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Use of nebulized ketamine for subarachnoid block in paediatric patient with g6pd deficiency: A case report

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Abstract

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is the commonest human enzyme defect with male predominance. Patients with Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency may face acute haemolysis precipitated by infection, certain medications and some of the anaesthetic drugs. Ketamine helps in providing anxiolysis, analgesia and sedation. Here, we report successful use of nebulized ketamine in a child to give subarachnoid block with G6PD deficiency undergoing below umbilical procedure.

Keywords: G6PD deficiency; Ketamine; Subarachnoid block; Paediatric anaesthesia.

Introduction

Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency is the commonest enzymatic disorder of red blood cells which affects approximately 400 million people worldwide. It is a X-linked recessive disorder affecting males more with highest prevalence in Africa, Southern Europe, Middle East and South East Asia. This is characterized by enzymatic defect in pentose phosphate pathway making red blood cells vulnerable to oxidative stress resulting into acute haemolysis. Infection, certain medications and some anaesthetic drugs may precipitate haemolysis during perioperative period in these patients. There is dearth in the literature regarding the management of G6PD deficient paediatric patients under regional anaesthesia [1,2]. The present case describes the anaesthetic management of a child with G6PD deficiency planned for herniotomy.

Case Report

A 2 yr 10 m, 15 kg child presented with complaint of groin swelling since birth and was diagnosed with right sided congenital hydrocele and was scheduled for herniotomy. At pre-anaesthetic checkup,

history of G6PD deficiency since birth was obtained. It was diagnosed after developing neonatal jaundice and indirect hyperbilirubinemia suggesting haemolysis for which he was kept under observation in neonatal intensive care unit. There was no past history of any other episode of acute or chronic haemolysis and blood transfusion. He had achieved developmental milestones as per his age and was immunized till date. On examination, he did not have pallor or icterus. Systemic examination and airway assessment revealed no abnormality. On investigation, haemoglobin - 9.2 g/dL, hematocrit - 31.6%. White blood cell count, platelet count, liver function and electrolytes were all within normal limits. Upon consultation with paediatrician no other anomalies were found.

The anaesthesia plan and management regarding benefits and risks of general and regional anaesthesia was informed to both parents and written informed consent was taken. The child was fasted for 6 hours for solid, 4 hours for milk and 2 hours for clear fluids. In pre-operative area baseline heart rate (106/min) and peripheral oxygen saturation (99%) was taken and he was then nebulized with 60 mg (4 mg/kg) ketamine diluted with saline by jet nebulizer via paediatric face mask with continuous 6 L/min flow of 100% oxygen which was stopped when the nebulizer started to sputter. The separation state, sedation score was assessed every 10 minutes and after achieving acceptable sedation level after 30 minutes of nebulization, patient was shifted to the operating room. All routine vital parameters were taken and continuously monitored. Intravenous cannulation with 22G cannula was done and warm Isolyte P infusion was started. Injection midazolam 0.5 mg was administered. Under all aseptic precautions, subarachnoid block was performed at L_{3-4} intervertebral space in right lateral position using a 25G Quincke's needle and 5 mg of hyperbaric bupivacaine (0.3 mg/kg) was injected after confirmation of free flow of CSF. Patient handed over to surgeon after achieving desired sensory and motor blockade. The child was covered with warm blankets and administered oxygen via facemask. Hemodynamic parameters were stable and the child remained calm throughout the surgery. After end of surgery, patient was shifted to post anaesthesia care unit with no motor blockade. Injection paracetamol 300 mg was given as the child started complaining of pain, 100 min after intrathecal injection. The peri-operative period was uneventful. Blood investigation was repeated after 12 hours of completion of surgery which did not reveal any haemolysis with haemoglobin-9 g/dL. The child was monitored for 3 days and was discharged with instructions to parents to look out for any signs of haemolysis (dark urine, fatigue, headache, difficulty in breathing) and was followed up after a week.

Discussion

G6PD is an enzyme which catalyzes the first step in pentose phosphate pathway in glucose metabolism and produces NADPH which acts as antioxidant. This NADPH helps in regeneration of reduced glutathione, which preserves the integrity of red blood cell membrane. NADPH is decreased in patients with G6PD deficiency and thus, leading to haemolysis in face of oxidative stress. Patients with G6PD deficiency are mostly asymptomatic until acute haemolysis occurs, after exposure to triggering agents like fava beans, surgical stress and certain medications [1,2].

G6PD deficiency is classified into five variants depending on the functional severity of G6PD

enzyme deficiency, with subsequent risk of haemolysis ranging from severe enzymatic defect with chronic haemolysis (class I) to normal to slightly increased activity without clinical significance (class V). Proper pre-anaesthetic evaluation with detailed history and examination; optimization of any metabolic conditions, anemia, prevention of infection and careful administration of drugs are of utmost importance in these patients [3].

Previous studies in G6PD deficient patients under general anaesthesia demonstrated safe use of sevoflurane and isoflurane [1,4], whereas in-vitro study has shown inhibitory effect of sevoflurane and isoflurane in G6PD enzyme [5]. We chose to administer regional anaesthesia in our case as the procedure was below the umbilicus, non-availability of sevoflurane vaporizer in our institution and to avoid the side effects of general anaesthesia. Regional anaesthesia is comparatively safer but using lignocaine in G6PD deficient patients may lead to haemolysis. Few studies have reported the safe use of bupivacaine in these patients [2,6]. Thus, sub-arachnoid block with hyperbaric bupivacaine was preferred in this case.

Ketamine does not cause G6PD inhibition and thus, can be used to produce anxiolysis, analgesia and sedation in these patients [5]. Upto 3 mg/kg of nebulized ketamine was ineffective in providing sedation [7,8]. So, we used 4 mg/kg of ketamine for nebulization. We observed satisfactory separation from parents, successful venous cannulation and spinal anaesthesia without any complications during the whole period.

Intraoperative hypothermia, hypoxia, acidosis, pain and infection can cause haemolysis and therefore, should be obviated [9,10]. These factors were avoided and optimized in our child and careful monitoring for acute haemolysis was done. Use of paracetamol is controversial [1,5,6] but it was used to provide postoperative analgesia as the mother didn't give any past history suggestive of haemolysis with paracetamol use.

In conclusion, nebulized ketamine (4 mg/kg) is safe and effective in providing adequate anxiolysis, analgesia and sedation for sub-arachnoid block in children with G6PD deficiency undergoing below umbilical procedure.

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