by 60% to 90%.

After the surgery, the patient with Parkinson disease takes the regular doses of those medications immediately. Overnight monitoring is the norm to ensure that no adverse reactions from the surgery occur (see *Patient teaching: What to expect after surgery*).

About a week postoperatively, the patient will return to the hospital to have the neurostimulator implanted in the chest or abdomen and the lead attached. Instruct the patient to avoid all arm movements over the shoulder or extensive stretching of the neck so that the incision will heal. Because neurostimulator placement takes about an hour, the patient usually returns home the same day.

Ten days later, an office visit will be scheduled to program the neurostimulator and adjust medication dosage. Every 3 weeks, the patient returns for programming, with about four sessions needed to attain maximum symptom control. Most of the time, the patient doesn't feel the neurostimulator as it decreases the symptoms; however, some may feel a tingling sensation. The patient may need to return periodically for the neurostimulator settings to be adjusted.

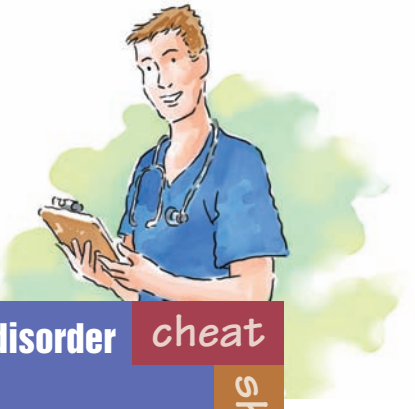
The essentials

General complications of any surgery, such as bleeding, infection, or blood clots, may occur. In addition, complications related to placement of the DBS device include seizures, infection, and bleeding into the brain. Additional surgery may be needed if a break of the extension wire occurs or for device removal due to infection. For some patients, DBS may cause or increase symptoms of depression or anxiety, so alert patients to report these symptoms to their healthcare provider. Any device dysfunction or unusual symptoms that occur may necessitate a return trip to the office for reprogramming.

Effectiveness of DBS depends on patient selection, appropriate selection of the brain area, precise positioning of the electrodes, effective programming, and medication management. With DBS, most patients with Parkinson disease are able to reduce both symptoms and medication dosages, which can decrease adverse reactions. DBS for essential tremors can reduce hand tremors by 60% to 90% and may improve head and voice tremors. DBS for dystonia may be one of the most effective treatments of symptoms.

Patient teaching: What to expect after surgery

- Rest: Go back to regular activities slowly.
- Falling: There's a high risk of falling in the weeks after DBS surgery, so be cautious.
- Bruising: There will be some bruising near the incision; swelling around the eyes and tenderness near the incision and behind the ear may occur.
- Swallowing: There may be swallowing problems immediately after DBS surgery that get better in a few days or weeks.
- Mood changes: DBS may increase or cause symptoms of depression or anxiety.
- Symptom control: Remember that DBS can help with symptom control, but doesn't stop the progression of the disease.



The nurse's role

Nurses are involved with all aspects of the DBS procedure. Advise patients what to expect before, during, and after the surgery. As a patient advocate, you can ensure that the surgeons and physicians thoroughly explain the risks, benefits, surgical procedure, and postoperative process to the patient. Be aware of all information that's taught to the patient so any questions can be answered as they arise.

Because there's a higher risk of falls after DBS surgery, review safety measures for the home and make sure that a cane or walker is provided if needed. In addition, instruct the patient that swallowing problems or mood changes can occur immediately after DBS surgery. Sometimes just knowing that these symptoms are expected can assist the patient to deal with them. Any signs of infection, such as increased redness, drainage, swelling, or pain, starting a few days to weeks postoperative necessitate an immediate call to the healthcare provider.

In the future, the patient should include DBS device implantation in his or her medical history because some procedures may need to be altered or not done at all.

You can also offer psychological support as the patient adjusts to DBS. There may be setbacks as the amount of stimulation and medications are adjusted. Help the patient understand that DBS alleviates symptoms, but doesn't stop the disease process. If the patient is planning a return to work, a request for accommodations in the workplace may be needed because any electromagnetic field exposure can interfere with device settings or deplete the device's battery.

Medical or dental procedures done directly over the DBS device or MRIs may cause damage, so advise patients to check with their provider before these treatments. The DBS device may set off the metal detector at the airport screening area, so the patient should ask security to perform a manual body scan. Instruct the patient to remove any unnecessary magnets at home and stand away from the microwave when it's in use.

Because of the possibilities of interference with the DBS device, the patient should wear a medical-alert bracelet and carry a wallet card outlining special warnings and precautions.

Movement disorder symptoms

cheat sheet

Parkinson disease

- resting tremor
- stiffness or rigidity
- bradykinesia or slowness of movement
- shuffling gait
- small handwriting (micrographia)
- difficulties with balance
- mood disturbances, such as depression, anxiety, or apathy
- cognition problems, such as memory difficulties or frontal lobe dysfunction

Essential tremor

- involuntary rhythmic movement of the hands and arms
- uncontrollable shaking of the head, arms, and voice

Dystonia

- involuntary movements and prolonged muscle contractions
- writhing body movement
- tremors
- abnormal posture

Advocate for success

Nurses play a vital role in all aspects of DBS therapy. As part of the neurologic team, you'll prepare the patient for the procedure with both basic preoperative education and specific information related to DBS. Nurses may be involved in assisting the surgeon in device placement. Postoperatively, you'll monitor for adverse reactions of the surgery or device functioning. Nurses play a supportive role while medications and the device are

adjusted, and an educator role when teaching the patient about all aspects of having an implanted DBS device. As a patient advocate, you can help ensure the success of DBS in controlling the symptoms of movement disorders. ■

REFERENCES

Fenoy AJ, Simpson RK Jr. Management of device-related wound complications in deep brain stimulation surgery. *J Neurosurg.* 2012;116(6):1324-1332.

International Essential Tremor Foundation. About essential tremor. www.essentialtremor.org/about-et.

Kim JP, Chang WS, Chang JW. Treatment of secondary dystonia with a combined stereotactic procedure: long-term surgical outcomes. *Acta Neurochir (Wien).* 2011; 153(12):2319-2327.

Larson PS. Deep brain stimulation for movement disorders. *Neurotherapeutics.* 2014;11(3):465-474.

Martikainen KK, Luukkaala TH, Marttila RJ. Parkinson's disease and working capacity. *Mov Disord.* 2006;21(12): 2187-2191.

Nolden LF, Tartavoulle T, Porche DJ. Parkinson's disease: assessment, diagnosis, and management. www.medscape.com/viewarticle/831281_4.

Okun MS. Deep-brain stimulation for Parkinson's disease. *N Engl J Med.* 2012;367(16):1529-1538.

Schwalb JM, Hamani C. The history and future of deep brain stimulation. *Neurotherapeutics.* 2008;5(1):3-13.

Serdans B. Deep brain stimulation: hope for dystonia patients. https://www.americannursetoday.com/deep-brain-stimulation-hope-for-dystonia-patients.

Temel Y. Limbic effects of high-frequency stimulation of the subthalamic nucleus. *Vitam Horm.* 2010;82:47-63.

U.S. Food and Drug Administration. FDA approves brain implant to help reduce Parkinson's disease and essential tremor symptoms. www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm451152.htm.

Weaver FM, Follett KA, Stern M, et al. Randomized trial of deep brain stimulation for Parkinson disease: thirty-six-month outcomes. *Neurology.* 2012;79(1):55-65.

Zesiewicz TA, Elble R, Louis ED, et al. Practice parameter: therapies for essential tremor: report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology.* 2005;64(12):2008-2020.

Kathryn Murphy is a Faculty Member at Chemeketa Community College in Salem, Ore., and a *Nursing made Incredibly Easy!* Editorial Board Member.

The author and planners have disclosed no potential conflicts of interest, financial or otherwise.

DOI-10.1097/01.NME.0000520138.79348.8c

CE CONNECTION

Earn CE credit online:
Go to www.nursingcenter.com/CE/nmie and receive a certificate *within minutes*.

INSTRUCTIONS

Dive into deep brain stimulation

TEST INSTRUCTIONS

- To take the test online, go to our secure web site at **www.nursingcenter.com/CE/nmie**.
- On the print form, record your answers in the test answer section of the CE enrollment form on page 56. Each question has only one correct answer. You may make copies of these forms.
- Complete the registration information and course evaluation. Mail the completed form and registration fee of $12.95 to: Lippincott Williams & Wilkins, CE Group, 74 Brick Blvd., Bldg. 4, Suite 206, Brick, NJ 08723. We will mail your certificate in 4 to 6 weeks. For faster service, include a fax number and we will fax your certificate within 2 business days of receiving your enrollment form.
- You will receive your CE certificate of earned contact hours and an answer key to review your results.
- Registration deadline is August 31, 2019.

DISCOUNTS and CUSTOMER SERVICE

- Send two or more tests in any nursing journal published by Lippincott Williams & Wilkins together by mail and deduct $0.95 from the price of each test.
- We also offer CE accounts for hospitals and other health care facilities on nursingcenter.com. Call 1-800-787-8985 for details.

PROVIDER ACCREDITATION

Lippincott Williams & Wilkins, publisher of *Nursing made Incredibly Easy!*, will award 1.0 contact hour for this continuing nursing education activity.

Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 1.0 contact hour. Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia, Georgia, and Florida CE Broker #50-1223.

Your certificate is valid in all states.