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The media buzz surrounding Deep Brain Stimulation (DBS) is exciting, but there are many questions and misconceptions about its use as a treatment for severe TS. Following are some of the most commonly asked questions about DBS.

What is Deep Brain Stimulation?

DBS is a relatively new procedure in which an electrode is used to alter the brain's circuitry. The electrode is implanted into a specific target area within the brain and a programmable pulse generator, or neurostimulator, is put under the skin — just below the collarbone for men and in the abdomen for women. An extension cable connects the neurostimulator to the electrode. The DBS electrode has four contact points (the sites through which electricity is delivered). The settings can be adjusted for different pulse widths (how long each pulse of stimulation lasts), frequencies (how many pulses are delivered each second), and amplitudes of stimulation (how much voltage is delivered).

Has the FDA approved DBS?

DBS has been approved by the FDA for Parkinson's disease, Essential Tremor, Dystonia and OCD. It is also being used on patients with TS who have not responded to standard medical or behavioral therapies.

Why would DBS help people with TS?

DBS has the potential to "neuromodulate" abnormal communications that occur deep within the brains of people with TS. So far researchers have probed several areas in the brain (centromedian thalamus, internal globus pallidus, external globus pallidus, and anterior limb of the internal capsule) and have had mixed success. The best target for "neuromodulation" has yet to be determined, however it does appear that DBS produces positive results for some patients.

Does DBS produce a miraculous change?

A popular misconception about DBS is that it is like a light switch and once it is turned on, there is a miraculous change in the patient's symptoms. This is not true. After the device has been activated many adjustments to the settings must be made over a period of months. With thousands of possible settings, this takes a great deal of time. Adjustments to medications are also part of this process. It is very important the patient and patient's family have realistic expectations about the outcome.

What kind of commitment is required of the patient?

DBS requires a significant commitment of time and motivation. Patients and their families must be prepared for the challenges associated with the pre-operative workup and with extensive follow-ups after. The average device may be reprogrammed 4–8 times during the first 6 months. This means the patient must return for multiple evaluations. Most experienced centers shy away from performing DBS in patients unless there is a spouse or a committed caregiver.

Who is a good candidate for DBS?

DBS is not for everyone. Careful selection of the patient will have a direct impact on the outcome. Despite the widespread use of DBS, there are no standardized criteria for determining good candidates. The evaluation should be done by a team of professionals experienced in TS and DBS including: a neurologist, a psychiatrist, a neurophysiologist and a neurosurgeon. Social workers, speech therapists and other specialists may also play an important role in this process. TSA has published recommendations for DBS in the journal, *Movement Disorders*. Some general considerations for patients and families are:

- The Yale Global Tic Severity Scale should be performed and

must reveal incapacitation with severe distress, self-injurious behavior, and/or quality of life disruption. OCD, depression and ADHD are not exclusionary, provided tics are the major difficulty requiring surgical intervention.

- The patient should be older than 25 years old. FDA guidelines and many studies exclude younger patients, but there may be exceptional cases where younger patients are considered acceptable candidates for DBS.
- The patient's symptoms have not responded to conventional therapies for tics. This includes treatment with at least three different classes of medications: an alpha-adrenergic agonist, dopamine antagonists (typical and atypical), and a benzodiazepine, as well as behavioral interventions.
- Patients must have received treatment for co-morbid and other medical, neurological and psychiatric disorders and be stable for the previous 6 months. This includes anxiety, depression and bi-polar disorder.
- If the patient has a tic that can be addressed with botulinum toxin (Botox), it should be considered before DBS.
- Patients must be screened for dementia or other cognitive dysfunctions, as these may have an impact on their ability to cooperate with the DBS process and the patient may be at risk for worsening of the cognitive problem.

What are the results of studies of DBS for TS?

The largest open label (non-randomized control study) of DBS for TS utilized a single brain target, the centromedian-parafascicular complex of the thalamus. The results were published in *The Journal of Neurology, Neurosurgery and Psychiatry*. The authors reported DBS significantly decreased motor tics in 18 patients, but the therapy was less effective for phonic tics and the therapy



was not as "promising" as the authors had hoped in addressing behavioral manifestations of TS. Other studies have focused on different parts of the brain, but the studies have been too small to be conclusive.

What are the complications?

DBS has both long and short-term "potential" complications. The device is a "foreign body" so infection is a primary worry. It can occur in 5% or more of patients. Another concern is that there will be bleeding or a stroke during the procedure. It is also possible that the device will fracture, migrate out of its position or malfunction, requiring another surgical procedure. DBS frequently affects speech, in particular verbal fluency. There can also be worsening of cognition or mood, and, in rare cases, suicidal thoughts. This is another reason for careful pre-screening and extensive follow-ups.

What is the future of DBS for TS?

Carefully controlled studies are needed for DBS to move forward as a viable therapy for severe TS. These studies should be undertaken by experienced multidisciplinary teams, be guided by experts in performing clinical trials and be evaluated by 'blinded' raters. Despite the positive results of some studies, we must learn from the failures of studies of DBS on other disorders and make serious early attempts to avoid them in TS.

More information about DBS is available on the TSA website at: <http://tsa-usa.org/news/DBSfall09.html>. ●