

Anaesthetic management for orthotopic liver transplantation in a patient with glycogen storage disease type IIIa

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Glycogen storage disease (GSD) type III is a metabolic disorder caused by a deficiency in amylo-1,6-glucosidase enzyme, which is responsible for the breakdown of the glycogen molecule, resulting in glycogen accumulating in the organs, hypoglycaemia, muscle weakness, liver dysfunction, delayed anaesthetic recovery, excessive surgical bleeding, cardiomyopathy and end-organ dysfunction. This case report presents a child with GSD type IIIa who underwent orthotopic liver transplantation (OLT) with her mother as a donor. A multidisciplinary approach should be provided to optimise the preoperative period and minimise complications in these patients.

Keywords: anaesthetic management, glycogen storage disease, tight glycaemic control, hypoglycaemia, liver transplantation

Introduction

Glycogen storage disease (GSD) type III, also known as Cory-Forbes, is an autosomal recessive metabolic disorder caused by a deficiency in amylo-1,6-glucosidase enzyme, which is responsible for the breakdown of the glycogen molecule. GSD III is divided into four types: IIIa, IIIb, IIIc and IIId. GSD types IIIa and IIIc mainly affect the liver and muscles, while GSD types IIIb and IIId typically affect only the liver.¹ Mutations in the amylo-alpha-1,6-glucosidase, 4-alpha-glucanotransferase (AGL) gene, which provides instructions for making the glycogen debranching enzyme, cause GSD type IIIa.² As a result, this abnormal glycogen accumulates in hepatocytes, myocytes and cardiomyocytes. Hepatomegaly, low blood glucose with ketosis on fasting, and elevated serum concentrations of transaminases and creatine kinase (CK) are some evidence of the disease.¹ From the anaesthetist's point of view, hypoglycaemia, muscle weakness, liver dysfunction, delayed anaesthetic recovery, excessive surgical bleeding, cardiomyopathy, reduced response to epinephrine and end-organ dysfunction are some of the complications that may occur during the perioperative period.² In this case report, we present a child with GSD type IIIa who underwent orthotopic liver transplantation (OLT) with her mother as donor.

Case presentation

A 4-years-9-months-old girl with a weight of 13 kg and a height of 94 cm was diagnosed with GSD type IIIa after investigations because of prolonged jaundice and elevated transaminase levels when she was three months old. The patient underwent a liver biopsy, a golden standard for diagnosing this disease. She was born at 38 weeks of pregnancy with a caesarean section and weighed 3 620 g. Her metabolic control was poor and her development was below the percentile for her gender and age. The patient had a history of seizures almost every week due to hypoglycaemia and she was prescribed a hydrothermally processed high amylopectin cornstarch diet. In addition, she was medicated with ursodeoxycholic acid and

vitamin A. Widespread liver necrosis, fibrotic changes in the liver and hepatosplenomegaly were reported in the upper abdomen computed tomography (CT) scan. Her physical examination revealed occasional gliding eyes, a doll-like face, increased abdomen circumference and thin atrophic limbs. Echocardiography, electrocardiography and X-ray findings were normal. Owing to milk, egg and fish allergies, she was referred to the Paediatric Allergy Department. They recommended that propofol should not be used during anaesthesia. She also had a history of nephrolithiasis. The American Society of Anesthesiologists (ASA) physical classification of the patient was class IV with a Mallampati score (MPS) of II.

We have obtained written informed consent from the patient's parents to publish this case report. Standard monitoring was placed, including pulse oximetry, electrocardiogram, capnography and invasive blood pressure. After preoxygenation by 80% O₂ for 3 minutes, general anaesthesia was induced with propofol 2 mg/kg, fentanyl 1 µg/kg and rocuronium 0.6 mg/kg followed by oral endotracheal intubation after the loss of train of four.

Using a direct laryngoscopy, the patient was intubated with a size 4.5 cuffed endotracheal tube without any problems. General anaesthesia was maintained with 2% sevoflurane and 50% O₂ in the air, remifentanyl infusion (0.01–0.5 µg/kg per hour) and rocuronium infusion (0.3 mg/kg). Proper ventilation settings were arranged. Gastric contents were suctioned. Since these patients have a low body temperature, we used a circulating-water mattress and a forced-air warming device to prevent hypothermia and followed up with a nasopharyngeal temperature probe. Haemodynamic changes were monitored with Pulse index Contour Continuous Cardiac Output (PiCCO) measured parameters, including stroke volume, stroke volume variation, pulse pressure variation and cardiac output.

Fluid therapy was administered, guided by an algorithm depending on the PiCCO parameters. In total, 110 ml of the red

blood cells (RBC) unit was transfused. Considering the possibility of hypoglycaemia in these patients, we used a glucometer to assess and assure adequate blood glucose levels every 30 minutes. Haemodynamic stability was maintained with a 0.01–0.5 µg/kg/min norepinephrine infusion. Hypocalcaemia detected in arterial blood gas was treated with 8 cc calcium chloride. Hypocalcaemia is crucial for the reperfusion phase to eliminate potassium.^{3,4} During the reperfusion phase, the patient developed no severe hypotension, bradycardia, arrhythmia, supraventricular tachycardia or asystole.

The cirrhotic liver weighed 1 495 g (Figure 1 and Figure 2) and the transplanted graft liver weighed 265 g. The operation duration was 6 hours and occurred without complications. After the operation, sugammadex (2 mg/kg) was administered intravenously (IV). The patient was extubated in the operating room without delay when she fulfilled standard clinical criteria. She was discharged from the operating room to the intensive care unit, and from the hospital 25 days later without complications.

Discussion

GSD poses serious challenges for anaesthetists as these patients present a very complicated clinical situation including clotting problems, cardiomyopathy as well as difficulty in intubation because of glycogen storage in the tongue and oropharynx, causing macroglossia or other facial anomalies.

For these patients, anaesthetics should be chosen based on their ability to avoid rises in catecholamine and cortisol levels. Especially in paediatric patients, premedication is necessary and it should be planned for each patient individually. We applied 0.01 mg/kg IV midazolam as premedication. In these patients, propofol usage is not recommended because of egg allergy. However, we used this agent based on our research in light of literature where no severe allergic reactions occurred. In our patient also, no allergic complication was recorded.

Shenkman et al.⁵ used a concentration of nitrous oxide in 70% O₂ with isoflurane 2% and maintained muscle relaxation with atracurium 45 mg in their GSD type Ib patient. In our case, maintenance of general anaesthesia was achieved with a mixture of 2% sevoflurane and 50% O₂ in the air and rocuronium infusion (0.3 mg/kg). In addition, sevoflurane is demonstrated to have an effect in helping protect the hepatocytes against ischaemia-reperfusion-induced necrosis.⁶

In patients with GSD type IIIa, hypoglycaemia is common, so we used an infusion of 5% dextrose to prevent this complication. To maintain a good urine output of 1–2 ml/kg/hour, 1 ml/kg 20% mannitol and 0.5–1 mg/kg furosemide were provided. Our patient maintained good diuresis during the operation.

We used a N-acetylcysteine 50 mg/kg IV infusion in 500 ml 5% dextrose over four hours, vitamin C for its antioxidant and mucolytic properties, and 10 mg/kg steroid IV bolus as an immunosuppressant.



Figure 1: The anterior side of the cirrhotic liver



Figure 2: The posterior side of the cirrhotic liver

During the anhepatic phase, the patient developed hypothermia. It was addressed with warm fluids, a circulating-water mattress, and a forced-air warming device to prevent hypothermia. She was monitored with an ear temperature probe to prevent acidaemia and thrombosis. Our patient maintained stable haemodynamics and an arterial blood gases showed no other complications except hypoglycaemia. Since we did not find many cases of GSD type III undergoing OLT in the literature, we decided to share this case with our colleagues worldwide.

Conclusion

In summary, meticulous preoperative planning should be done to minimise physical and psychological distress, retain optimum hydration status, avoid protein catabolism and prevent hypoglycaemia attacks. Paediatric patients with GSD type III should have their procedures done by trained multidisciplinary teams, including anaesthesiologists, surgeons, paediatricians, and metabolic professionals at specialist centres. Comprehensive and detailed perioperative assessment and treatment for these patients are critical.

Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

No IRB approval was required. Informed consent by the patient's parents was obtained to publish this case.

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