Case Report

Preventive strategy for hyperkalemia during resection of a large sacrococcygeal teratoma in a neonate

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A neonate weighed 3.3kg with a huge Sacrococcygeal teratoma extending up to the level of S3, anterior displacement of the anus and rectum underwent operation. He had hyperkalemia caused by massive transfusion and tumor lysis. Regular insulin 0.3 unit and 4ml of normal saline mixture were infused by microinfusion pump at a rate of 3cc/hr with continuous 10% dextrose solution during resection of tumor. During the operation, appropriate potassium concentration was maintained and surgery was completed uneventfully. (Rawal Med J 201;40: 348-350).

Keywords: Hyperkalemia, neonate, sacrococcygeal teratoma.

INTRODUCTION

Sacrococcygeal teratoma (SCT) is the most common congenital tumor in neonates with an incidence of 1:35,000 to 1:40,000 live births.[1] Surgical removal should be performed in early time before severe adverse events arise. Hyperkalemia, especially, could be a main cause of cardiac arrest during pre and intraoperative periods in neonates with large SCT.[2,3] Surgery in this tumor requires careful anesthetic management including maintenance of adequate potassium levels. In this case, we report a use of continuous glucose and insulin infusion during resection of a large SCT in a neonate.

CASE PRESENTATION

At 24 weeks of gestation, a large mass was detected by ultrasound in the fetus of a 27-year-old primigravida that had no past medical history. The mass was about 6x7 cm in size on last antenatal care. Because of preterm premature rupture of membrane, an emergency cesarean section was performed without any difficulty at 36 weeks and 6 days of gestation. The infant weighed 3.3kg, 1 and 5 minutes Apgar scores of 9 and 10. Postnatal MRI confirmed a sacrococcygeal teratoma lobulating contoured multiloculated huge cystic mass in the sacrococcygeal lesion (about 11x11x6cm) extending up to the level of S3, anterior displacement of the anus and rectum (Fig.1)

Figure 1. A huge sacrococcygeal teratoma.

Preoperative chest x-ray and electrocardiogram were normal and the echocardiograph confirmed 1.5mm size of atrial septal defect. On day 2 after delivery, the patient entered the operating room with an endotracheal tube, umbilical artery catheter and pulse oximetry. In the operating room, ECG, non-invasive blood pressure, oxygen saturation and umbilical arterial pressure were monitored during the operation. Anesthesia was induced with rocuronium (0.6mg/kg) and maintained with 1.5 vol% of sevoflurane, a medical 50% oxygen/air mixture, intermittent administration with 1 mcg of fentanyl.

Table 1. Perioperative arterial blood gas analysis.

	Pre op	Post induction	2 hours	2hr 30min	3 hours	3hr 30min	4 hours	4hr 30min
Hgb	15.3	13.6	12.4	13.0	14.3	15.2	14.6	14.9
Hct (%)	45	44	40	42	46	49	47	48
pH	7.54	6.90	7.22	7.28	7.18	7.22	7.21	7.20
pCO_2	25	119	64	54	57	57	50	58
pO_2	275	142	168	181	132	146	147	144
Na^+	136	138	137	137	138	139	139	139
K^+	5.6	5.8	5.8	5.5	5.6	4.8	4.7	4.6
Ca^{2+}	1.07	1.02	1.07	0.96	0.93	0.92	0.83	0.84
Glucose	190	150	174	162	153	152	167	177

The infant has two 24-guage peripheral (saphenous vein) intravenous catheters and one PCVC (percutaneous venous catheter) at the left arm. After the operation started, the first ABG showed inadequate ventilation with respiratory acidosis (Table 1). By auscultation, the one lung ventilation that caused by changing depth of endotracheal tube due to prone position was excluded. So ventilator was set to PIP of 20 mmHg, RR of 35~40 breathes/min and 3meq of sodium bicarbonate was administered to correct acidosis. As the operation proceeded, estimated blood loss (EBL) was 100cc/hr and blood pressure decreased to 45/30mmHg, but heart rate was relatively well maintained. Therefore, dopamine was administered at a rate of 5~10mcg/kg/hr with titration and the irradiated pRBC and FFP were transfused.

In consideration of the hyperkalemia caused by massive transfusion and tumor lysis, 0.3 unit of regular insulin and 4ml of normal saline mixture were infused by microinfusion pump at a rate of 3cc/hr with continuous 10% dextrose solution by another intravenous route. During the operation appropriate potassium concentration was maintained (Table 1). Total operation time was 5 hours and 30 minutes. Total EBL was about 350ml and the infant received 230ml of crystalloid and 260ml of pRBC, 60ml of FFP. Total urine output was 30ml. The infant was transferred to the NICU with endotracheal tube. The infant was extubated on 4th postoperative day and stitches were removed on 14th postoperative day.

DISCUSSION

There are many reports of cardiac arrest caused by hyperkalemia during the removal of sacrococcygeal teratoma in a neonate.[2-4] The most probable causes of intraoperative hyperkalemia would have been the potassium release provoked by pressure on many necrotic foci resulting from surgeons' manipulation of the SCT and massive transfusion of packed RBCs containing high levels of potassium.[4] In addition, metabolic and respiratory acidosis, hypocalcemia, hypothermia and oliguria may aggravate hyperkalemia.5 Cardiac rhythm or functional disturbances may be caused by hyperkalemia. Therefore, several reports emphasize frequent intraoperative analysis of the potassium levels to forecast impending irreversible cardiac arrest.

In this case, the preoperative potassium level was 5.6mEq/L, so we wanted to maintain the potassium level under 6.0 mEq/L to avoid cardiac arrest. Before the operation, we decided to infuse regular insulin and dextrose in order to remain the potassium 4.0 mEq/L to 6.0mEq/L range, and the level was maintained with stability.

Even though respiratory acidosis may aggravate hyperkalemia, mechanical respiratory ventilation during the surgery was too difficult to ensure adequate CO_2 exchange because of the huge tumor pressing onto the chest, and that can be worsen by prone with the pelvis raised on a rolled towel. This is reflected in extremely high PaCO2 just after prone positioning. Moreover, pulmonary immaturity, especially preterm neonate, can impede ventilation. In this challenging situation, anesthetists should endeavor to assure appropriate ventilation.

Robinson et al reported that blood loss is usually related to both size and site of the tumor and some patients with intrapelvic teratomas lost more than 60ml/kg.[6] Anesthetists should prepare for massive hemorrhage, depending on the character of the tumor. Transfusion of cold blood into a central line exacerbates the risk because cold blood in the small volume of the atrium combine with hyperkalemia and hypocalcemia can slow down SA/AV nodes to a low cardiac output state.[7] Passing blood through a fluid warmer may reduce the risk of hypothermia and more importantly the risk of serious arrhythmias because of hyperkalemia and/or hypocalemia during rapid transfusions. In addition, it is preferred to transfuse this blood through a peripheral IV rather than a central line to dilute the transfused blood and minimize the risk of atrial-induced arrhythmias.[8]

The aggressiveness of therapy for hyperkalemia is directly related the rapidity with which the condition

developed, the absolute level of serum potassium, and the evidence of toxicity. When severe hyperkalemia (potassium >7.0 mEq/L) or electrocardiographic abnormalities along with hyperkalemia are observed, treatments focuses on immediate stabilization of the myocardial cell membrane, rapid shifting of potassium to the intracellular space, and total body potassium elimination.[9] First emergent therapy is cautious administration of intravenous calcium (calcium chloride 10 to 30 mg/kg, or calcium gluconate 30 to 100mg/kg) over 3 to 5 minutes for stabilizing myocardiac membrane. Serum potassium is then reduced by returning potassium to the intracellular space. This can be achieved by administration of insulin and glucose by infusion over 30 to 60 minutes, controlled hyperventilation, inhalation of salbutamol, albuterol, or ventolin, intravenous furosemide, and administration of sodium bicarbonate if acidosis coexists.[10]

In summary, anesthetists should be prepared for unexpected intraoperative hyperkalemia during the resection of huge SCT, and before the surgery, preventive strategy for hyperkalemia regular insulin and dextrose infusion, could be considered if the need arise.

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