

Extracorporeal Membrane Oxygenation as a Treatment of Intractable Supraventricular Tachycardia in Infant

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Abstract Although supraventricular tachycardia (SVT) is usually well tolerated in most infants and older children, it can lead to cardiovascular collapse in some infants. We present one neonate in whom venoarterial extracorporeal membrane oxygenation (VA ECMO) was used to support for life-threatening cardiogenic shock secondary to intractable SVT. ECMO facilitated myocardial recovery and subsequently antiarrhythmic medications could be optimised to control the SVT.

Key words Extracorporeal membrane oxygenation; Infant; Supraventricular tachycardia

Introduction

Infant can rarely present with circulatory collapse due to intractable supraventricular tachycardia (SVT). Pharmacological treatment and direct current (DC) cardioversion are the mainstay treatment for SVT in paediatric patients. Venoarterial extracorporeal membrane oxygenation (VA ECMO) is a well-established method of providing cardiorespiratory support in infants with low cardiac output from various cardiac problems.¹ There have been few reports on the use of ECMO for treatment of cardiogenic shock due to intractable arrhythmias.²⁻⁶ We describe our experience of using VA ECMO for treatment of intractable SVT resulting cardiovascular collapse in a neonate.

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Case Report

A 9-day-old Chinese male infant, weighting 3.2 kg, with unremarkable perinatal course was referred to our hospital in May 2013 for treatment of intractable SVT. His mother reported poor feeding and lethargy two days prior to admission to the referring hospital. Electrocardiogram showed narrow-complex tachycardia with rate 240 beats per minute (Figure 1). Facial ice packing, multiple doses of adenosine and synchronised DC cardioversion had no sustained effect in termination of SVT. Intravenous amiodarone loading doses and continuous infusion were given. He developed poor peripheral circulation, respiratory distress and hepatomegaly. He required mechanical ventilation and dobutamine infusion at 5 µg/kg/min was initiated before transfer to our hospital.

After admission to our intensive care unit, he was noted to have profound shock (mean blood pressure was 23 mmHg; capillary refill time more than 5 seconds, arterial blood gases: pH 7.2; base deficit -16). Echocardiography showed structurally normal heart with very poor ventricular contraction. Left ventricular ejection fraction was estimated to be less than 10%. The SVT showed no sustained response to maximal conventional treatment including intravenous adenosine, amiodarone and synchronised DC cardioversion. Transient termination of SVT resulted in severe sinus bradycardia and hypotension requiring cardiopulmonary

resuscitation. We decided for VA ECMO support four hours after admission. Before establishment of ECMO the patient had brief periods of closed chest cardiac massage and several doses of intravenous adrenaline.

VA ECMO was performed via sternotomy and central cannulation using 20-Fr right atrial and 10-Fr aortic cannula (Figure 2). SVT terminated once ECMO flow was established at the operating room. Satisfactory peripheral tissue perfusion was achieved and all inotropes were stopped.

Antiarrhythmic drugs including amiodarone and digoxin were optimised. On day 2 after ECMO, blood clots were noted in the centrifugal pump and oxygenator and changing of the circuit was performed uneventfully. He required large amount of blood transfusion on the next day due to significant bleeding over the cannulation and sternotomy sites. Eighty hours after ECMO, there was echocardiographic evidence of restoration of biventricular function and he was weaned and decannulated successfully



Figure 1 Electrocardiogram showing supraventricular tachycardia of rate 240 beats per minute.

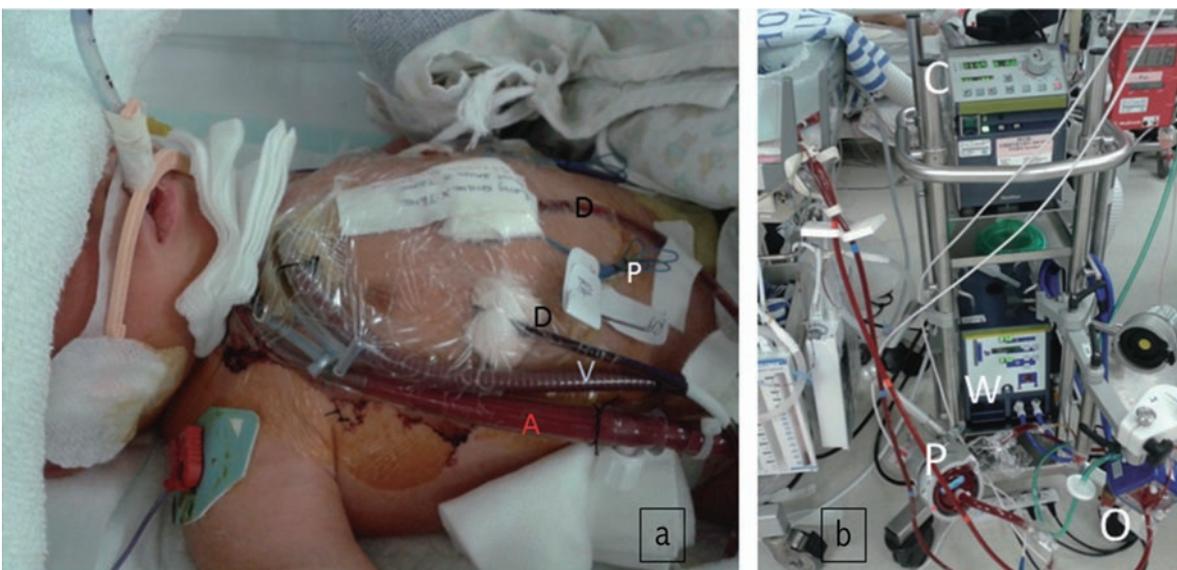


Figure 2 (a): Patient with venous cannula (V), aortic cannula (A), pacing wires (P) and drainage tubes (D). (b): ECMO circuit showing Maquet Rotaflow pump (P), Maquet Quadox-iD Paediatric oxygenator (O), console (C) and warmer (W).

at the operating room. All inotropes were weaned off after six days. Mechanical ventilation was required for eight days since admission.

He had nonsustained episodes of SVT which were finally controlled with four oral antiarrhythmic medications including amiodarone, propranolol, digoxin and propafenone. He was discharged seven weeks after admission. Echocardiography before discharge showed normal left ventricular size and ejection fraction (74%). All his electrocardiograms showed no evidence of ventricular pre-excitation. He was followed-up for 30 months and there was no recurrent SVT. All antiarrhythmic medications were weaned off. He had no neurological sequelae and assessment revealed normal developmental milestone.

Discussion

Supraventricular tachycardia is the commonest tachyarrhythmia in paediatric patients. This is usually well tolerated in most infants and older children. Vagal manoeuvre, pharmacological treatment and synchronised DC cardioversion are usually effective in termination of SVT. Rarely, intractable SVT refractory to conventional treatment can result in severe cardiovascular collapse in infant. Our patient likely had SVT already for two days before admission to hospital that resulted in severe impairment of ventricular function and cardiogenic shock. Antiarrhythmic drugs have myocardial depressant effect that will further compromise the low cardiac output state. On the other hand, inotropic agents for treatment of cardiogenic shock are proarrhythmic and will result in recurrence of SVT. VA ECMO acts as a bridge to recovery in patients with intractable arrhythmias. By establishment of a period of hemodynamic stability and weaning of inotropic agents, myocardial recovery can be facilitated. Antiarrhythmic medications can be optimised when satisfactory peripheral tissue perfusion is achieved. There have been few reports demonstrating the successful usage of VA ECMO as treatment of dysrhythmia in paediatric patients.²⁻⁶ The largest retrospective review study by Silva et al⁶ showed that SVT was the most common arrhythmia requiring mechanical circulatory support but there were significant proportion of patients having other associated heart conditions in this study. Half of the patients in this study had congenital heart disease and 17% had dilated cardiomyopathy. There was no data on the proportion of SVT patients without structural

heart disease. They reported a mortality of 20.5% but detail causes for mortality was not available. Complications occurred in five patients out of the total 39 patients. These included two patients having thrombosis requiring thrombolytic therapy, one patient had hypoxic encephalopathy, one patient had mitral valve damage requiring surgical repair and another patient had gastric perforation. Large study on ECMO treatment for primary SVT paediatric patients without structurally heart disease remains rare.

If patient has incessant SVT despite antiarrhythmic drug therapy, electrophysiology study and transcatheter ablation can be performed while patient is still on ECMO support. There have been several reports describing successful transcatheter radiofrequency ablation or cryoablation in patients while on full VA ECMO support.^{2,4,6-8} Pharmacological treatment was effective in our patient and we did not need to consider transcatheter ablation.

We performed VA ECMO via central cannulation rather than cut down of carotid artery and internal jugular vein because of the moribund condition of the patient. Our surgeons are more familiar in establishing quick ECMO support via central cannulation. ECMO flow was able to be established 18 minutes after general anaesthesia in this patient. However, central cannulation is associated with higher risk of bleeding and this occurred in our patient. The need of replacement of pump and oxygenator on day 2 due to blood clots had prompted us to aim at a higher activated coagulation time of 200 seconds that aggravated the bleeding complication on day 3. Fortunately, this patient had quick myocardial recovery and early weaning from ECMO was possible. He had no complication of massive blood transfusion.

Conclusion

Our patient described in this report demonstrates that VA ECMO is an effective treatment for infant with cardiogenic shock due to intractable SVT. Paediatricians should consider referring haemodynamic unstable patients who have refractory SVT to centres that can provide ECMO support.

Declaration of Interest

We declare that we have no conflict of interests.

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