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A Case of Neonatal Heart Failure Caused by Left Ventricular Diverticulum: Successful ECMO Support Application

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ABSTRACT

Congenital left ventricular diverticulum is a rare cardiac anomaly. During the newborn period, symptomatic patients are diagnosed with heart failure findings. We present a 23-day-old male newborn with congenital left ventricular diverticulum diagnosed during fetal echocardiographic examination. After the birth, the patient had heart failure symptoms and his echocardiographic examination showed low cardiac ejection fraction. Diverticulum was operated with endoventricular circular patch plasty (DOR) technique, and after, cardiopulmonary bypass venoarterial extracorporeal membrane oxygenation (ECMO) support was performed because of low cardiac output syndrome. On postoperative day 17, he was discharged with no problem.

INTRODUCTION

Ventricular diverticulum is a rare congenital anomaly, and poorly understood. The first patient was described by O'Bryan in 1838 [O'Bryan 1838]. It is usually detected in children with other cardiac abnormalities, as reported by Cantrell et al in 1958 [Cantrell 1958]. About 30% of cases are not associated with other congenital malformations and are defined as isolated ventricular diverticula. They are most often found in the left ventricle (LV) but have been reported in all chambers of the heart [Ohlow 2006]. An isolated ventricular diverticulum is often asymptomatic unless it grows quite large. Therefore, it is usually an incidental finding during transthoracic echocardiography or cardiac catheterization. Here we report a newborn who had heart failure symptoms with a giant isolated left ventricular diverticulum.

CASE REPORT

A 23-day-old, 4.2 kg male newborn presented with heart failure symptoms with congenital left ventricular diverticulum. He was diagnosed during fetal echocardiographic examination. On physical examination he had dyspnea and tachypnea. His heart rate was 156/bpm and blood pressure was 56/22 mean 32 mmHg. Electrocardiography was in sinus rhythm with tachycardia. X-ray showed severe cardiomegaly (Figure 1). Echocardiography described an adequate left-sided pumping chamber in addition to the 37 × 20 mm left ventricular posterior apical diverticulum (Figure 2) and low ejection fraction (50%). Under inotropic support, the patient underwent urgent surgery.

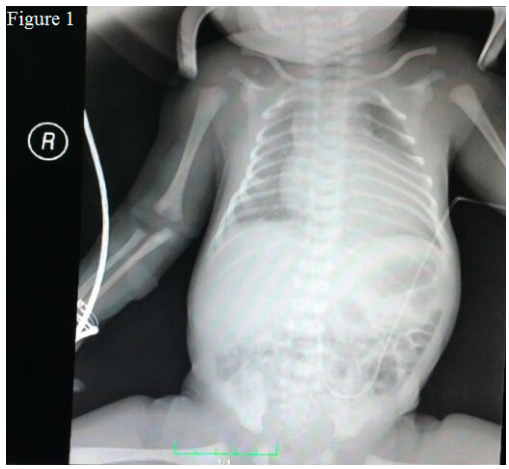

Figure 1. Preoperative X-ray shows cardiomegaly.

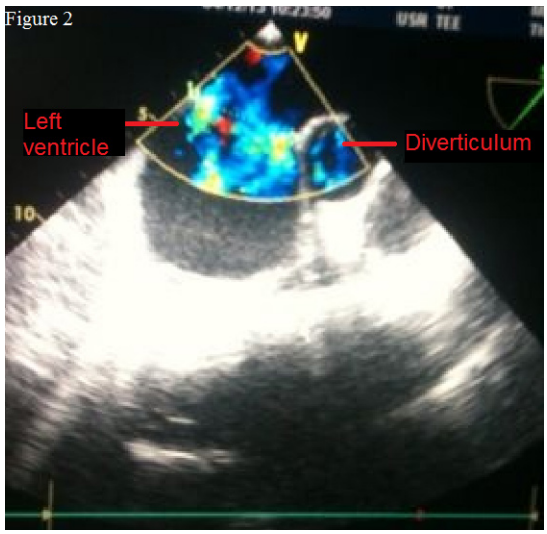

Figure 2. Preoperative echocardiography shows diverticulum and left ventricle.

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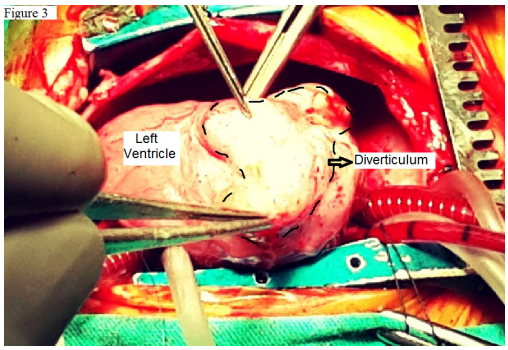

Figure 3. Perioperative image of left ventricular diverticulum.

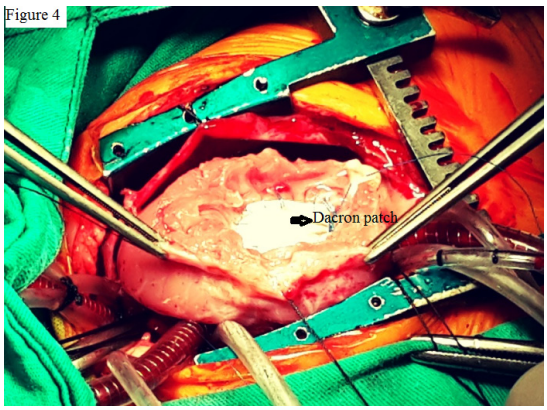

Figure 4. Perioperative image of endoventricular circular patch plasty technique (DOR technique).

Operation was performed under mild hypothermic (32°C) cardiopulmonary bypass. After cross-clamping and blood cardioplegia was administered, left ventricular apical diverticulum was seen (Figure 3). Cardioplegia was given at 20-minute intervals for myocardial protection. The diverticulum area affected the end part of the left anterior descending and circumflex arteries. After stay sutures were placed, the diverticulum was opened and it contained fibrous and muscular lamina. Excessive fibrous tissue was partially resected and then the left ventricle was repaired with endoventricular circular patch plasty technique (DOR) (Figure 4). At the end of the operation, although given high doses of inotropic support, the patient couldn't wean from cardiopulmonary bypass. Perioperative echocardiographic examination showed low ejection fraction. We decided to apply ECMO, and then perioperative central venoarterial extracorporeal membrane oxygenation (ECMO) support was applied (Figure 5). He was followed with ECMO support for 4 days with low dose inotropic support (dopamine 7 mcg/kg/min) in the cardiac intensive care unit. Serial echocardiographic examinations showed an increasing in cardiac ejection fraction. On the 4th day of ECMO support, the patient's hemodynamic parameters were stable and he was weaned from ECMO. On the 5th day, the patient was extubated. Postoperative echocardiographic examination showed good cardiac performance with intact ventricular repair and sinus rhythm. On postoperative day 17

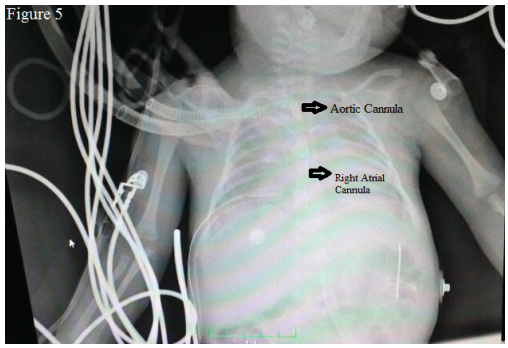

Figure 5. Postoperative X-ray shows ECMO cannulas.

he was discharged uneventfully. Histopathologic examination showed mild myocardial hypertrophy and fibrosis.

DISCUSSION

Left ventricular diverticulum is a rare congenital anomaly. The reported incidence is 0.4% in a postmortem study of cardiac deaths [Mardini 1984] and 0.26% in a group of patients undergoing routine cardiac catheterization [Baltaxe 1979]. It is frequently associated with other cardiac or extracardiac congenital abnormalities, including Cantrell's syndrome. In the heart, it is preferably located in the left ventricle [Ohlow 2006], and there are two types of diverticulum: muscular and fibrotic [Archbold 1999]. Usually the muscular type is located in the apex of the left ventricle; it does not affect the myocardial structure and the amount of tissue is minimal. Our patient had no other abnormalities and it was located on the left ventricle posterior apical area.

Isolated cardiac diverticulum is usually asymptomatic; however, there are some reports associated with cardiac failure, arrhythmias, embolic events, and even death due to diverticulum rupture. The treatment of this anomaly in asymptomatic patients is controversial and there have been some treatments such as antiplatelets, anticoagulants, and even surgical removal. Our patient was a newborn and had a giant left ventricular diverticulum with heart failure. After the surgery, the effective left ventricular volume was not enough for adequate contractile force and ejection fraction. For this reason, ECMO support was applied for the left ventricle's adaptation.

Children with congenital heart disease are usually at risk of heart failure. That is why in pediatric patients with congenital heart disease, ECMO procedures have traditionally been utilized preoperatively, intraoperatively, or postoperatively. Cardiac ECMO provides support for babies or children with severe heart failure. The aim is to rest the child's heart so it is not under any stress and is given time to recover. In our case, ECMO support was applied due to heart failure after cardiopulmonary bypass and results were favorable.

Conclusion

Congenital ventricular diverticulum is usually asymptomatic or can cause a variety of results like heart failure,

arrhythmia, and systemic embolization. In those patients with symptomatic and giant congenital ventricular diverticulum, surgical resection should be indicated for major complications. ECMO support should be applicable to low cardiac output syndrome after diverticulum operation. Because the operation may reduce left ventricular volume, low cardiac output and heart failure may develop. Therefore, we offer that these kinds of operations should be done at the center applying ECMO support.

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