Patients' Perioperative Experience of Awake Deep-Brain Stimulation for Parkinson Disease

Eoin Mulroy[1], Nigel Robertson[2], Lorraine Macdonald[1], Arnold Bok[3], Mark Simpson[1]

BACKGROUND: **Awake craniotomy for tumor resection and epilepsy surgery is a well-tolerated procedure. Qualitative data on patients' experience of awake deep-brain stimulation (DBS) are, however, lacking. We collected qualitative data on patients' experience of awake DBS with a view to identifying areas for improvement.**

METHODS: **Forty-one patients undergoing DBS for Parkinson disease between 2009 and 2015 were surveyed with a structured questionnaire designed to receive patient feedback regarding perioperative management of the awake stage of the procedure.**

RESULTS: **More than 90% of patients felt well-informed. Most remembered the procedure, and almost all were happy that they did. One half of the patients experienced pain, often significant, during the procedure. This mainly occurred during burr-hole drilling and stereotactic frame placement.**

CONCLUSIONS: **Although awake DBS is well-tolerated, pain and off-period symptoms are an issue for a significant number of patients. Efforts should be made to minimize these unpleasant aspects of awake DBS.**

INTRODUCTION

Since its first use in 1987 by French neurosurgeon Alim Benabid,[1] deep-brain stimulation (DBS) has revolutionized the care of patients with Parkinson disease (PD) and other movement disorders. More than 100,000 procedures have been performed worldwide, and DBS is now an accepted treatment not only for PD and other movement disorders (such as dystonia and essential tremor) but also has a role in the treatment of epilepsy, obsessive-compulsive disorder, and Tourette syndrome.[2]

The DBS procedure involves a number of steps. First, preoperative anatomic localization of target structures is performed, generally with magnetic resonance brain scanning. Intraoperatively, stimulating electrodes are stereotactically implanted through burr holes created in the skull and guided into position under image guidance. Correct placement in the target nucleus is assisted by intraoperative microelectrode recordings (MERs).[3] Intraoperative macrostimulatation can also be performed to assess benefit and threshold for side effects.

The procedure can be carried out either with local anesthesia (with or without sedation) or with the patient under general anesthesia. Neither method has been proven superior, but awake procedures offer a number of advantages, including the ability to use MERs for accurate electrode placement, to macrostimulate, and to avoid general anesthesia and its potential complications. Length of hospital stay and health care resource use also may be reduced by opting for the awake procedure.[4]

Anesthetic management during awake DBS procedures aims to maintain subjects in a cooperative and comfortable state but is challenging in that many sedative and anesthesia drugs alter the firing characteristics of target nuclei. In our institution, we use dexmedetomidine, a nonamnestic highly selective alpha 2 adrenergic agonist drug, which provides sedation, anxiolysis, and a degree of central analgesia while resulting in minimal respiratory depression. In addition, dexmedetomidine has little effect on the firing characteristics of the subthalamic nucleus (STN), especially if stopped shortly before MERs are carried out.[5-8]

Patients' experience of awake craniotomy for tumor resection and epilepsy surgery is a well-studied area. These awake

Key words
- Anesthesia
- Local
- Conscious sedation
- Craniotomy
- Deep brain stimulation
- Parkinson disease

Abbreviations and Acronyms
DBS: Deep-brain stimulation
MER: Microelectrode recording
PD: Parkinson disease
STN: Subthalamic nucleus

From the Departments of [1]Neurology, [2]Anesthesia, and [3]Neurosurgery, Auckland City Hospital, Auckland, New Zealand

To whom correspondence should be addressed: Eoin Mulroy, M.B., B.Ch., B.A.O. [E-mail: EoinM@adhb.govt.nz]

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neurosurgical interventions are generally well tolerated, especially if the procedure is thoroughly explained to the patient pre- and intraoperatively.[9,10] Qualitative data on patients' experience of awake DBS procedures are, however, lacking. Our study aimed to collect qualitative data relating to the patient's experience of awake DBS with a view to identifying areas for improvement in the patient's journey through the perioperative period.

MATERIALS AND METHODS

Forty-one patients underwent awake STN DBS for PD under local anesthesia and conscious sedation at Auckland City Hospital, New Zealand, between 2009 and 2015. All underwent a 2-stage procedure, the first stage consisting of stereotactic electrode implantation with both intraoperative image guidance, MERs from the target nucleus, and macrostimulation of the target area. During this stage, patients were awake but sedated with dexmedetomidine. The second stage, performed some weeks later, involved tunneling of the DBS electrodes under the skin and their attachment to a pulse generator implanted in the infraclavicular area. This was performed with the patient under general anesthesia.

Preoperative counseling consisted of an initial 90-minute consultation with a neurologist, where the patient's suitability for DBS was assessed and the surgery was explained. Questions and concerns were further addressed during preoperative neuropsychological, psychiatric, and neurosurgical consultations. Subsequently, our movement disorder nurse specialist re-explained the awake procedure to the patient, and they were shown a slideshow of a typical procedure and given another opportunity to ask questions. All patients received a written guide explaining the procedure, its risks, expected side effects, and a list of frequently asked questions. Our movement disorder nurse specialist remained available by phone to provide further information up until the time of surgery, and she reviewed the patients and allayed any remaining concerns immediately preoperatively. The anesthesia team usually met the patient on the day before the procedure, providing information and a chance for discussion before finalizing the consent for anesthesia care.

For the first stage of the procedure, a dexmedetomidine infusion was commenced before stereotactic frame placement, administered as a slow loading dose (0.7 μg/kg over 30 minutes) followed by a 0.2–0.5 μg/kg/h infusion, titrated to maintain patient response to voice. Remifentanil, a potent ultrashort-acting opioid, was used to supplement the local analgesia during pin placement by infusion at 0.05 μg/kg/min.

Frame placement and surgery were either completed under local infiltration anesthesia using 0.5% bupivacaine with adrenaline 1:200,000, or with the addition of scalp block performed by the attending anesthetist. Scalp block involved anatomical placement of local anesthetic adjacent to 5 peripheral branches of the trigeminal nerve, superficial cervical plexus, and posterior primary ramus of C2 on both sides, using an aseptic technique and ropivacaine 0.75%.

A short burst of subsedation, target-controlled infusion of propofol (a potent, short-acting intravenous hypnotic drug) was used to provide amnesia during burr-hole formation. Propofol was administered by a target controlled infusion pump to an effect-site concentration of 0.5 μg/mL for approximately 10 minutes, a dose that was unlikely to influence MER.

In 2015, after we received ethical approval from local authorities, a questionnaire was designed to retrospectively receive patient feedback regarding perioperative management during their DBS first stage procedure (**Supplementary Table 1**). All 41 patients were either contacted directly by telephone, e-mailed the survey via SurveyMonkey (https://www.surveymonkey.com/), or completed the survey by hand in the clinic. Telephone and manual surveys were entered directly into the SurveyMonkey database. A total of 27 of 41 (65%) patients completed the survey. Median time from DBS surgery to survey completion was 2 years. Questions were designed to assess 2 main areas of pre- and perioperative DBS care, namely 1) the delivery, quality, and utility of preoperative counseling and 2) intraoperative experiences. At the end of the survey, patients were given the opportunity to provide unstructured self-directed feedback.

RESULTS

The first part of the questionnaire asked about preoperative counseling of patients for the procedure. Overwhelmingly (>90% of cases), patients felt well-informed. More than 95% of patients felt they had a chance to ask questions about local anesthesia and sedation for the procedure and all felt their questions were adequately answered by the anesthetic team. Only 4% of patients reported feeling "very anxious and fearful" on the day of the procedure; a further 63% felt "a bit nervous but OK," and one third felt "excited and motivated." Two thirds of patients remembered "most of the operation," and almost 90% felt happy that they did.

Roughly one half the patients reported experiencing pain during the procedure (severe in 40%), mostly during burr hole drilling but also during local anesthetic infiltration into the scalp and placement of the stereotactic frame. Stereotactic frame placement and burr hole drilling were the most unpleasant parts of the procedure, with 11 of 23 patients (48%) commenting particularly on this part of the operation. Two patients reported significant discomfort during macrostimulation. Postoperative pain was an issue only in a minority of patients (19%). When asked what could be improved, suggestions included extra sedation at the time of burr-hole insertion, extra scalp analgesia, particularly towards the end of the procedure, and urinary catheter placement for the duration of the procedure.

DISCUSSION

Although studies have examined patient experiences of awake craniotomy, our qualitative study of patient experiences during awake DBS is the first of its kind. Despite the poor amnestic effect from dexmedetomidine,[11] most patients welcomed being part of the operation, and almost 90% reported that they were happy they remembered the experience. As one patient put it: "Dare I say it was an enjoyable experience?" This is similar to published data on awake craniotomy, which also is generally well tolerated from a patient perspective.[9,10] Patients appeared satisfied with preoperative information provided, with 7% reporting that they would have liked more information.