CASE REPORT

Perioperative hypertensive response in a patient with implanted deep brain stimulation device: a case report

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Abstract

This case report features unique anaesthetic management of a patient with implanted deep brain stimulation (DBS) device undergoing abdominal surgery. It features the intraoperative measures taken for this patient for the implanted DBS. After turning off the DBS preoperatively, the patient showed an exaggerated sympathetic response which was very much resistant to medicines. It was unique to this patient that restarting the device alleviated refractory hypertension. The report also includes review of literature for anaesthetic management of patients with implanted DBS.

Keywords: Deep brain stimulation, Dystonia, Hypertension, Hysterectomy.

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Introduction

Hypoxic-ischaemic injury is the most common cause of acquired dystonia in adults.[1] For medically resistant focal and generalised dystonia, deep brain stimulation (DBS) is considered the treatment of choice.[2] However, in addition to motor symptoms, literature has shown its effect on non-motor symptoms as well.[3] There is very scarce data regarding anaesthetic management of patients with DBS implants. We report a patient with intraoperative refractory hypertension despite administration of anaesthetic, analgesics, and multiple antihypertensive medications. The patient became normotensive when her DBS device was switched on. Thermal damage to DBS and interaction with intraoperative monitoring has been reported but the impact of DBS on perioperative non-motor symptoms is still a matter of concern.[4]

Case Report

A 40-year-old female presented with Criggler-Najjar Syndrome Type-II. She had a history of hypoxic cardiac arrest 18 years back secondary to eclamptic fits and was bedridden since then. Later, she developed dystonia of the face, neck, and bilateral upper limbs. She underwent DBS insertion in India five years back. The dystonia was markedly improved after the DBS device (Medtronic). On examination, sustained contraction of bilateral upper limbs was observed with abnormal posturing. The speech was limited, perseverant, and stammering. Drug history comprised Tetrabenazine, Divalproex sodium, Clonazepam, Baclofen, Trihexyphenidyl, and iron supplements.

She was planned for total abdominal hysterectomy and bilateral salphingo-oophorectomy due to uterine fibroids at Aga Khan University Hospital, Karachi on May 2022. She visited the preoperative clinic where the neurology team was taken on board for DBS device adjustment. Her biochemical investigations were normal except for the liver function test which showed total bilirubin of 13.9 mg/dl with predominant indirect bilirubin 12.6 mg/dl and elevated SGPT of 114 IU/L. Chest X-ray showed DBS neurostimulator (Figure).

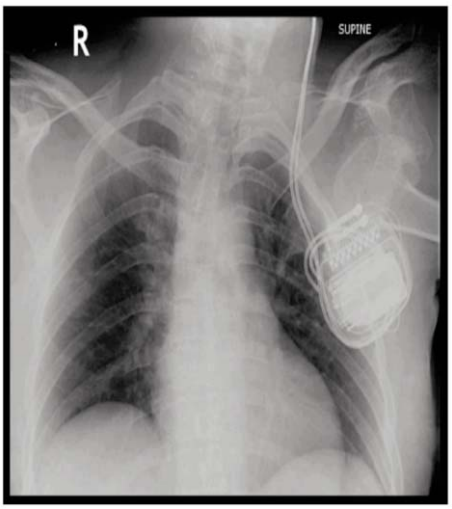

Figure: Preoperative chest X-ray showing the implantable pulse generator with its leads going to the head.

On the day of surgery, the neurology team turned off the DBS in the preoperative area. The preoperative vitals were

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normal with heart rate 84/min and blood pressure 135/80mmHg. The patient was taken to the operating room. In addition to standard monitoring, entropy was also applied. All pressure points were secured. Anaesthesia was induced with Etomidate 16mg, fentanyl 100 microgram, and Atracurium 30 mg. Transversus abdominis plane block was performed with 0.25% Ropivacaine, 15 ml on each side. Anaesthesia was maintained with Isoflurane, 60: 40 mixtures of nitrous oxide and oxygen. The depth of anaesthesia was guided by entropy, the target values were kept between 45-60. The surgeon was requested to use bipolar cautery. No haemodynamic disturbance was observed on surgical stimulus. After 15-20 minutes her blood pressures started to rise i.e. 180/110 mmHg. Due to the possibility of inadequate analgesia or insufficient relaxation, Fentanyl 50 micrograms bolus and Atracurium 10mg were repeated. Entropy monitoring showed an adequate depth of anaesthesia, still her blood pressure did not settle. Analgesia was further supplemented with Morphine 6mg, but she remained hypertensive. Later, this refractory hypertension was managed with Metoprolol 4mg, Hydralazine 15mg bolus followed by Glyceryl Trinitrate infusion (GTN) at 1.5-3 mics/kg/min throughout the intraoperative period.

The duration of surgery was 2.5 hours, and the blood loss was 500ml which was replaced initially with crystalloid followed by one unit of packed red blood cell. After the conclusion of the surgical procedure, Neostigmine/Glycopyrrolate was used for the reversal of neuromuscular blockade and endotracheal tube was extubated. GTN infusion was continued in the post anaesthesia care unit (PACU) as well. In PACU, the DBS device was switched 'on'. Consequently, her blood pressure started to normalise, and eventually GTN infusion was stopped. The patient remained haemodynamically stable after that without any anti-hypertensive medicine and was discharged after four days.

Informed consent was taken from the patient for publishing her case before she was discharged from the hospital.

Discussion

Deep brain stimulation involves using a pacemaker-like device to deliver constant electrical stimulation within the brain. The mechanism of action of DBS remains multimodal but the commonly accepted hypothesis is that it dissociates input and output signals in the targetted area and disrupts abnormal information flow.[5] DBS has a significant impact on non-motor symptoms, e.g. autonomic function, pain, alteration of mood, sleep, micturition, and gastrointestinal effects.

In this case the DBS device was turned off preoperatively to avoid interference with the electrocardiogram. In addition, by turning off the DBS, accidental burn and malfunctioning of the device due to the use of electrocautery can also be prevented. The surgical team was advised to use bipolar electrocautery instead of unipolar because bipolar electrocautery reduces electromagnetic interference. That's why the use of bipolar electrocautery is considered safe.[6]

We were unable to identify the cause of hypertension. Intraoperatively, pain was ruled out by supplementing analgesia with Morphine, inadequate depth of anaesthesia with Entropy, and inadequate relaxation with an additional dose of muscle relaxant. Although the patient did not give a history of hypertension, her intraoperative course does depict exaggerated arterial vasoconstriction.

Along with pharmacological treatment, there are surgical therapeutics for the treatment of hypertension which include renal denervation, chronic carotid baroreflex stimulation, and deep brain stimulation.[7] DBS has an established role in the treatment of refractory hypertension by targetting the ventral periaqueductal grey region. Erin L. O'Callaghan et al reported a 54-year-old female whose blood pressure was uncontrolled despite eight antihypertensive medications, baroreflex activation therapy, and bilateral renal nerve ablation. After DBS implantation in the periventricular grey region, her blood pressure was significantly improved.[8] In our opinion, we encountered a hypertensive patient whose blood pressure was controlled with DBS. Intraoperative hypertension was an unexpected experience that occurred probably by turning off the DBS device.

DBS has a substantial role in chronic pain management. However, literature has not shown its role in acute pain treatment. N. K. Patel et al reported a case of a 55-year-old male who underwent DBS insertion in the periaqueductal grey/ periventricular grey region for treatment of central pain syndrome. They observed that DBS-induced analgesia was of limited duration, but the antihypertensive response was persistent.[9] Our patient suffered from brain hypoxia after which she developed muscle spasms and contractures of the upper limb which may have led to chronic pain. So, the turning off the DBS device preoperatively might have aggravated the chronic pain as well leading to raised blood pressure. The response expected from a DBS device depends on the target location that's being stimulated and the type of

signals (excitatory vs inhibitory). Little was known about the patient's DBS surgery due to the unavailability of records; we were unaware of the area that was being targeted.

Based on this case, it is recommended that DBS should be turned on after the surgical procedure and before reversal from anaesthesia to avoid postoperative complications. Tze Yeng Yeoh et al also suggested turning the device on before reversal of anaesthesia.[4]

Conclusion

As medical treatment evolves, anaesthesiologists face new challenges. In order to prevent intraoperative device malfunctions, we took all necessary precautions. Nonetheless, the intraoperative non-motor response was unexpected and managed with antihypertensives. We recommend that an anaesthesiologist or neurophysician should also contact the manufacturers or device representatives to obtain relevant information. We believe that information regarding DBS and associated concerns, especially under anaesthesia, is still in an evolving stage.

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