Deep Brain Stimulation

Deep brain stimulation (**DBS**) is a surgical technique in which an **electrode** (an uninsulated wire) is placed in the **subcortical** (below the surface) structures of the brain. This electrode is connected to a **stimulator** (a battery) usually placed near the collarbone.

TECHNIQUE

Deep brain stimulation requires precisely locating a specific target area in the brain using **stereotactic** (3-dimensional) imaging techniques with x-ray, computed tomography (CT), or magnetic resonance imaging (MRI). After drilling a small hole in the skull, special hardware allows accurate image-guided placement of an electrode in the targeted part of the brain. Testing during the surgery may be done to ensure that the electrode will stimulate only **neurons** (nerve cells) that reduce symptoms. Each neurological disease has specific target neurons. For example, for Parkinson disease, these are neurons in the **subthalamic nucleus** or **globus pallidus** (regions of the brain); for essential tremor or epilepsy, neurons in the **thalamus** (another region in the brain). Because the most effective intensity and frequency of electric stimulation vary among diseases and patients, electrode placement is followed by testing to choose proper stimulation settings. Although it is unclear how DBS works, the most likely explanation is that it rewires brain circuits and leads to a better balance between inhibitory and excitatory pathways in the brain.

INDICATIONS

Use of DBS has been limited to the severe forms of disease that have not responded to the usual medical treatment. DBS is approved by the US Food and Drug Administration for use in Parkinson disease, **essential tremor** (uncontrollable shaking of the hands), and **dystonia** (uncontrollable movements of the body). It is being studied for use in

- Depression
- Epilepsy
- Obsessive-compulsive disorder (OCD)
- Eating disorder
- **Cluster headaches** (a type of extremely severe headache)
- Chronic and phantom limb pain
- **Tourette syndrome** (uncontrollable tics of face and extremities)
- Posttraumatic coma

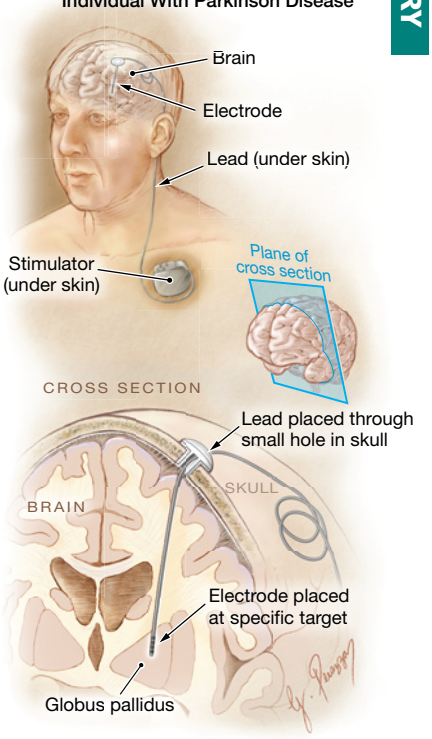
RISKS

Because DBS is an invasive procedure, serious complications may occur, including bleeding and infection, scarring, and stroke. Other complications may include headaches, neuropsychiatric problems (mood changes, apathy, hallucinations), and broken wire, battery malfunction, or electrode displacement. Because the battery has a limited life span, it needs to be surgically replaced on a regular basis.

LIMITATIONS

DBS is expensive and requires a long-term commitment from patient, family, and physician. It may have unknown long-term effects. Because DBS does not cure a disease, typically only patients who are severely disabled and who do not respond to medical therapy are considered for this treatment.

Deep Brain Stimulation in Individual With Parkinson Disease



FOR MORE INFORMATION

- National Institute of Neurological Disorders and Stroke www.ninds.nih.gov/disorders/deep_brain_stimulation

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To find this and previous JAMA Patient Pages, go to the Patient Page link on *JAMA*'s Web site at www.jama.com. Many are available in English and Spanish. A Patient Page on epilepsy surgery was published in the December 3, 2008, issue; one on epilepsy was published in the February 4, 2004, issue; and one on Parkinson disease was published in the January 21, 2004, issue.

Sources: National Institute of Neurological Disorders and Stroke at the National Institutes of Health

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