Kapoor *et al.*
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CASE REPORT Open Access

Anesthetic considerations in pediatric renal autotransplantation

Hemlata Kapoor*, Milin Shah and Mohan K. Terdal

Abstract

Background: Renal autotransplantation is a complex procedure involving reimplantation of the renal artery and vein at a different site. Anesthetic management of renal autotransplant is challenging because of associated morbidities and intraoperative hemodynamic changes.

Case presentation: We present a case of a 14-month-old male who had severe hypertension and cardiomyopathy due to renal artery stenosis. Echocardiography reported dilated left atrium and left ventricle, moderate to severe left ventricular systolic dysfunction, and a left ventricular ejection fraction of 30%. The renal artery and renal vein were anastamosed to the great vessels. Anesthetic management included maintaining normal baseline diastolic pressure, systemic vascular resistance, and preload and avoiding tachycardia. Milrinone infusion was used.

Conclusions: Anesthetic management was challenging as adequate perfusion pressures had to be maintained while keeping the patient hemodynamically stable.

Keywords: Renal, Autografts, Anesthesia, Hypertension, Cardiomyopathies, Transplantation

Background

Renal autotransplantation is a complex procedure involving reimplantation of the renal artery and vein at a different site. It is usually performed for renal vascular abnormalities and sometimes urological abnormalities. Anesthetic management of renal autrotransplant is challenging because of associated morbidities and intraoperative hemodynamic changes.

Case presentation

A 14-month-old male child weighing 7.8 kg and height 72 cm was scheduled for right-sided renal autotransplant. The child had presented with history of fever and cough for 2 months. On investigation, he was found to have severe hypertension with cardiomyopathy. Subacute infective endocarditis was ruled out. Computerized tomography (CT) angiography reported a short segment of severe stenosis in the right renal artery. The left renal artery was reported to be normal. Based on the absence of clinical findings and normal laboratory parameters and CT findings, vasculitis was ruled out. All laboratory parameters were within normal limits. These are serum creatinine 0.27 mg/dL, serum blood urea nitrogen 11.2 mg/dL, and serum C-reactive protein < 0.060 mg/dL. Echocardiography reported dilated left atrium and left ventricle, mild mitral regurgitation, moderate to severe left ventricular systolic dysfunction, and a left ventricular ejection fraction of 30%. The right ventricle was reported to be of normal morphology and size. Electrocardiogram showed T-wave inversion in leads V_2 and V_3.

Medications started were nifedipine sustained release tablet 5 mg twice a day, metoprolol tartrate 5 mg twice a day, ecosprin 37.5 mg, and clopidogrel 0.7 mg. Balloon dilatation of right renal artery was attempted twice but was not successful. Hence, right renal autotransplant was planned for the patient.

Left femoral artery and left femoral vein were cannulated before induction of anesthesia. Blood pressure was 130/58 mm of Hg and heart rate 120/min. Induction was

*Correspondence: h_sarinkapoor@hotmail.co.uk

Department of Anaesthesiology, Kokilaben Dhirubhai Ambani Hospital and Research Institute, Mumbai 400053, India

done with titrated doses of fentanyl and propofol. Muscle relaxation was attained with atracurium, and the trachea was intubated with size 4.5 uncuffed tube. Anesthesia was maintained with sevoflurane in oxygen/air mixture. Atracurium and fentanyl infusions were started as per body weight. The radial artery could not be cannulated; hence, upper limb blood pressure measurement was done by noninvasive method. The renal artery and the renal vein were anastomosed end to side to the aorta and the inferior vena cava respectively. Milrinone infusion was started and titrated at a dose of 0.25–0.75 μg/kg/min. The aorta was cross clamped *for 20 min* during arterial anastomosis. Sodium bicarbonate was given as per body weight, and before the release of vascular clamps, heparin bolus 1000 μg was given followed by an infusion of 10 μg/kg/h. The systolic blood pressure was maintained between 120 and 150 mm of Hg and diastolic blood pressure between 58–70 mm of Hg intraoperatively. Dextrose and normal saline (DNS) and blood were transfused intraoperatively based on pulse pressure variation (PPV) and central venous pressure (CVP). Milrinone was gradually tapered off and stopped towards end of surgery due to increase in blood pressure. The operative time was 2 h and 15 min, and total blood loss was around 80 ml. The patient was shifted and intubated to the pediatric intensive care unit (PICU) and extubated after around 4 h. The stay in the PICU was uneventful.

Conclusions

Pediatric hypertension is defined as systolic blood pressure more than 95th percentile for age, sex, and height of the child (Patel and Cahill 2021). Renal vascular hypertension is reported to be the cause of 5–25% of pediatric hypertension (Patel and Cahill 2021). Early identification and management can control and sometimes cure hypertension. It also reduces the risk of long-term cardiac and renal complications. Renal artery stenosis can be unilateral or bilateral. In the pediatric age group, it has been reported to be bilateral in 24–78% of the cases (Lobeck et al. 2018).

Initial management is stabilization of blood pressure with antihypertensive medications. It has been reported that in renovascular hypertension in children, even up to six to seven antihypertensives may not be sufficient to control blood pressure (Tullus et al. 2008). In such situations and where significant adverse effects of hypertension are manifested, angioplasty and other modes of endovascular intervention are indicated (Patel and Cahill 2021). In case angioplasty is ineffective or not feasible or the patient develops some complication like dissection or pseudoaneurysm, surgical intervention is indicated.

The first renal autotransplant was described by Hardy in 1963 (Ogawa et al. 2012). It involves donor nephrectomy and a standard renal transplant in the same patient. Renal autotransplant is used to treat complex renovascular diseases, ureteral disease, and neoplastic disease. Takayasu's arteritis is a known cause of renal artery stenosis (Pa et al. 2009). It was however ruled out in our patient.

Our patient was not an end-stage renal disease patient and had normal creatinine. Therefore, electrolyte imbalance, acidemia, and anemia were not present, and alteration in renal metabolism and excretion of drugs and their metabolites were not expected. Uncontrolled hypertension leading to cardiomyopathy and reduction in cardiac function necessitated autotransplant.

Pediatric patients weighing less than 25 kg and younger than 12 years are more likely to develop perioperative complications during renal transplant (Della Rocca et al. 2001). In renal autotransplant, adequate renal perfusion is required which involves maintainance of euvolemia and adequate perfusion pressure (Babazade et al. 2020). Children with cardiomyopathies are more prone to develop perioperative arrhythmias and cardiac arrest (Ing et al. 2012). Anesthetic management requires maintaining normal baseline diastolic pressure, systemic vascular resistance, and preload and avoiding tachycardia (Ing et al. 2012). If systemic vascular resistance is high, a ventricle with poor contractility will not be able to maintain the cardiac output. In such circumstances, vasodilating agents such as milrinone and dobutamine are useful (Ing et al. 2012).

In our patient, the left femoral vein and left femoral artery were cannulated prior to induction of anesthesia to avoid sudden hemodynamic variations during induction of anesthesia. Intra-arterial monitoring is mandatory for the pediatric age group when the allograft vessels are anastamosed to the great vessels. Adequate intravascular volume and perfusion pressure are required for immediate graft function and graft survival (Pa et al. 2009). Fluid management was guided by central venous pressure and pulse pressure variation. Noninvasive blood pressure (NIBP) readings from right upper arm correlated with the invasive left femoral artery values. During aortic cross clamping for arterial anastomosis, we relied on NIBP value for hemodynamic management. Milrinone infusion was started at 0.25–0.75 μg/kg/min. Milrinone is a positive inotrope and a vasodilator. Optimization of intravascular fluid management for good renal perfusion while avoiding fluid overload and vigilant hemodynamic monitoring is essential for successful outcome (Tiwari et al. 2021; Reyle-Hahn et al. 1997). Excessive blood loss should be replaced with blood in these patients. Immediate complications include bleeding from vascular anastomosis or renal vessel thrombosis. Heparin bolus and infusion were given to prevent thrombus formation. The

patient was not immediately extubated to prevent sudden hemodynamic changes. Extubation was done on the same day in the PICU. The patient had an uneventful recovery.

Anesthetic management is challenging in these patients as adequate perfusion pressures have to be maintained while keeping the patient hemodynamically stable. Preoperative optimization, intraoperative hemodynamic stability, and vigilant perioperative monitoring are essential for a successful autotransplant.

Abbreviations
CT: Computerized tomography; DNS: Dextrose and normal saline; PPV: Pulse pressure variation; CVP: Central venous pressure; PICU: Pediatric intensive care unit.

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"HK," "MS," and "MT" have contributed equally in the preparation of the manuscript. The authors read and approved the final manuscript.

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The authors declare that they have no competing interests.

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