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A case of a neonatal cardiac tumor with ventricular tachycardia undergoing emergency surgery

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Abstract

Background Cardiac tumors in children are rare and usually have no obvious clinical symptoms. However, a small number of children may experience serious conditions such as arrhythmia, heart obstruction, and even death. When severe arrhythmia cannot be controlled by conservative treatment, surgical intervention is needed.

Case presentation A 20-day-old male neonate, born full-term via cesarean section, was admitted to the emergency department with complaints of jaundice for 16 days and a rapid heart rate detected for one day. The heart rate was recorded at 280 beats per minute. An electrocardiogram (ECG) initially suggested supraventricular tachycardia, later progressing to ventricular tachycardia. A bedside echocardiogram indicated an intracardiac mass. Conservative treatment failed to restore normal heart rhythm, then the patient underwent emergency surgery with tumor resection under general anesthesia and cardiopulmonary bypass. Post-surgery, ventilator-assisted breathing was administered, along with inotropic support, diuretics, anti-infective therapy, and fluid management. the heart rate and rhythm returned to normal. Postoperative pathology revealed the presence of a cardiac rhabdomyoma, and follow-up was arranged post-discharge.

Conclusion Cardiac tumors in children are relatively rare, mostly benign, and have a good prognosis. But for some emergency situations or heart tumors that cause adverse effects, timely and effective intervention is needed to avoid adverse consequences.

Keywords Neonatal Cardiac Tumor, Ventricular tachycardia, Emergency surgery

Background

Cardiac tumors are neoplasms that originate from the pericardium, myocardium, or endocardium and can occur across all age groups. They are classified as either primary or secondary. In children, cardiac tumors are mainly primary tumors, and approximately 80% of them are benign, leading to a relatively favorable prognosis. While many pediatric cardiac tumors remain asymptomatic, some patients may present with arrhythmias, syncope, or heart failure, which can pose significant risks. In this case, the neonate initially presented with arrhythmias due to a cardiac tumor. Pharmacological and

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electrical cardioversion were unsuccessful in controlling the arrhythmias, prompting an emergency surgical intervention, which resulted in a favorable outcome.

Case presentation

A 20-day-old male newborn, G1P1, received symptomatic treatment in the local hospital due to "jaundice" after birth. Later, the newborn was admitted to our hospital through the emergency department because of a rapid heart rate. The heart rate was 280 beats per minute upon admission. After a 12-lead electrocardiogram was completed, it suggested supraventricular tachycardia. The doctors in the neonatal intensive care unit first gave an intravenous push of adenosine triphosphate (ATP), and the heart rate dropped to 170 beats per minute. Meanwhile, propafenone was continuously pumped in. However, four hours later, the heart rate became 260 beats per minute. Adenosine triphosphate (ATP) was given by intravenous push again, and after the heart rate dropped, it rose back to 260 beats per minute.Three hours later, the infant's heart rate changed to ventricular tachycardia. Synchronized electrical cardioversion was performed and sinus rhythm was restored. However, ventricular tachycardia recurred 10 min later. After a consultation with the Department of Cardiology, propafenone was replaced with amiodarone for continuous infusion, but there was no improvement. Synchronized electrical cardioversion was carried out again, yet the restored sinus rhythm only lasted for 5 min. During this period, while the infant was in a sedated state, the blood pressure was around 68/31 mmHg with some fluctuations, the respiratory rate was 50–70 breaths per minute, and the percutaneous oxygen saturation was 96–99% under nasal catheter oxygen inhalation. The bedside emergency echocardiogram indicated that the preoperative cardiac color Doppler ultrasound showed an EF value of 57%, and the inner diameters of the left atrium and left ventricle were slightly enlarged. A high-echo mass could be seen beside the posterior leaflet of the mitral valve, with a size of approximately 14.9 mm × 4.8 mm. Its boundary with the posterior leaflet was unclear, and part of it was located on the left ventricular side (from the posterior leaflet of the mitral valve on the left ventricular side to the basal segment of the papillary muscle), and part was on the left atrial side, causing a slight change in the direction of the blood flow through the mitral valve. The foramen ovale was patent, there was moderate mitral regurgitation, moderate tricuspid regurgitation, and a left ventricular false tendon. LVIDd z score is + 1.1 and LA/Ao ratio is 23.2/9.0=2.58. A preliminary consideration was rhabdomyoma or myxoma in the heart (Fig. 1). After a consultation with the Department of Thoracic and Cardiovascular Surgery, it was considered that the infant's arrhythmia was related to the space-occupying lesion in the heart and could not be well controlled by drugs. To avoid hemodynamic disorders, it was recommended to complete the preoperative preparations and undergo emergency surgical treatment.

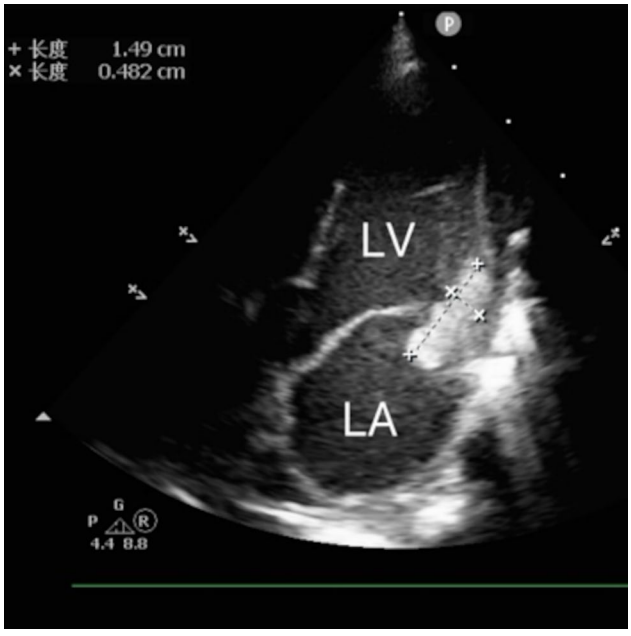

Fig. 1 Two dimensional images of preoperative cardiac ultrasound. LA: left atrium, LV: Left ventricle

The operation was performed on the evening of the day when the infant was admitted to the hospital. The operation was carried out under general anesthesia, hypothermia and cardiopulmonary bypass, with a median sternotomy. During the operation, a mass with a size of 15 mm × 8 mm × 8 mm could be seen at the posterior annulus of the mitral valve (Fig. 2). It was light yellow, solid and of moderate texture. There was also a similar mass on the left ventricular side below the mitral valve, with a size of 5 mm × 5 mm × 5 mm. The mitral annulus was enlarged, resulting in severe regurgitation. The tricuspid annulus was enlarged with moderate regurgitation. The patent foramen ovale was 2 mm × 2 mm in size, and the course of the coronary artery was normal. The atrial septum was opened through an incision in the right atrium, and cardiac tumor resection was performed. Meanwhile, mitral valvuloplasty, tricuspid valvuloplasty and repair of the foramen ovale were carried out. The operation went smoothly, and the infant was safely transferred back to the surgical intensive care unit for monitoring after the operation.

The electrocardiogram of the infant on the day after the operation showed sinus rhythm (Fig. 3). The EF value in the postoperative cardiac color Doppler ultrasound was 66%. The inner diameters of the left atrium and left ventricle were smaller than those before the operation. The echoes of some chordae tendineae, papillary muscles and the root of the posterior mitral valve leaflet

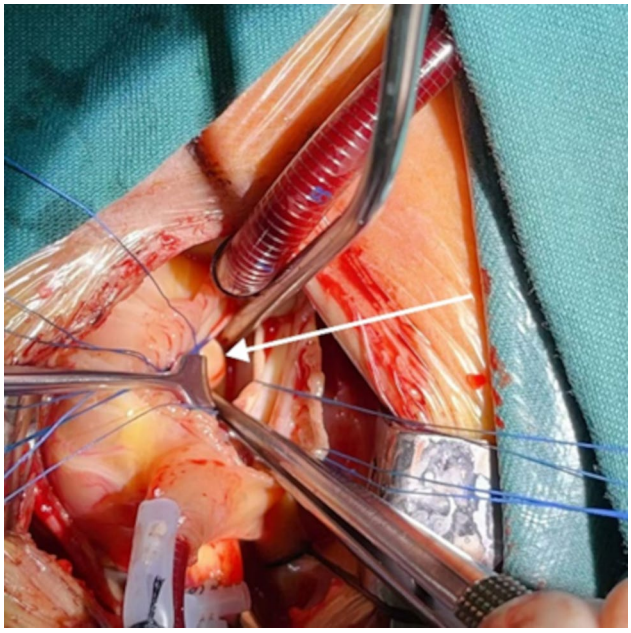

Fig. 2 The appearance after right atrial incision during surgery (The thing pointed by the arrow is the cardiac tumor)

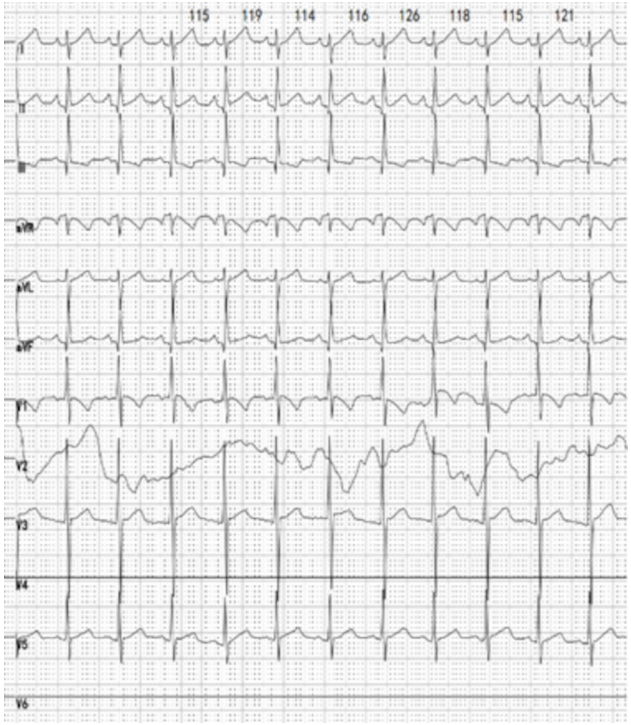

Fig. 3 Postoperative ECG: sinus rhythm

were enhanced. There was mild mitral regurgitation and slight tricuspid regurgitation. A few days later, a cranial MRI was completed, and no obvious abnormalities were found. Moreover, there were no abnormalities on the infant's whole body skin. Therefore, tuberous sclerosis complex was not considered for the time being. Three

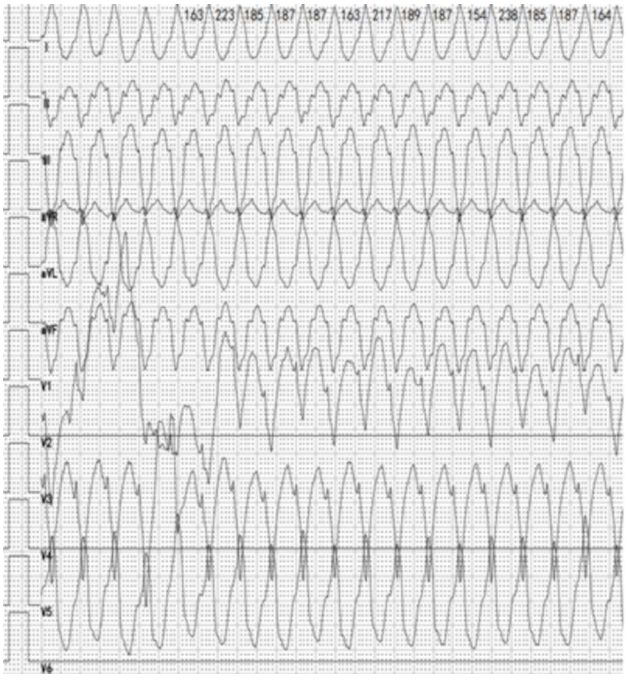

Fig. 4 Preoperative ECG: ventricular tachycardia

months after the operation, the infant's mental response was good, the growth and development were normal, the diet and sleep were fine, and the weight increased.

Discussion

Cardiac tumors can be classified into two types: primary tumors that originate within cardiac tissue and secondary tumors that spread from other tissues to the heart. Primary cardiac tumors are rare in all age groups, while secondary tumors are 30 times more common than primary ones [1]. Most primary cardiac tumors are benign, with myxomas being the most common in adults, while nearly half of pediatric cardiac tumors are rhabdomyomas. Other common pediatric cardiac tumors include fibromas, intrapericardial teratomas, myxomas, and hemangiomas [2].

The incidence of primary cardiac tumors in children ranges from 0.027 to 0.080%. Although rare, their presence, whether benign or malignant, can lead to serious consequences due to the heart's critical function in the body. The symptoms of cardiac tumors depend on their size, location, invasiveness, number, and growth rate. Patients may be asymptomatic or present with symptoms such as outflow tract obstruction, congestive heart failure, arrhythmias, pericardial effusion, syncope, or sudden death. Arrhythmias associated with cardiac tumors can manifest as cardiac arrest, ventricular fibrillation, ventricular tachycardia, or supraventricular tachycardia [3, 4]. In this case, the neonate experienced frequent arrhythmias that initially presented as supraventricular

tachycardia but later evolved into ventricular tachycardia. The arrhythmias were not controlled with medication, and the patient's blood pressure fluctuated, necessitating emergency surgery to save the child's life.

Diagnosing cardiac tumors is not difficult. Chest X-rays and ECGs may show abnormalities, though these findings are often nonspecific. Echocardiography is the most accessible non-invasive diagnostic technique and is often used to detect cardiac masses incidentally. Echocardiography can accurately and rapidly assess the tumor's location, size, and characteristics, making it the preferred diagnostic tool. Cardiac magnetic resonance imaging (MRI), with its ability to offer multiple imaging planes and superior tissue characterization, provides a more precise assessment of cardiac tumors, delineating the relationship between the tumor, normal myocardium, and major vessels. MRI can also help differentiate between cardiac tumors and thrombi, offering supplementary information to echocardiography [5]. Angiography was once considered a primary diagnostic tool for cardiac tumors; however, modern catheterization techniques are now reserved for select cases where congenital heart disease or hemodynamic assessment is necessary, particularly when coronary artery involvement is suspected. For tumors in the right heart system, endomyocardial biopsy via catheterization may be performed preoperatively to guide therapeutic strategies. However, most cases require intraoperative or postoperative pathological examination.

In 1954, Crafoord [6] performed the first successful resection of an atrial myxoma using cardiopulmonary bypass. In pediatric patients, most cardiac tumors are benign, and if they do not cause significant clinical symptoms or hemodynamic compromise, surgery may not be necessary. This is particularly true for rhabdomyomas, which may regress spontaneously over time [4, 7]. Multicenter studies in Europe suggest that the timing of surgery for pediatric cardiac tumors should be based on the patient's clinical symptoms and the degree of ECG or echocardiographic abnormalities [8]. When surgery is indicated, complete excision of the tumor is necessary to prevent local invasion and recurrence [3]. However, when complete resection would compromise vital cardiac structures, partial resection is often performed. Whether complete or partial, surgical treatment of cardiac tumors is a viable option, with postoperative echocardiographic follow-up required to monitor for potential complications such as ventricular aneurysms or cardiac dysfunction [9]. In this case, the neonate presented with sustained ventricular tachycardia that affected hemodynamics and posed a life-threatening risk. The cardiac tumor was large and located near the mitral annulus, occupying both the left atrium and left ventricle, obstructing blood flow and causing mitral and tricuspid regurgitation. During surgery, careful dissection was required to differentiate the tumor from the mitral valve tissue and excise it without damaging surrounding structures such as the valve annulus, chordae tendineae, or leaflets. When plicating the annulus, care was taken to avoid suturing into the coronary and pulmonary veins. Although the patient resumed sinus rhythm postoperatively, given the neonate's young age and the myocardial edema following surgery, there was a risk of low cardiac output syndrome or persistent arrhythmias. Therefore, delayed chest closure was performed, and the patient was managed with supportive care until the chest was successfully closed three days later.

The pathological nature of the excised cardiac tumor determines the patient's treatment strategy and prognosis. Rhabdomyomas are benign tumors of cardiac myocytes and are more common in neonates and infants, with the potential for spontaneous regression. Asymptomatic patients can be followed with echocardiography, and surgery is generally not required [4]. Symptomatic patients may present with heart murmurs, obstructive symptoms, or arrhythmias. Surgery is indicated for patients with arrhythmias refractory to medical management or those with hemodynamic obstruction. In this case, the patient had a rhabdomyoma located near the mitral valve annulus, presenting with malignant arrhythmias—ventricular tachycardia unresponsive to medication. After tumor excision, the patient returned to sinus rhythm, and no further arrhythmias were observed during follow-up. Additionally, rhabdomyomas are often associated with tuberous sclerosis, an autosomal dominant genetic disorder. Tuberous sclerosis can affect any organ system, with the classic triad including cortical tubers causing seizures, intellectual disability, and characteristic skin lesions (adenoma sebaceum). Thus, it is essential to monitor patients with cardiac rhabdomyomas for the subsequent development of these clinical features. There have been reports of using mTOR inhibitors (such as sirolimus and everolimus) to treat fetal rhabdomyomas associated with tuberous sclerosis in pregnant women. However, due to the limited number of cases, the optimal dosage, efficacy, and safety of these drugs require further investigation [10].

Cardiac tumors in children are relatively rare, mostly benign, and have a good prognosis. But for some emergency situations or heart tumors that cause adverse effects, timely and effective intervention is needed to avoid adverse consequences. Cardiac surgery during the neonatal period is difficult and requires comprehensive diagnosis and treatment during the perioperative period.

Abbreviations

ECG	Electrocardiogram
LA	Left atrium
LV	Left ventricle

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Not applicable.

Author contributions
PJL drafted the initial manuscript, ZB and YHC revised the manuscript.All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study involving the collection and analysis of patient case data was conducted in accordance with ethical principles, and all procedures were carried out following the Declaration of Helsinki. The study strictly adhered to patient confdentiality and privacy standards. Informed consent was obtained from the parents (also the legal guardians) of the child patient, and all the data were anonymized to ensure the protection of personal information. Ethics approval was not needed for this case report.

Consent for publication
Written informed consent for publication of their clinical details and clinical images was obtained from the patient's parents of the patient.

Competing interests
The authors declare no competing interests.

Clinical trial number
Not applicable.

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