

New ideas - Congenital

Venous cannulation for extracorporeal circulation after total cavopulmonary connection with extracardiac conduit

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Abstract

We report two cases of venous cannulation after a total cavopulmonary connection (TCPC) with extracardiac conduit. Venous cannulation was performed via side graft sutured to the extracardiac conduit in an end-to-side fashion. The first case was a 3-year-old girl, who suffered from an atypical inferior vena cava obstruction after TCPC. The obstruction region was distal to the anastomosis site of extracardiac conduit and inferior vena cava. She underwent a surgical release of obstruction under cardiopulmonary bypass without circulatory arrest. The second case was a 2-year-old girl, who needed an extracorporeal membrane oxygenation support after TCPC due to severe low cardiac output syndrome. She was decannulated successfully after thirty-nine-hour support.

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1. Introduction

Clinical results of Fontan type operation have improved progressively and impressively after the introduction of a total cavopulmonary connection (TCPC) [1]. TCPC with extracardiac conduit was recently accepted as a standard Fontan modification due to the potential benefits; the avoidance of postoperative supraventricular arrhythmias over the long-term, hemodynamic benefits of laminar flow, possibility of completion without anoxic arrest, and applicability to anomalous systemic and/or pulmonary venous return [2,3]. Some patients need cardiopulmonary bypass (CPB) for re-operation or extracorporeal membrane oxygenation (ECMO) due to severe hemodynamic instability after Fontan operation. Venous cannulation after TCPC with extracardiac conduit can be occasionally difficult due to the fragile venous cannulation site at an early stage of operation or the adhesion at long-term after operation. Venous drainage from the inferior vena cava (IVC) is important to maintain CPB flow or ECMO support. However, adequate venous cannulation method for the venous drainage from IVC is especially difficult. We report two cases of venous cannulation after TCPC with extracardiac conduit. Venous cannulation was performed via side graft sutured to the extracardiac conduit in an end-to-side fashion.

2. Clinical summary

2.1. Case 1

A 3-year-old girl, who had been operated on by the bidirectional Glenn procedure due to double outlet right

ventricle, mitral valve straddling, pulmonary stenosis, underwent a staged TCPC with the extracardiac conduit using an 18 mm polytetrafluoroethylene graft. A central venous pressure (superior vena cava pressure) and a right femoral venous pressure (IVC pressure) were monitored continuously by a fluid-filled pressure line. Weaning from CPB was smooth, and the patient was extubated within 1 h after operation in the intensive care unit. However, the next morning after operation, a right femoral venous pressure was elevating gradually and the pressure difference between a right femoral venous pressure and a central venous pressure had reached 3 mmHg. Echocardiography showed the IVC obstruction distal to the anastomosis site. Emergent operation was performed. The re-cannulation to the IVC was difficult due to the fragile venous cannulation site and the obstructive site was distal to the cannulation site. After CPB was instituted with the venous return from the superior vena cava and arterial outflow through the ascending aorta, an 8-mm polytetrafluoroethylene graft was sutured to the extracardiac conduit in an end-to-side fashion with a 5-0 polytetrafluoroethylene suture, and then a 16 Fr straight venous cannula was directly inserted through the side graft, and the venous return from IVC was also drained to CPB circuit. Extracardiac conduit was cut at 1 cm proximal site from the anastomosis site with IVC. Flesh thrombus inside the conduit was removed and the membranous tissue causing IVC obstruction was resected (Fig. 1). Weaning from CPB was easy, and the pressure differentiation between the central venous pressure and the right femoral venous pressure disappeared after the operation. The anticoagulation was performed by the drip-infusion of heparin sodium and then warfarin sulfate after

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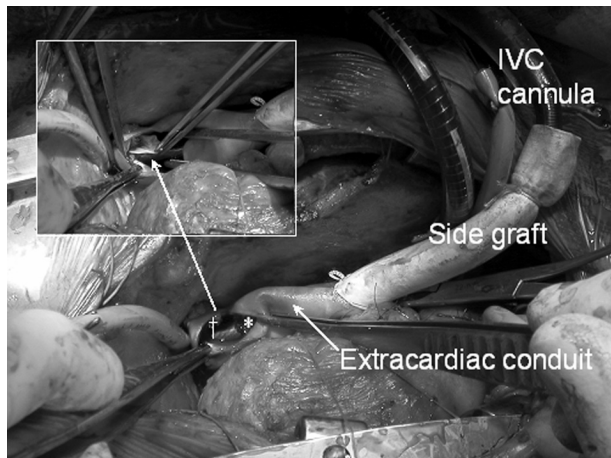


Fig. 1. Operative findings. A straight venous cannula was directly inserted through the side graft sutured to the extracardiac conduit in an end-to-side fashion, and the venous return from IVC was drained to CPB circuit. Extracardiac conduit was cut at 1 cm proximal site from the anastomosis site with IVC. Flesh thrombus (*) inside the conduit was removed and the membranous tissue (†) causing IVC obstruction was resected. CPB, cardiopulmonary bypass; IVC, inferior vena cava.

oral intake was established to prevent thromboembolism for up to 1 year after operation.

2.2. Case 2

A 2-year-old girl, who had been operated on by the bidirectional Glenn procedure due to right single ventricle, pulmonary atresia, underwent a staged TCPC with the extracardiac conduit using an 18 mm polytetrafluoroethylene graft. Fenestration was made due to severe low output syndrome and peripheral circulatory failure. Hemodynamic instability still continued after fenestration, and then ECMO support was begun with the venous return from a 16 Fr straight venous cannula inserted through an 8-mm polytetrafluoroethylene graft sutured to the extracardiac conduit in an end-to-side fashion and the arterial outflow through a 12 Fr straight arterial cannula inserted into the ascending aorta. She was decannulated successfully after thirty-nine-hour ECMO support.

3. Discussion

The present venous cannulation via side graft sutured to the extracardiac conduit in an end-to-side fashion after

TCPC saved both the IVC obstruction patient who needed re-operation, and the severe low output syndrome patient who needed ECMO support. Both patients were critical cases dependent from maintaining adequate venous return.

IVC obstruction after TCPC is a critical complication. In the present case, the re-cannulation to the IVC was difficult due to the fragile venous cannulation site and the obstructive site was distal to the cannulation site. Venous drainage through femoral vein cannulation [4] was difficult due to the small patient weighing 14 kg. Circulatory arrest was considered to be necessary for the release of IVC obstruction. The present venous cannulation method enabled the avoidance of circulatory arrest and then brought about the good clinical results. ECMO support provides the effective mechanical circulatory support for the failing circulation in children. However, the clinical result of ECMO support after a right heart bypass surgery is poor [5]. The adequate venous return is one of the most important factors for improving the clinical outcome of ECMO support. The present venous cannulation after TCPC with extracardiac conduit was the optimal technique to maintain adequate venous drainage and then sufficient systemic perfusion.

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