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Case Report

CASE REPORT

Acute-right-ventricular-failure post-cardiotomy: RVAD as a bridge to a successful recovery

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Abstract

This is the case of a 57-year-old woman who underwent coronary-artery-bypass-grafting following a diagnosis of NSTEMI with triple-coronary-vessel-disease. During separation from cardiopulmonary-bypass she developed acute severe-right-ventricular-failure refractory to inotropic support and intra-aortic-balloon-pump-counterpulsation. Therefore VA-ECMO was established in order to separate the patient from cardiopulmonary-bypass. VA-ECMO was then transitioned to RVAD support which allowed complete recovery of RV-function and subsequent explantation. The patient was eventually discharged home.

INTRODUCTION

Acute-right-ventricular (RV) failure is a well-recognized, although rare, cause of morbidity and mortality following cardiac surgery. Although it is seen more commonly following heart transplantation (2–3%) and left-ventricular-assist-device implantation (20–30%) it also observed in 0.04–0.1% of patients following cardiac surgical procedures [1]. RV-failure following cardiac surgery is usually the result of ischemia-reperfusion-injury and in the majority of the patients is associated with mild depression of RV-function. In most patients this is self-limiting and does not affect patient outcome. In a minority of patients, especially those with precipitating factors, acute severe-RV-failure can develop resulting in hemodynamic instability. Factors which can predispose to RV-injury include sub-optimal myocardial protection, long CPB time, RV myocardial ischemia or infarction, atrial arrhythmias, reperfusion lung injury and pre-existing pulmonary-vascular-disease. In patients who develop severe-RV-failure the risk of mortality can range up to 70–75% [1, 2]. Treatment can be difficult and includes the use of pulmonary vasodilators, inotropic support, mechanical support with counterpulsation, ECMO (extracorporeal-membrane-oxygenation) or insertion of a RV-assist-device (RVAD).

This report describes the course of a patient who developed severe-acute-RV-failure following coronary-artery-bypass-grafting (CABG). Initially veno-arterial (VA)-ECMO was established due to inability to separate from cardiopulmonary-bypass (CPB). This was then transitioned to RVAD support which allowed recovery of RV-function and subsequent explantation.

CASE REPORT

A 57-year-old woman was admitted with a diagnosis of NSTEMI. Her risk factors for coronary-artery-disease were hypertension, hypercholesterolemia and type-2-diabetes. She had no other major medical problems. Investigations revealed significant coronary-artery-disease, good left-ventricular (LV) function and no valvular pathology. She underwent urgent CABGx3 (LIMA-to-LAD, SVG-to-PDA-and-OM2). The operation was uneventful but while weaning from CPB she developed severe-RV-dysfunction. Infusions of Dopamine and Noradrenaline were commenced and CPB was eventually discontinued with atrioventricular-pacing. Shortly after closing the sternum there was a sudden drop in blood pressure. Haemodynamics improved

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following a bolus infusion of Adrenaline. A decision to commence intra-aortic-balloon-pump-counterpulsation was made. During insertion of the intra-aortic-balloon catheter the patient developed ventricular-fibrillation. This was followed by emergency re-sternotomy and reinstitution of CPB.

The heart was rested on CPB for a period of time. However due to persistent RV-dysfunction and haemodynamic instability after further attempts to wean CPB a decision was made to institute VA-ECMO. She remained haemodynamically stable and 72 h after the operation an attempt was made to wean the patient from VA-ECMO. This was unsuccessful due to persistent severe-RV-dysfunction requiring insertion of an RVAD for continued support the RV.

RV-assist-device support was continued for 15 days and following which the RVAD was successfully explanted. Before explantation intraoperative-TOE and visual inspection revealed a good RV-function. During hospital admission she unfortunately suffered of respiratory-failure requiring reintubation. To assist respiratory weaning, a tracheostomy was placed and successfully removed after 2 weeks. She also suffered of stroke and a CT-head demonstrated a left-occipital-infarct and a small focus of ischemia in the left-cerebellum from which she made a good recovery. She was eventually discharged home a month after RVAD explantation and she is still making good progress.

DISCUSSION

Acute severe-post-cardiotomy-RV-failure is associated with a poor prognosis. When the RV fails, maintenance of haemodynamic stability depends on LV-contraction, however excessive RV volume loading results in severe RV dilation. This can result in leftward shift of the ventricular septum and modification of LV geometry. The culmination of these findings results in a reduced cardiac output, systemic congestion, hypoxemia and circulatory failure with a mortality rate that can reach 70–75% [1, 2].

Numerous factors contribute to this phenomenon. RV-failure following cardiac surgery is often the result of induced ischemia and myocardial depression during CPB. CBP is also associated with a concomitant increase in pulmonary vascular reactivity. In addition to RV ischemia and altered interventricular mechanics, other factors involved in the perioperative management of these patients also must be considered as potential contributors to RV failure. Extensive bleeding requiring transfusion of blood and clotting factors increases both intravascular volume and the pulmonary vascular resistance. Similarly, the addition of vasopressors to these patients also increases pulmonary vasoreactivity. This is associated with increased RV-afterload secondary to an increase in both pulmonary-vascular-resistance (PVR) and left atrial afterload [3].

Implantation of RVADs has been described as an effective treatment option in patients who develop isolated severe RV failure after cardiac surgery. Osaki *et al*. have described a similar case of a patient who developed right-heart-failure post-cardiotomy, VA-ECMO was instituted to separate the patient from CPB and an RVAD was implanted to bridge the patient to a successful recovery with no evidence or recurrence of heart failure 668 days after RVAD explantation [4]. A best evidence topic, conducted by Lang *et al*., showed that RVADs have been successfully used to bridge patients to recovery after cardiac surgery. In this study they reported a significant reduction in central-venous-pressure and mean-pulmonary-artery-pressure during and after RVAD support. Additionally they described an increase in RV-cardiac-output and stroke work and an increase in pulmonary-artery-oxygenation-saturations. Furthermore following RVAD explantation on Day 7 they demonstrated an increase in RV-ejection-fraction up to 40% and also a significant reduction in right-heart-chamber-dimensions [5]. Importantly there is evidence which suggests that RVADs work most effectively if implanted early, thereby avoiding significant end-organ injury [3]. Some risks and complications associated with RVAD support include bleeding, stroke, thromboembolism, renal failure, hepatic failure, infection, arrhythmias, multi-organ failure and death.

RV-assist-device support can be used safely as a bridge to recovery in patients who develop acute-isolated-RV-failure after cardiac surgery. Early implantation is favored in this setting, particularly when the patient is refractory to inotropic support or VA-ECMO.

CONFLICT OF INTEREST STATEMENT

None declared.

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