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Practice and Potential of Deep Brain Stimulation

PRACTICE AND POTENTIAL OF DEEP BRAIN STIMULATION

You are listening to ReachMD, the Channel for Medical Professionals. Welcome to Medical Breakthroughs from the University of Pennsylvania Health System with your host, Northwestern University Internist Dr. Lee Freedman. Known as the "pacemaker for the brain," deep brain stimulation has made noteworthy progress with Parkinson disease, so how exactly does it work and is there potential for patients with other disorders. Joining me today is Dr. Gordon Baltuch, Director of the Center for Functional and Restorative Neurosurgery at the University of Pennsylvania.

DR. LEE FREEDMAN:

Thank you so much for being with us Dr. Baltuch.

DR. GORDON BALTUCH:

Thank you for having me Dr. Freedman:

DR. LEE FREEDMAN:

Tell us a little bit about deep brain stimulation. It sounds every exotic. Exactly, what is this technique?

DR. GORDON BALTUCH:

Basically, deep brain stimulation is putting wires in people's brains and connecting those wires to pacemakers, basically running electricity into their brains and modulating different types of disease states by running that electricity into their brain. This is not particularly a new technology. It's been available since the 70s pretty much, but since the advance of some of the newer advances in imaging, we have been able to actually very, very accurately target specific parts of the brain with electrodes and attach them to those pacemakers.

DR. LEE FREEDMAN:

This is practically done through making holes in the skull I imagine and then attaching these wires to a pacemaker similar to a cardiac pacemaker.

DR. GORDON BALTUCH:

Exactly what we do is we put patient's head in frames and then this is done under IV sedation with a little bit of freezing and after that we go and we get imaging. After that imaging is done, we actually don't even shave any hair at all and we make very dime-sized holes in the skull, which we actually cover afterwards with little caps. So, it's really minimally invasive surgery.

DR. LEE FREEDMAN:

Very interesting, I imagine the imaging is MR imaging.

DR. GORDON BALTUCH:

It's MR and CT and it's often a combination of both. With fusion technology, you can get an MR a few weeks before the procedure and you can get a CT on the day of procedure and infuse both images.

DR. LEE FREEDMAN:

So, that's fascinating and we have heard about this being used for Parkinson disease. I imagine the wires are put into the thalamic areas for that.

DR. GORDON BALTUCH:

Yeah, the most classic target now for Parkinson disease is an area about the size of a Rice Krispy and it sits right under the thalamus and it's called the subthalamus and we put these wires right into those what we call these little Rice Krispies or the subthalamus and that tends to be now the most popular target to treat sort of the cardinal features of Parkinson disease, the slowness, the stiffness, the freezing, and the tremor of PD or Parkinson disease. Another target for Parkinson disease, which is used less, is globus pallidus internus. STN or subthalamic nucleus tends by far and way to be the most popular target for Parkinson disease and now in the past couple of years, there has been class I evidence, which has emerged, published in the New England Journal of Medicine, demonstrating that in certain groups of patients a surgical approach to the PD actually does better than best medical therapy.

DR. LEE FREEDMAN:

That's very interesting and it sounds like we are getting very deep into the brain, that these wires are innocuous enough to surrounding tissue that there aren't a lot of side effects.

DR. GORDON BALTUCH:

A very interesting question. Yes, it's brain surgery, bad things can happen in brain injury. You can have, you know, bad complications. We reduce that complication rate to make it very low. I think the chance of stroke, which is I think the worse complication, is about 1% to 2%. Certainly, you could die from a stroke, but that's a very, very rare. It's unusual to have neurological complications from this procedure when done well and this is not an ablative procedure per se. However, it still is brain surgery and you can have neurological side effects from the procedure, which are often transient and then go away and often from programming because as you just said, this is deep in the brain, it's close to a lot of very vital structures which do a lot of things in the nervous system and by stimulating either too high or in the wrong direction, you can potentially have adverse effects.

DR. LEE FREEDMAN:

That makes good sense that those will be potential risks. This is medication therapy ever combined along with deep brain stimulation for Parkinson's.

DR. GORDON BALTUCH:

Absolutely, the success of a deep brain stimulation program is multifactorial and a strong movement disorder neurologist is essential to that multidisciplinary sort of success. The neurologist has to choose the right patient for this procedure to begin with and then after the procedure is done, the neurologist is very intimally involved with programming the stimulators and adjusting medications with those stimulators in place. Adjusting medications in Parkinson patients can be very complex because there are a whole series of different medications to choose from and the combinations of those medications is individualized and I think it's both an art and a science. By the same token, the manipulation of those medications in the post deep brain stimulation patient is really its own art.

DR. LEE FREEDMAN:

So, definitely we need a neurologist who has experience and who is very familiar with all the intricacies of the different medications and then it becomes a whole another type of picture once the deep brain stimulation is one of the therapeutic arms of treatment.

DR. GORDON BALTUCH:

Absolutely, I think the components are good selection of the patient, putting the lead in the right place, good management of the medication, and the programing postoperatively and other components are things like rehab. I think it's important to keep the patient moving and doing things and I think that's another important component.

DR. LEE FREEDMAN:

And is this technology widely available or only in specialist centers at this point?

DR. GORDON BALTUCH:

This technology now has been approved for I think about 5 or 6 years exactly approved in the country and I think most major University Medical Centers in the United States are starting to offer deep brain stimulation. You know, originally it was only a few places, but I think

it started to get much more a widespread acceptance in the last few years and not only academic centers, but I think there are actually people up in practice now who have really picked it up showing that there really is adoption and acceptance in the community of this procedure.

DR. LEE FREEDMAN:

If you have just tuned in, you are listening to Medical Breakthroughs from University of Pennsylvania Health System on ReachMD, the Channel for Medical Professionals. I am you host Dr. Lee Freedman and we are discussing deep brain stimulation with Dr. Gordon Baltuch of the University of Pennsylvania Health System.

Dr. Baltuch, this sounds very exciting for Parkinson's. Where else can this take us, are there other disorders that have been looked at?

DR. GORDON BALTUCH:

Definitely have. There are other groups of neurologists who have looked at this and said well how can we use this technology to treat our disease stage that we look at. The first group really was the epileptologist. There is a long history of doing deep brain stimulation procedures. Most of the results have been out at places like Mexico and Canada. There have been things out of the United States, but not a lot, but there are targets for epilepsy that you can use deep brain stimulation for. Now, the mechanisms are very different, as the circuits are very different in epilepsy than they are in a movement disorder, but a major trial was launched and has just been finished targeting the anterior thalamic nucleus for medically intractable seizures and we are hoping to see the results of this randomized trail should be presented in December at the American Epilepsy Society meeting. I think probably more than 100 patients were treated and there was randomization, so in this randomization some people were turned on and some people thought they were being turned on, but they weren't being turned on. That was a 50/50 randomization and then they studied their seizure severity and frequency. So, it's going to be very exciting to see if deep brain stimulation can work for epilepsy and these are people in whom nothing else works. Many of them have had either surgery, i.e. resective surgery of their brain or they weren't candidates for any form of surgery. We are really looking forward to see what the results of this are going to be and it's quite exciting.

DR. LEE FREEDMAN:

Can we feed some wires into the limbic areas and look at mood disorders?

DR. GORDON BALTUCH:

Yeah, I mean this has been a very, very hot area. They have been doing it for obsessive-compulsive disorder and with some very, very interesting results and a couple of years ago, the Toronto group published a series of patients on who they stimulated subgenual cingulate, which is associated with limbic projections and they were able to treat a group of people with bad depression. There have been other targets for depression as well. The Brown and Cleveland Clinic group have looked at the area of sort of the subcaudate area or the anterior capsular area, also known as VC or nucleus accumbens region for treatment-resistant depression and also have been publishing some very, very interesting pilot results and I think the next step is to move towards what we would see as probably a phase 2 trial with some randomization to see if severe depression can be treated with stimulation. Now, this represents a form of psychosurgery. It's very different from things like ablative operations. As we said before, deep brain stimulation is reversible. We are not injuring the brain with the stimulation, we are doing modulation, but it does represent a form of psychosurgery and it has to be handled very carefully.

DR. LEE FREEDMAN:

The potential certainly sounds exciting, particularly for refractory cases. You were mentioning obesity at certainly the cannabinoids and then Meridia target areas in the brain. Tell me about that, that's such an important problem.

DR. GORDON BALTUCH:

I mean, obesity as you know is a huge health problem and bariatric surgery is an answer to some patients, but there are also patients who fail bariatric surgery and it has a complication rate associated, so there have been some targets. One of those targets is in the hypothalamus that has been investigated in Canada and another potential target again is the nucleus accumbens for obesity. Now, these targets are different. When we discussed a hypothalamic target, we are talking about sort of appetite control. When we discuss nucleus accumbens, we are talking about reward systems, the desire to eat different from appetite itself. One of the issues with the hypothalamus is you have deep brain stimulation in the hypothalamus. You may not be hungry, but you may want to eat and subsequently you may just turn off your stimulators, so you can eat. Accumbens is a step back and tentatively you could say this would get right to the reward that is associated with ingesting high-fat foods. So, it is a tentative target. Hasn't yet been tried because it's a similar target to what you would do to perform for depression. I don't think it's yet been tried for obesity, but do I think it is a potential target, I definitely think it is. There have been some very interesting results coming out of Asia on targeting this area for things like addiction with some very interesting pilot results. Case series and N numbers are very, very low, but very interesting. There was another case that was also published in Germany last year in which they targeted this area for obsessive-compulsive disorder and the patient also had alcoholism, which was essentially eliminated by stimulating in this area. So, really a brave new world.

DR. LEE FREEDMAN:

As you look ahead are there any things on the horizon that you're particularly excited about.

DR. GORDON BALTUCH:

The other really exciting thing is that when they stimulate it, some of these patients in their hypothalamus, they were able to improve their memory and they postulate that they are stimulating into a forniceal systems and they offer the possibility that they could offer memory enhancement and now they have gone ahead in Toronto and they are doing a small series of patients with Alzheimer disease to see if by using forniceal stimulation they can actually improve memory, so we are talking about stimulation to make you thinner, happier, smarter, all types of things. However, we also have to be careful because the circuitry of some of these conditions that we are discussing is much less well understood than movement disorder circuitry.

DR. LEE FREEDMAN:

Well, I would like to thank my guest, Dr. Gordon Baltuch, Director of the Center for Functional and Restorative Neurosurgery at the University of Pennsylvania. This is Dr. Lee Freedman. Thank you for listening.

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