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Deep Brain Stimulation for Essential Tremor Refractory to Thalamotomy

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INTRODUCTION

Deep Brain Stimulation (DBS) is an accepted treatment for many psychiatric and neurologic disorders, including essential tremor. The procedure has some distinct advantages over traditional surgical ablative procedures such as thalamotomy and pallidotomy in that it is adjustable, reversible, and no tissue is destroyed in the process. The implanted device consists of three components: 1) intracranial electrodes, 2) a single or dual chamber programmable internal pulse generator (IPG) with battery, and 3) an extension cable that connects the two. The implantation procedure itself is staged with the first portion, "awake brain surgery," involving placement of the electrodes in the target area of the brain and subcutaneous tunneling of the extension cable from the electrodes to the site of the IPG. The second stage, usually a separate procedure from the first, involves implanting the IPG device into the infraclavicular area.[1]

CASE DESCRIPTION

A 59-year-old right-handed woman with a history of type II diabetes mellitus, bronchitis and essential upper extremity tremors that started when she was a teenager. She stated that the tremors interfered with her ability to perform her activities of daily living, including drinking fluids without spilling, and writing. She denied head or voice tremor. She tried multiple medications with very minimal effect. She also tried a left thalamotomy but reported that she did not have any benefit of her right upper extremity. So she presented for DBS. Patient was anesthetized with dexmedetomidine bolus and continuous infusion (0.2-0.5mcg/kg/hr), propofol (30-80mcg/kg/min) and remifentanil (0.01-0.03mcg/kg/min) infusions which were titrated to effect before incision and weaned off prior to anticipated wake-up. While awake, patient was asked to complete tasks as microelectrodes stimulated the ventral intermediate thalamus of the nucleus bilaterally and tremor response was observed. Patient remained awake for about 1.5 hrs for correct positioning after which infusions were restarted, patient went back to sleep and electrodes were fixed into place.

DISCUSSION

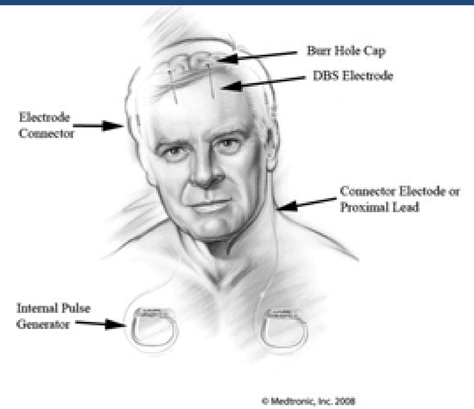
Anesthesia for DBS is a challenge as a balance must be struck between analgesia and preventing interference with brain mapping and testing, all while preventing respiratory depression. The ideal agents should not interfere with microelectrode recording and testing and should have either no effect or an easily reversible effect on subcortical neuronal activity. While the surgery can be accomplished with either MAC or general anesthesia, MAC is preferred and offers a few advantages over general. MAC allows clinical symptoms like tremors to be evaluated during surgery as certain brain structures are stimulated by the electrodes. MAC also allows better control of patient hemodynamics which is important since hypertension leading to intracerebral hemorrhage is a potential complication of the procedure. Benzodiazepines and high-dose opioids interfere with microelectrode recording during stimulation testing, as subcortical areas are sensitive to GABA medications. Short-acting opioids, however, have little effect on microelectrode recording.[2]
During our case, we employed a combination of dexmedetomidine, propofol and remifentanil as these drugs allow for appropriate sedation, analgesia and blood pressure control but are easily titratable to prevent respiratory depression. Propofol and remifentanil can be run early during placement of stereotactic head frame and stopped well before the macrostimulation phase of surgery, given that they are short-acting, while dexmedetomidine can be kept running as the patient is woken up since it has no effect on microelectrode recording.[3]

Indications for DBS

Neurologic
- Parkinson's Disease
- Essential Tremor
- Dystonia
- Epilepsy
- Tourette's syndrome

Psychiatric
- Obsessive Compulsive Disorder
- Depression
- Anorexia nervosa
- Addictive disorder

Agents	Advantages	Disadvantages
Benzodiazepines	Anxiolysis	Abolishes Microelectrode Recording (MER)
Propofol	Short acting, predictable emergence profile	Abolishes tremors, attenuates MER
Fentanyl	? Minimal effect on MER	Rigidity
Remifentanil	Short acting	suppresses tremors
Dexmedetomidine	Less effect on MER, Anxiolysis/analgesia Preserved respiration Favorable hemodynamic profile	High doses abolish MER Hypotension, bradycardia



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CONCLUSION

Anesthesia for DBS presents a challenge for anesthesiologists as patients must be appropriately sedated to comfortably undergo placement of intracranial electrodes but must also be easy to arouse for the macrostimulation phase of said electrodes so that they can be appropriately placed for treatment. Short-acting opioids like remifentanyl and the alpha-2 adrenergic agonist dexmedetomidine are good choices as neither will affect microelectrode recording. Propofol can also be used for portions of the procedure but should be appropriately timed to stop before the macrostimulation phase.

REFERENCES

1. Venkatraghavan L, Luciano M, Manninen P. Review article: anesthetic management of patients undergoing deep brain stimulator insertion. Anesth Analg. 2010 Apr1; 110(4):1138-45.
2. Lionel J. Velly, M.D., Marc F. Rey, M.D., Ph.D., Nicolas J. Bruder, M.D., François A. Gouvitsos, M.D., Tatiana Witjas, M.D., Jean Marie Regis, M.D., Jean Claude Peragut, M.D., François M. Gouin, M.D.; Differential Dynamic of Action on Cortical and Subcortical Structures of Anesthetic Agents during Induction of Anesthesia. Anesthes 2007;107(2):202-212.
3. Chakrabarti R, Ghazanwy M, Tewari A. Anesthetic Challenges for Deep Brain Stimulation: A Systematic Approach. North American Journal of Medical Sciences. 2014;6(8):359-369. doi:10.4103/1947-2714.139281.