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Deep brain stimulation

Deep brain stimulation (DBS) uses a device called a neurostimulator to deliver electrical signals to the areas of the brain that control movement, pain, mood, weight, obsessive-compulsive thoughts, and awakening from a coma.

Description

The DBS system consist of four parts:

- One or more, insulated wires called leads, or electrodes, that are placed into the brain
- Anchors to fix the leads to the skull
- The neurostimulator, which puts out the electric current. The neurostimulator is like a heart pacemaker. It is usually placed under the skin below the collarbone, but may be placed under the skin in another area of the body
- In some people another thin, insulated wire called an extension is added to connect the lead to the neurostimulator

Surgery is done to place each part of the neurostimulator system. In adults, the whole system can be placed in 1 or 2 stages (two separate surgeries).

Stage 1 is usually done under local anesthesia, meaning you are awake, but pain-free. (In children, general anesthesia is given.)

- Your surgeon may shave some hair prior to making the skin incisions.
- Your head may be placed in a special frame using small screws to keep it still during the procedure. Numbing medicine is applied where the screws contact the scalp. Sometimes, the procedure is done in the MRI machine and a frame is on top of your head rather than around your head.
- Numbing medicine is applied to your scalp at the site where the surgeon will open the skin, then drill a small opening (burr hole) in the skull and place the lead into a specific area of the brain.
- If both sides of your brain are being treated, the surgeon makes an opening on each side of the skull, and two leads are inserted.
- Electrical impulses may need to be sent through the lead to make sure it is connected to the area of the brain responsible for your symptoms.
- You may be asked questions, to read cards, or describe images. You may also be asked to move your legs or arms. These are to make sure the electrodes are in the right positions and the expected effect is achieved.

Stage 2 is done under general anesthesia, meaning you are asleep and pain-free. The timing of this stage of surgery depends on where in the brain the stimulator will be placed.

- The surgeon makes a small opening (incision), usually just below the collarbone and implants the neurostimulator under the skin. (Sometimes it is placed under the skin in the lower chest or belly area.)
- The extension wire is tunneled under the skin of the head, neck, and shoulder and connected to the neurostimulator.
- The incision is closed. The device and wires are under the skin and can appear as a slight bump.

Once connected, electric pulses travel from the neurostimulator, along the extension wire, to the lead, and into the brain. These tiny pulses interfere with and block the electrical signals that cause symptoms of certain diseases.

Why the Procedure is Performed

DBS is commonly done for people with Parkinson disease when the symptoms cannot be controlled by medicines. DBS does not cure Parkinson disease, but can help reduce symptoms such as:

- Tremors
- Rigidity
- Stiffness
- Slow movements
- Walking problems

DBS may also be used to treat the following conditions:

- Major depression that does not respond well to medicines
- Obsessive-compulsive disorder (OCD)
- Pain that does not go away (chronic pain)
- Severe obesity
- Shaking movement that cannot be controlled and the cause is unknown (essential tremor)
- Tourette syndrome (in rare cases)
- Uncontrolled or slow movement (dystonia)
- Epilepsy

Risks

DBS is considered safe and effective when done in the right people.

Risks of DBS placement may include:

- Allergic reaction to the DBS parts
- Problem concentrating
- Dizziness
- Infection

- Leakage of cerebrospinal fluid, which can lead to headache or meningitis
- Loss of balance, reduced coordination, or slight loss of movement
- Shock-like sensations
- Speech or vision problems
- Temporary pain or swelling at the site where the device was implanted
- Temporary tingling in the face, arms, or legs
- Bleeding in the brain

Problems may also occur if parts of the DBS system break or move. These include:

- Device, lead, or wires break, which can lead to another surgery to replace the broken part
- Battery fails, which would cause the device to stop working properly (the regular battery normally lasts 3 to 5 years, while the rechargeable battery lasts about 9 years)
- Wire that connects the stimulator to the lead in the brain breaks through the skin
- The part of the device placed in the brain may break off or move to a different place in the brain (this is rare)
- You will also trigger alarms when you are scanned at the airport, but the TSA agents are used to this happening

Possible risks of any brain surgery are:

- Blood clot or bleeding in the brain
- Brain swelling
- Coma
- Confusion, usually lasting only for days or weeks at most
- Infection in the brain, in the wound, or in the skull
- Problems with speech, memory, muscle weakness, balance, vision, coordination, and other functions, which may be short-term or permanent
- Seizures
- Stroke

Risks of general anesthesia are:

- Reactions to medicines
- Problems breathing

Before the Procedure

You will have a complete physical exam.

Your surgeon will order many laboratory and imaging tests, including a CT or MRI scan. These imaging tests are done to help the surgeon pinpoint the exact part of the brain responsible for the symptoms. The images are used to help the surgeon place the lead in the brain during surgery.

You might have to see more than one specialist, such as a neurologist, neurosurgeon, or psychologist, to make sure that the procedure is right for you and has the best chance of success.

Before surgery, tell your surgeon:

- If you could be pregnant
- What medicines you are taking, including herbs, supplements, or vitamins you bought over-the-counter without a prescription
- If you have been drinking a lot of alcohol, more than 1 or 2 drinks a day

Planning for your surgery:

- If you have diabetes, heart disease, or other medical conditions, your surgeon may ask you to see the provider who treats you for these conditions.
- If you smoke, it's important to cut back or quit. Smoking can slow healing and increase the risk for blood clots. Ask your provider for help quitting smoking.
- If needed, prepare your home to make it easier to recover after surgery.
- Ask your surgeon if you need to arrange to have someone drive you home after your surgery.

During the week before the surgery:

- You may be asked to temporarily stop taking medicines that keep your blood from clotting. These medicines are called blood thinners. This includes over-the-counter medicines and supplements such as aspirin, ibuprofen (Advil, Motrin), naproxen (Aleve, Naprosyn), and vitamin E. Many prescription medicines are also blood thinners.
- If you are taking other medicines, ask your surgeon if it is OK to take them on the day of or in the days before surgery.
- Let your surgeon know about any illness you may have before your surgery. This includes COVID-19, a cold, flu, fever, herpes breakout, or other illness. If you do get sick, your surgery may need to be postponed.

The night before and on the day of surgery, follow instructions about:

- When to stop eating and drinking.
- Washing your hair with special shampoo.
- Taking the medicines your surgeon told you to take with a small sip of water.
- When to arrive at the hospital. Be sure to arrive on time.

After the Procedure

You may need to stay in the hospital for about 3 days.

Your surgeon may prescribe antibiotics to prevent infection.

You will return to your surgeon's office at a later date after surgery. During this visit, the stimulator is turned on and the amount of stimulation is adjusted. Surgery is not needed. This process is also called programming.

Contact your surgeon if you develop any of the following after DBS surgery:

- Fever
- Headache
- Itching or hives
- Muscle weakness
- Nausea and vomiting
- Numbness or tingling on one side of the body
- Pain
- Redness, swelling, or irritation at any of the surgery sites
- Trouble speaking
- Vision problems

Outlook (Prognosis)

People who have DBS usually do well during the surgery. Many people have great improvement in their symptoms and quality of life. Most people still need to take medicine, but at a lower dosage.

This surgery, and surgery in general, is riskier in people over age 70 and those with health conditions such as high blood pressure and diseases that affect blood vessels in the brain. You and your health care provider should carefully weigh the benefits of this surgery against the risks.

The DBS procedure can be reversed, if needed.

Alternative Names

Globus pallidus deep brain stimulation; Subthalamic deep brain stimulation; Thalamic deep brain stimulation; DBS; Brain neurostimulation

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