Perioperative Management of Deep Brain Stimulator (DBS) Devices including Surgery, MRI Scanning, and External Defibrillation

Anesthesia Guideline
University of Washington Medical Center
Department of Anesthesiology & Pain Medicine

Overview

The use of deep brain stimulators (DBS) for treatment of Parkinson’s Disease and other movement disorders was first introduced in 1972 and has greatly increased over the last 5 to 10 years. The DBS consists of a neurostimulator typically placed in the anterior chest wall (similar to pacemaker generators) with a thin coiled wire lead that is stereotactically placed in either the globus pallidus or subthalamic nucleus. The wire is tunneled subcutaneously from the head to the neurostimulator.

The DBS neurostimulator can be affected by or adversely affect medical equipment such as cardiac pacemakers or therapies, cardioverter/defibrillators, external defibrillators, ultrasonic equipment, electrocautery, MRI, lithotripsy, or radiation therapy.

Diathermy used in shortwave, microwave, or ultrasound devices for therapy for painful joints and muscles with “deep heat” treatment may cause permanent nerve or tissue damage in patients with a neurostimulation system even if the diathermy is set at power levels that do not cause deep heating. “Medtronic has received two case reports of patients implanted with deep brain stimulation systems who received shortwave therapy (diathermy), one following oral surgery, the other for treatment of chronic scoliosis. In both cases, the shortwave energy caused severe and permanent brain damage in the area of the lead electrodes implanted in the brain. Both patients remain in a comatose condition since receiving shortwave diathermy.”¹ This type of diathermy does not include electrocautery or ultrasonic imaging.

The neurostimulator can be reprogrammed by Medtronic representatives or physician (e.g., neurologist) programmers. It can also be turned off or on by magnets or a handheld device that are provided to patients.

Recommendations for Perioperative Management of DBS Devices

1) Have patient bring their remote controller for the DBS device which allows them to turn the device “on” and “off”.

2) Turn the DBS device “off” just after induction and before electrocautery is used. (When the DBS device is “on”, it may interfere with the ECG.)

3) Use bipolar cautery if possible, at the lowest effective power settings.
4) If not possible to use bipolar cautery, then place the grounding pad of the unipolar cautery as far away as possible from the neurostimulator device (typically found on the anterior chest wall) and leads. Make sure that the neurostimulator device and leads are not placed between the grounding pad and the surgical site.

5) Once electrocautery use has ceased, the DBS device may be turned back “on” prior to emergence. Failure to turn the DBS back “on” may result in return of severe Parkinson’s Disease symptoms such as hypoventilation, bradykinesia/akinesia, prolonged emergence, etc.

Recommendations for Management of DBS Devices in Patients Needing MRI

MRI can cause significant heating at the lead electrodes or at breaks in the lead. “Excessive heating may occur even if the lead and/or extension are the only part that is implanted. Excessive heating can result in serious and permanent injury including coma, paralysis, or death. MRI examinations of patients with DBS devices should only be done IF ABSOLUTELY NEEDED and then only if these guidelines are followed. (For detailed instructions refer to the Medtronic website). MRI should not be done if other potentially safer diagnostics tests such as CT scan, x-ray, ultrasound can provide adequate diagnostic information.

Patients with a DBS device should NOT be exposed to an MRI using a full body radiofrequency coil, a receive–only head coil or a head transmit coil that extends over the chest area.

Inform the patient of the risks of undergoing an MRI. Check if the patient has any other implants or conditions that may contraindicate an MRI examination.

1) Alert the radiology attending and technicians that the patient has a DBS device. Specific information for MRI scan settings and radiofrequency coils can be found under the subheading of MRI Operation Settings at

http://professional.medtronic.com/interventions/deep-brain-stimulation/overview/index.htm

This information was last updated in September 2010 and provides detailed precautions and information on performing the MRI.

2) Obtain remote controller for DBS device from patient or manufacturer representative and turn device “off”.

3) “Carefully weigh any decision to perform magnetic resonance imaging (MRI) examinations on patients who require the neurostimulator to control tremor. Image quality during MRI examinations may be reduced, because the tremor may return when the neurostimulator is turned off.”

4) “A responsible individual with expert knowledge about MRI, such as an MRI radiologist or MRI physicist, must assure all procedures in this guideline are followed and that the MRI scan parameters, especially RF specific absorption rate (SAR) and gradient dB/dt parameters, comply with the recommended settings, both for the pre-scan (tuning) and during the actual MRI examination.”

5) “MRI images may be severely distorted or image target areas can be completely blocked from view near the implanted DBS System components, especially near the neurostimulator. If the MRI targeted image area is near the neurostimulator, it may be necessary to move the neurostimulator to obtain an image, or use alternate imaging techniques. Do not remove the
neurostimulator and leave the lead system implanted as this can result in higher than expected lead heating."

6) “If possible, do not sedate the patient so that the patient can provide feedback of any problems during the examination.”

7) “Monitor the patient during the MRI examination. Verify that the patient is feeling normal and is responsive between each individual scan sequence of the MRI examination. Discontinue the MRI immediately if the patient becomes unresponsive to questions or experiences any heating, pain, shocking sensations/uncomfortable stimulation, or unusual sensations.”

8) After the MRI, switch the DBS device “on” and verify that it is functional. Reprogramming may be necessary.

**Recommendations for Management of DBS Devices in Patients Needing External Defibrillation**

External defibrillation can reprogram or damage a DBS neurostimulator. In animal studies, repeated defibrillation attempts with in situ cerebral stimulator electrodes did not cause acute histopathologic damage consistent with thermal injury in brain tissue adjacent to electrodes. However, the functionality of the neurostimulator ranged from normal to total loss of function.

1) Turn the DBS device “off” if time permits.

2) Place the paddles or pads as far away from the device as possible (minimum 2 inches), and oriented perpendicular (anterior - posterior) to the neurostimulator - lead system using the lowest effective energy setting possible.

3) Have the DBS device interrogated and reprogrammed after the procedure.

**Electroconvulsive Therapy (ECT)**

The safety of ECT in patients with a DBS system has not been established. Induced electrical currents may interfere with the intended stimulation or damage the neurostimulation system components resulting in loss of therapeutic effect, clinically significant undesirable stimulation effects, additional surgery for system explantation and replacement, or neurological injury.

**REFERENCES**


2. [http://professional.medtronic.com/interventions/deep-brain-stimulation/overview/index.htm](http://professional.medtronic.com/interventions/deep-brain-stimulation/overview/index.htm) under the section “MRI information”
