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Case report

Dexmedetomidine for deep brain stimulator placement in a child with primary generalized dystonia: case report and literature review

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Abstract Dexmedetomidine, which is a relatively selective alpha2-adrenoceptor agonist, is used for sedation and analgesia in intensive care unit patients, during awake craniotomies in pediatric and adult patients, and during magnetic resonance imaging, with minimal depression of respiratory function. The successful use of dexmedetomidine in a pediatric patient undergoing bilateral deep brain stimulator placement for the treatment of generalized dystonia, is presented.

1. Introduction

Asleep-awake-asleep anesthesia is particularly challenging in children. One reason is the higher incidence of laryngospasm in this age group [1] in a setting where the airway is unprotected. A second factor is the patient's immature psychological and cognitive condition, which may lead not only to fear or panic in the neurosurgical operating room (OR), but also to uncontrolled patient movement with potential surgical injury and dislodgment of life support devices. This situation is further complicated during deep brain stimulation (DBS) surgery, as the patient's cooperation is required for neurophysiological mapping so as to position accurately the brain stimulating electrodes.

Choosing the optimal sedative should be based on the ability to achieve adequate sedation and minimal disturbance

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of respiratory and cardiovascular homeostasis. At the same time, sedative agents must not affect the neuronal recordings used during brain mapping for accurate stimulator placement. Dexmedetomidine hydrochloride is a relatively selective alpha2-adrenoceptor agonist with sedative, analgesic, amnestic, and anesthetic-sparing properties. Minimal respiratory depression and easy reversibility from sedation to responsiveness makes dexmedetomidine a commonly used drug for "asleep-awake-asleep" anesthesia, especially for neurosurgical procedures performed near eloquent areas of the brain and for placement of DBS.

The successful use of dexmedetomidine during bilateral globus pallidus internus (GPI) mapping and DBS placement in an 8-year-old patient for the treatment of generalized dystonia is presented.

2. Case report

An 8-year-old, 24.6 kg, 120 cm child developed primary generalized dystonia at age two. He developed hypertonicity in both the upper and lower limbs, which led to spastic contractures that restricted voluntary movement of the upper extremities and ambulation. Pharmacologic treatment with levodopa, baclofen, and trihexyphenidyl did not produce functional improvement. His preoperative neuropsychiatric assessment showed average intellectual development, memory, and no mood disorders. He had a high degree of understanding of the surgical procedure to be performed.

Placement of bilateral GPI DBS was planned to improve our patient's dystonia. Placement of right and left DBS leads was staged one side at a time, with a 6-week interval, followed by placement of two implantable pulse generators (IPGs).

During the first DBS placement, the patient was premedicated with 10 mg of oral midazolam; standard ASA monitors were then attached. Sevoflurane inhalation induction, intravenous (IV) catheter placement, and tracheal intubation occurred prior to head pinning for frame placement. The anesthetized patient next underwent magnetic resonance imaging (MRI) and computed axial tomographic (CAT) scans of his brain to assist with accurate DBS placement. A propofol infusion of 200 μg/kg/hr was used for maintenance of anesthesia during transport to the radiology suite and scanning. No opioids were administered until successful DBS placement was achieved so as to allow for his neurological assessment.

After head MRI and CAT scanning, the patient was transported to the OR, where propofol was discontinued and the trachea was extubated. Oxygen by nasal cannula was started and capnographic monitoring continued. The patient's head frame was attached to the OR table in preparation for burr hole placement and DBS insertion. The propofol infusion was restarted at 200 μg/kg/hr, and the neurosurgeon injected local anesthesia into the surgical area prior to incision. Once the burr hole was performed, propofol was discontinued to allow for neurophysiologic assessment. When the child awoke, he started to cry. To decrease his anxiety, we tried to reassure him about the surgical procedure. Additional local anesthesia was given by the surgeon to improve analgesia; however, neither intervention calmed him down. Dexmedetomidine was then started. A bolus of one mcg/kg over 30 minutes, followed by a maintenance infusion of 0.7 mcg/kg/hr, gradually made him more cooperative and calm. His respiratory rate was 14 to 20 breaths per minute, oxygen saturation (SpO_2) was 100% on 4 liters of oxygen by nasal cannula, systolic blood pressure (SBP) values remained at 90 to 100 mmHg, and heart rate was 70 to 90 beats per minute.

The dexmedetomidine infusion was delivered for 7 hours and 30 minutes without side effects, achieving successful sedation and analgesia. Neurologic assessment, which consisted of micro-electrode recording (MER) for physiological targeting, was unaffected by the dexmedetomidine. The patient was given motor tasks to assess the movement-related driving of the GPI neurons. Visual evoked potentials and stimulation near the optic tract were performed to ensure proper electrode placement. The patient was asked about sensory changes and was monitored for muscle twitching. Once the dexmedetomidine infusion was discontinued, its sedative effect continued while the patient was in the recovery room but it did not affect his neurological assessment, which remained unchanged. As expected, the procedure lasted 11 hours and 30 minutes. Six weeks later, our patient underwent DBS placement on the contralateral side. The same anesthetic technique was used, but this time dexmedetomidine was started earlier and continued with a maintenance infusion during the awake phase, again without complications. The child started to show improvement as soon as two weeks after surgery. At his 6-month follow-up visit, he could stand straight with support and walk.

3. Discussion

The treatment of dystonia today remains palliative. Deep brain stimulation is a good alternative when minimal improvement to medical therapy (anticholinergics, baclofen, benzodiazepines, muscular injections of botulinum toxin) occurs or when compared with lesioning of subcortical nuclei [2].

Despite neuropsychiatric evaluation and communication with the patient and the patient's family, we could not predict our patient's emotional breakdown. Talking, consoling, and explaining to him how important it was to avoid movement did not help. It was only after the start of the dexmedetomidine infusion that he gradually calmed down.

Dexmedetomidine is an α2-adrenoreceptor agonist with a differential specificity for the α2/α1 receptor of 1620/1 [3]. It binds the α2 adrenoceptor subtypes α2A, α2B, and α2C.