Cannulation techniques for temporary right and left ventricular support: simple solutions for a difficult problem

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Abstract

End-stage cardiac failure where appropriate is best treated with cardiac transplantation. With improvements in medical therapy, the emergence of primary percutaneous coronary intervention, and an increasingly ageing population, patients with right, left or biventricular failure, who are not suitable for cardiac transplantation or long-term ventricular assist device therapy, present for cardiac surgery. The modern cardiac surgeon needs to have a safe strategy for dealing with these complex cases. We report two cases that illustrate simple and safe cannulation techniques for temporary left and right ventricular failure.

Keywords: Heart failure • Ventricular assist • Extracorporeal membrane oxygenator • Circulatory support

INTRODUCTION

Changes in patient demographics and advances in medical and surgical technology have resulted in older and sicker patients presenting with heart failure for cardiac surgery. Often, heart recovery is dependent on volume and pressure unloading of the heart. This can be achieved with temporary ventricular assist devices that provide an excellent backup and bridge to recovery or decision [1].

We describe two cases that illustrate two simple techniques to implant temporary mechanical support of the right and left ventricle, which result in less bleeding and allow the chest to be closed during support.

CASE ONE: TEMPORARY RIGHT VENTRICULAR SUPPORT

A 14-year-old female with dilated cardiomyopathy in cardiogenic shock had a VentrAssist™ left ventricular assist device (LVAD) implanted as a bridge to transplantation. The weaning from cardiopulmonary bypass (CPB) was followed by precipitous right heart failure that required immediate right heart mechanical support.

An extracorporeal membrane oxygenator was modified to be a right ventricular assist device (RVAD). Venous drainage was via a venous cannula placed in the right atrium percutaneously via the left femoral vein. An 8-mm vascular graft was anastomosed end-to-side to the main pulmonary artery trunk and tunnelled out through the chest wall, exiting the skin in the epigastrium (Fig. 1). Arterial return from the RVAD circuit was via a 17-F cannula that was secured into the vascular graft by multiple silk ties. The patient was weaned from CPB with matching RVAD and LVAD flows.

Ten days later, the patient returned to the theatre after successful weaning of RVAD. The femoral vein was decannulated, with pressure over the venepuncture site securing haemostasis. The silk ties securing the arterial cannula into the gortex graft were cut and the cannula removed. The gortex graft was cut flush with the skin while maintaining traction on it, the end oversewn and then allowed to retract 2 cm into the wound, which was then closed over it. The patient was discharged from hospital 15 days later.

CASE TWO: TEMPORARY LEFT VENTRICULAR SUPPORT

After a successful resuscitation from out-of-hospital cardiac arrest, a 68-year-old man was transferred to our Department. Coronary angiography revealed significant multiple vessels disease involving the left main stem (LMS). Due to the prolonged period of cardiopulmonary resuscitation with probable neurological complications and metabolical derangement, surgical revascularization was deemed inappropriate. With an intra-aortic balloon pump in situ, a Taxus Element (Boston Scientific, MA, USA) was placed in the LMS and balloon angioplasty to the marginal and right coronaries performed. Due to a diffuse disease pattern, flow in the distal vessels postprocedure showed partial reperfusion at best; left ventricular function was extremely poor. After a multidisciplinary team meeting, the patient was taken to theatre for surgical revascularization and temporary LVAD support. During reperfusion, before discontinuation of CPB, a descending aortic homograft was anastomosed to the junction of the right superior pulmonary vein with the left atrium. A
right-angled, wire reinforced venous cannula was introduced through this conduit into the centre of the left atrium. Silk ligatures were placed around the homograft to retain the cannula in place. The distal end of the venous cannula was tunneled through the skin, below the sternotomy wound. A Dacron graft was anastomosed to the ascending aorta using a side clamp. A straight arterial inflow cannula was inserted through this graft and secured using silk ligatures, and brought out through the skin adjacent to the venous cannula (Fig. 2). The circuit was connected to a Levotronics CentriMag pump (Levotronics LLC, Waltham, MA, USA) [2]. CPB was weaned off and the chest formally closed. Over the following 16 days, the LVAD was gradually weaned off. To remove it, the ligatures on the homograft were cut, the venous cannula was withdrawn, and the homograft was trimmed and double ligated at its base. A similar procedure was carried out on the Dacron graft. The chest was closed, and the patient transferred back to the intensive care unit.

DISCUSSION

The modern cardiac surgeon has to face a growing number of patients with heart failure not responding to optimal medical therapy. A proactive mechanical device-based surgical strategy is often the only chance to support a stunned and fragile myocardium. Symptomatic benefit to survivors is considerable.

New generation ventricular assist devices (VADs) are expensive and generally have limited use in designated cardiothoracic transplant centres. Older VADs, such as the Rotaflow RF32 or CentriMag pumps are less costly and neither portable nor designed for long-term support; they are, however, a good option for patients with ventricular failure who are not enrolled in a transplant programme and need temporary ventricular assist [3–5].

Traditional cannulation techniques for temporary ventricular support with the cannulae being directly inserted into the
relevant artery/vein/cardiac chambers are technically easy, but prone to haemorrhage during circulatory support, can be challenging to decannulate and require the chest to remain open. Sepsis, blood product transfusions and re-explorations for bleeding tip the balance in favour of death, in these precariously positioned patients [6, 7]. The cannulation techniques we describe are designed to minimize these risks. The technique for right ventricular support, moreover, allows for decannulation without reopening the sternotomy, making it a very attractive technique.

Conflict of interest: none declared.

REFERENCES


