Is Dexmedetomidine the Answer to Neonatal Anesthesia?

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Introduction

Studies have demonstrated the neurotoxic effects of many commonly used anesthetic agents to the immature brain in animal models; the question remains as to how this translates to the pediatric population. Dexmedetomidine is a sedative medication that does not seem to have potential neurotoxic effects in the developing brain. We present the case of a neonate who underwent two different anesthetics in the interventional radiology (IR) suite with dexmedetomidine as the primary sedative.

Case Description

- Our patient is a full-term neonate presenting with a history of congenital bilateral hydroureteronephrosis, CKD secondary to posterior urethral valves, HTN and anemia.
- Given his age, high likelihood of undergoing multiple anesthetics for future procedures, and history of laryngomalacia, we formulated a safe anesthetic plan to minimize his exposure to agents that could potentially affect his neurocognitive function in the future.
- At 12 days of age, the patient underwent anesthesia in the interventional radiology (IR) suite for a nephrostogram with nephrostomy tube exchange.
- He received supplemental oxygen via nasal cannula and was breathing spontaneously.
- A 1 mcg/kg bolus of dexmedetomidine was given over 15 minutes, followed by a dexmedetomidine infusion at 1 mcg/kg/hr for the duration of the procedure.
- The patient was appropriately sedated with optimal conditions for the IR team to complete the procedure without difficulty.
- The patient returned for the same procedure at a corrected age of 23 days, and we followed a similar anesthetic plan.
- An awake peripheral IV was placed. A 1 mcg/kg bolus of dexmedetomidine was given over 15 minutes, followed by a dexmedetomidine infusion at 1 mcg/kg/hr, which was titrated to effect.
- A total of 30 minutes passed from start time until the patient was adequately sedated for the procedure.
- Prior to incision, the IR physician administered local anesthetic to the surgical site.
- A total of 0.5 mcg/kg of IV fentanyl was given in divided doses.
- The patient was safely anesthetized while avoiding airway instrumentation.

References

1. Briner A et al. Volatile Anesthetics Rapidly Increase Dendritic Spine Density in the Rat Medial Prefrontal Cortex during Synaptogenesis. Anesthesiology 2010, 112(3): 546-556.
2. Jevtovic-Todorovic V et al. Early Exposure to Common Anesthetic Agents Causes Widespread Neurodegeneration in the Developing Rat Brain and Persistent Learning Deficits. J Neurosci 2003, 23(3):876-882.
3. Perez-Zoghbi JF et al. Dexmedetomidine-Mediated Neuroprotection Against Sevoflurane-Induced Neurotoxicity Extends to Several Brain Regions in Neonatal Rats. Br J Anaesth 2017, 119(3):506-516.
4. Sanders RD et al. Dexmedetomidine Provides Cortical Neuroprotection: Impact on Anaesthetic-Induced Neuroapoptosis in the Rat Developing Brain. Acta Anaesthesiol Scand 2010, 54(6):710-716.
5. Vutskits L, Davidson A. Update on Developmental Anesthesia Neurotoxicity. Curr Opin Anaesth 2017, 30(3):337-342.

Discussion

- A large number of studies have shown neurotoxic effects of many common anesthetic agents on the immature brain in rat models.
- Understandably, there is growing concern as to whether exposure to these anesthetic agents will cause long-lasting structural and functional changes to the developing human brain.
- Until definitive evidence can be obtained from ongoing human studies, one chief concern is what can be done in the interim to help attenuate the potential adverse effects of anesthetic agents in children.
- Dexmedetomidine was considered the ideal choice in our neonatal patient because he would need multiple anesthetics for the treatment of his underlying disease.
- It has exhibited potential neuroprotective effects in several studies involving inhaled anesthetics.
- It works independently of the NMDA and $GABA_A$ receptors, which have been targeted as negatively impacting synaptogenesis in the developing brain.
- The lack of potential neurotoxicity, combined with its analgesic, sedative and anxiolytic properties, made it the ideal choice.
- Given his history of laryngomalacia, we also wanted to avoid any significant respiratory depression.
- Carrying out two successful anesthetics as described above shows that with careful planning and the patience of all involved staff, dexmedetomidine may be a very good option for neonatal anesthesia.