Use of Dexmedetomidine for Magnetic Resonance Imaging under Sedation in a Pediatric Patient with Phenylketonuria

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Abstract

Phenylketonuria (PKU) is an inborn error of metabolism caused by a deficiency of the enzyme phenylalanine hydroxylase which results in accumulation of phenylalanine. Patients of PKU presents with seizures, mental retardation, and organ damage and possess a unique challenge to the anesthesiologists when they need anesthetics for diagnostic or surgical procedures. There is limited literature regarding the safety of various anesthetic drugs in PKU patients. None of them reported the use of dexmedetomidine as safer sedative option for such patients. Therefore, we describe the management of such a case posted for magnetic resonance imaging under dexmedetomidine sedation.

Keywords
- phenylketonuria
- dexmedetomidine
- propofol
- magnetic resonance imaging
- sedation

Introduction

Phenylketonuria (PKU) is an inborn error of metabolism caused by a deficiency of the enzyme phenylalanine hydroxylase (PAH). The deficiency of the enzyme PAH impairs the ability to metabolize the essential amino acid phenylalanine resulting in accumulation of phenylalanine in body fluids. Accumulation of phenylalanine results in seizures, mental retardation, and organ damage.[1] PKU should be diagnosed in the neonatal period and treated immediately by restricting dietary phenylalanine. The satisfactory control of blood phenylalanine levels (3–8 mg/dL) should be achieved.[2] PKU may be associated with Charcot–Marie–Tooth disease, Down's syndrome, cystinuria, bilateral iris coloboma, cataracts and enamel hypoplasia, microcephaly, and other facial anomalies.[3] These patients present a challenge to the anesthesiologists when they come for various diagnostic or surgical procedures. The available literatures provide very scant information regarding safety of various anesthetic drugs in PKU patients and successful management of a case with this inherited error of metabolism. Especially, there has been no literature providing the information regarding the usage of dexmedetomidine in such patients. Therefore, we report a case of a patient with PKU posted for magnetic resonance imaging (MRI) under sedation using dexmedetomidine.

Case Report

A 2-year-old male child, weighing 14 kg, born to a nonconsanguineous marriage with full-term normal vaginal delivery with no perinatal insult presented with history of intermittent tonic–clonic seizures with mild global developmental delay. The child had no facial dysmorphism with no anticipation of difficult airway. He was found to have elevated phenylalanine levels and was diagnosed of PKU.

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Liver, kidney, and cardiac functions tested normal. The child had history of bronchopneumonia 3 months back for which he was treated at a pediatric intensive care unit. He was on oral ethosuximide 100 mg two times a day and primidone 50 mg three times a day. He was posted for MRI brain under sedation. High risk consent for bronchospasm, aspiration, and possible endotracheal intubation was obtained. No premedication was administered due to the risk of respiratory depression and possible extrapyramidal symptoms in PKU patients with antihistamines. Intravenous cannulation was done in awake state only. He was posted first in the procedure list and was started on 5% dextrose-containing solution at 45 mL/hour. Standard American Society of Anesthesiologists monitors including electrocardiography, blood pressure, saturation probe, and capnography were used. Bolus dose of dexmedetomidine of 1 mcg/kg was administered over 10 minutes followed by infusion at 0.5 mcg/kg/h, but due to inadequate sedation infusion dose was incrementally increased to 1 mcg/kg/h. Supplemental oxygen was provided using facemask at a flow rate of 4 L/min. During MRI, heart rate gradually decreased from 90 to 64 beats per minute, so dexmedetomidine was reduced to 0.5 mcg/kg/h. MRI lasted for 40 minutes and the rest of the procedure was uneventful. Child was shifted to postanesthesia care unit where maintenance fluid with dextrose-containing fluid was continued. Child was observed there for 2 hours until completely awake and was discharged on the same day.

Discussion

PKU is the most common genetic disorder leading to mental retardation in the West; however, it is less common in India. Kaur et al[4] screened 4,451 cases for inborn errors of metabolism in Delhi and detected PKU in 4 (0.08%) cases. A higher incidence of PKU has been reported in South India.[5]

Patients of PKU often presents with seizures and mental retardation and thus will require sedation for various procedures like MRI. A thorough preoperative assessment is of paramount importance and should include clinical evaluation of the child's cardiac and respiratory systems. Up to 50% of PKU patients experience seizures. Although there is no recommended antiepileptic of choice in PKU, our patient had well-controlled seizure with tablets ethosuximide and primidone which are considered to be a safe choice in PKU with no significant drug interaction.[6] Difficult airway should be anticipated in patients with PKU and the full range of difficult airway adjuncts should be made available. Preoperative assessment should be undertaken along with involvement of the metabolic team and previous anesthetic record should be consulted. Fasting increases the risk of metabolic decompensation. Prolonged perioperative fasting should be avoided and hydration[7] should be maintained as a catabolic state will promote flux through the abnormal metabolic pathway in PKU. Schedule PKU patients should be posted first on the operating list and 10% glucose should be commenced.[7] Clear high carbohydrate energy drinks may be beneficial and can be consumed up to 2 hours before anesthesia.[8] The goal in PKU patients is to prevent metabolic acidosis[9] as these patients are at high risk to develop metabolic decompensation. We chose dexmedetomidine as the agent for sedation in our patient because of two prime reasons, first because of its respiratory safety profile considering history of pneumonia 3 months back. Second, we wanted to avoid propofol as this child was at a higher risk of developing metabolic acidosis.[8] Dexmedetomidine has significant advantages as a procedural sedative in pediatric patients.[10] Its limited effect on respiratory drive makes it a useful tool for the management of pediatric patients. Literature mentions safe use of dexmedetomidine in higher dose with 2 to 3 mcg/kg/h as bolus, followed by infusion 1 to 2 mcg/kg/h safe.[11] Dexmedetomidine has no significant drug interactions, with only bradycardia and hypotension as adverse effects.[11] We observed bradycardia during the procedure which was resolved with dose adjustment of dexmedetomidine. On the other hand, infusion of propofol in such patients might not be a safe option as it results in impaired mitochondrial β-oxidation of fatty acids, and it is well known to cause uncoupling oxidative phosphorylation and inhibit mitochondrial complex I function.[8] Although ketamine has a good safety profile, it was avoided because of its proconvulsant properties.[12] Opioid was not used because of its potential to cause respiratory depression.[13] PKU patients are at risk of functional vitamin B12 deficiency, and hence use of nitrous oxide is not advocated in such patients.[11] Inherited metabolic diseases like PKU are rare conditions contributing significantly to pediatric morbidity and mortality. Catastrophic metabolic decompensation may occur in the perioperative period and a multidisciplinary approach is essential to ensure safe management of these patients. Anesthesiologists may encounter patients with inherited metabolic diseases presenting for both emergency and elective procedures. A better preparation and knowledge can help us manage such high-risk patients with a good outcome.

Conflict of Interest
None declared.

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