Window anastomosis technique for repair of supracardiac total anomalous pulmonary venous connection in infants

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Abstract

Outcomes of operations for total anomalous pulmonary venous connection (TAPVC) have improved.However, postoperative pulmonary venous obstruction (PVO) remains the most significant complication, with high morbidity and mortality. We introduce a window anastomosis technique for repair of supracardiac TAPVC in infants. The mainstay of the surgical technique is to resect the anterior wall of the pulmonary vein confluence(PVC) and part of the posterior wall of the left atrium to form a large and undistorted "window to window" anastomosis.

Introduction

Total anomalous pulmonary venous connection (TAPVC) is a rare and serious cardiac anomaly, accounting for approximately 1%-3% of congenital heart diseases [1]. Supracardiac TAPVC is the most common type [2]. The anastomosis of pulmonary vein confluence(PVC) and left atrium is the key step of operation. Anastomotic stenosis or distortion can induce progressive postoperative pulmonary venous obstruction (PVO), which is associated with increased late mortality and morbidity. In order to create a large and undistorted anastomosis, we developed an modified anastomosis technique for repair of supracardiac TAPVC in infants.

Surgical technique

After performing a median sternotomy, cardiopulmonary bypass is established by aortobicaval cannulation. Immediately after the initiation of cardiopulmonary bypass, the ductus arteriosus or ligament is ligated. The patient is cooled to mild hypothermia at 28-30°C. The aorta is cross-clamped and cardiac arrest induced with antegrade cardioplegic solution.

The right pleural cavity is opened widely. The heart is retracted cephalad and pushed into the right pleural cavity exposing the posterior pericardial area.The vertical vein is ligated near its connection with the innominate vein or superior vena cava.The pulmonary vein confluence(PVC) is incised longitudinally until the individual ostias of pulmonary veins are exposed,but do not extend into the ostias. The anterior wall of the PVC is resected along the incision to form a window of the PVC(figure 1). The ostias of pulmonary veins are clearly visible from the window of the PVC. The left atrial appendage is retracted.In the supracardiac TAPVC the confluence is mostly transversal rather then vertical, therefore we resect part of the posterior wall of the left atrium to form a transverse rectangular window, corresponding to the window of the PVC(figure 2). The window of left atrium and the window of PVC are anastomosed using running suture with 7-0 polypropylene suture. The heart is put back into the mediastinum. The atrial septal defect is repaired using a bovin pericardium patch.

We had successfully treated 9 infants with supracardiac TAPVC using this surgical technique. All patients were discharged uneventfully.The median surgical age was 53 days [interquartile range (IQR): 32-92] days.

The median body weight at surgery was 4.2 (IQR: 3.3-6.5) kg. The median time of CPB and aortic cross-clamp were 105 (IQR: 87-119) mins and 58 (IQR: 46-75) mins, respectively.The median follow-up was 7 months (range: 3 to 15 months). During the follow-up, no postoperative PVO was found in all patients, and all survivors were in New York Heart Association Functional Classification I or II.

Comment

Postoperative pulmonary venous obstruction (PVO) develops in approximately 10% to 20% and is associated with an extremely poor prognosis[3]. Anatomic subtypes, preoperative obstruction, and surgical techniques have been implicated in the occurrence of postoperative PVO[4-5]. In most cases, the obstruction is located at the anastomosis between the left atrium and the pulmonary venous confluence[6]. So, we consider that clear intraoperative exposure and creating the largest possible anastomosis without distortion are crucial to surgical repair.The posterior approach that heart is retracted cephalad and pushed into the right pleural cavity can offer better exposure,and has reported good outcomes in several studies[7-8]. However, this approach carries a potential risk of anastomotic distortion because the anastomosis is performed with the heart not in an anatomic position.We modified the anastomosis technique for posterior approach. The anastomosis was enlarged by resecting the anterior wall of the PVC and part of the posterior wall of the left atrium to form a window-to-window anastomosis.This window-to-window anastomosis can also decrease the risk of anastomosis distortion caused by poor alignment of traditional incision-to-incision anastomosis. A 3D geometry model study demonstrated that window anastomosis had a lower pressure difference of anastomosis and higher energy conversion efficiency than the traditional surgery for supracardiac TAPVC[9].

Sutureless technique have been engaged and proved to be an effective means to relieve postoperative PVO for the primary repair for TAPVC. But sutureless technique has both advantages and disadvantages. We think that sutureless technique has advantages for patients with hypoplastic PVC and pulmonary veins,but it is controversial for patients without preoperative PVO. Primary sutureless technique has a relatively benign type of peripheral PVO could occur[10].In this study, we selected cases without obvious preoperative PVO, so we did not open the individual pulmonary vein and directly anastomosised the left atrium and PVC.

The main limitations of this study were the small number of cases and short follow-up time. A larger patient population and long-term follow-up are needed in the future to assess its outcomes.

In conclusion, we think that the window anastomosis can creat a large and undistorted anastomosis.This anastomosis technique is simple,safe and effective. It could decrease the incidence of postoperative PVO.

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Figure Legend

Figure 1. The heart is retracted cephalad and pushed into the right pleural cavity exposing the posterior pericardial area. The anterior wall of the pulmonary vein confluence(PVC) is resected to form a window of the PVC (yellow arrow). Part of the posterior wall of the left atrium is resected to form a transverse rectangular window of the left atrium(red arrow).

Figure 2. The anterior wall of the pulmonary vein confluence(PVC) is resected to form a window of the PVC (yellow arrow). Part of the posterior wall of the left atrium is resected to form a transverse rectangular window of the left atrium(red arrow) (MPA,main pulmonary artery;VV,vertical vein;LUPV,left upper pulmonary vein;LLPV,left lower pulmonary vein;IVC,inferior vena cava;LV,left ventricle).