Right ventricular temporal assist device for cardiac recompensation

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Abstract

In this case report, we discuss treatment of a 66-year-old patient with right heart failure due to chronic left heart failure caused by ischemic cardiomyopathy. We decided to manage this patient by implanting a temporary right ventricular assist device (Impella RP®) as a novel therapeutic option for acute on chronic right heart decompensation.

Keywords
Right heart failure; Mechanical circulatory support; Percutaneous microaxial pump; Chronic biventricular failure

Introduction

The prevalence of heart failure (HF) is about 1–2% of the adult population. While chronic right HF (RHF) is common, the real-life prevalence of acute RHF is unclear. For the specific management of acute RHF, several uncertainties remain, which make treatment decisions challenging. Echocardiographic assessment is focused on right ventricular size, function, and load and should exclude extrinsic causes of acute RHF like pericardial tamponade, which mimics acute RHF and needs acute treatment. The use of temporal right ventricular mechanical circulatory support may be required in acute certain clinical situations such as right ventricular (RV) myocardial infarction (MI), acute pulmonary embolism, following left ventricular assist device (LVAD) implantation, or primary graft failure after heart transplantation.

The application of Impella RP® is already published1,2 for acute RHF post-LVAD, postcardiotomy, and post-transplant (Figure 1). In most cases, the RHF occurs as a consequence of chronic left HF. Many patients with or without LVADs suffer from chronic RV failure. They are often admitted to hospital with recurrent acute on chronic right heart decompensation despite maximal pharmacologic therapy. The following case report describes the use of Impella RP® in the context of acute decompensation of chronic RV failure.

Case report

A 66-year-old patient appeared with signs and symptoms of an acute right heart decompensation with gain of weight (+10 kg), peripheral oedema, and exercise intolerance as manifestation of severe congestion (‘warm and wet’) to be evaluated for further treatment options for terminal HF due to ischemic heart disease. His medical history began with an acute ST-elevation MI in July 2015 with a successful percutaneous coronary intervention of the proximal left anterior descending artery. Echocardiography revealed severely reduced left ventricular pump function with an ejection fraction of 15%, diastolic dysfunction, and severely reduced RV function, with mitral regurgitation grade IV and moderate insufficiency of the tricuspid valve. Despite maximal pharmacologic therapy, biventricular pump function could not be improved. The severe mitral valve insufficiency was treated via percutaneous approach with implantation of two MitraClips® in October 2016 resulting in a reduced regurgitation from grade IV to grade I–II. Despite this treatment, recurrent cardiac decompensations still occurred (Table 1).

The admission transthoracic echocardiography revealed severely diminished biventricular systolic and diastolic function, persistent moderate mitral valve regurgitation, and severe tricuspid insufficiency.
Thoracic X-ray showed significant pulmonary venous stasis. The laboratory analysis revealed elevated NT-proBNP (29 000 ng/L) and liver enzyme values (Table 2).

During the next few days, the patient was treated with high dose loop diuretics (furosemide 240 mg/day). Despite sufficient renal function, loss of weight or improvement of the symptoms could not be observed.

Treatment with positive inotropes like levosimendan did not show any positive effects. The sustained biventricular HF, age, co-morbidities, and slight cognitive impairment showed that the patient was not suitable for LVAD implantation (high risk of RHF after LVAD) or cardiac transplantation. Therefore, we used a temporary mechanical support device for the management of RHF at day 9 after admission.

During treatment, the patient required bed rest and was fully monitored under intensive care conditions with continuous blood pressure measurement and blood-gas analysis. After relief of symptoms and loss of weight, the device was explanted after 6 days.

Treatment results showed a weight loss of 10 kg, a massive reduction in pro-BNP value, stable blood pressure, increased diuresis, and a subjective improvement of clinical symptoms. The patient was discharged from the hospital on day 35.

**Discussion**

Right heart failure is associated with high mortality and limited prognosis. The current therapy includes optimization of volume status, application of inotrope therapy and surgical options like atrial septostomy, implantation of a RV assist device, treatment with veno-arterial extracorporeal membrane oxygenation, or cardiac transplantation as a last resort.

New RV assist devices can be implanted via surgical or percutaneous (femoral and transjugular) approach. In this case, an Impella RP® was implanted under fluoroscopic guidance via percutaneous puncture of the femoral vein.

Anderson et al. (2015) described the use of the Impella RP® as a safe, easy to perform, and reliable option, which offers patient with acute RHF a novel bridging tool. Cheung et al. (2014) compared patients with acute RHF treated with surgically (Impella RD) and percutaneously (Impella RP®) implanted devices. Nevertheless, this cohort included only patients with acute RHF due to MI, or patients post-LVAD, post-cardiotomy, and post-transplant. In our case report, we utilized this method for a patient with RHF due to chronic biventricular failure resulting in loss of weight and improved clinical symptoms. Finally, the patient was discharged from hospital.

In summary, an acute RV decompensation in the context of chronic biventricular HF refractory to pharmacologic therapy could be treated by the implantation of an Impella RP®. Implantation was easy to perform, with neither complications, local problems such as secondary haemorrhage, nor haemodynamic problems such as left HF.

On the other hand, the use of the Impella RP® in the treatment of RV failure is still limited. The positive effects

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**Table 1 Patient baseline characteristics**

| Baseline data |  |
|--------------|---|
| Age, years   | 66 |
| Sex          | Male |
| Hypertension | Yes |
| Diabetes     | No |
| Chronic kidney disease | Yes |
| Left ventricular | 10 |
| ejection fraction, % | 9 |
| Right ventricular function: TAPSE, mm | 9 |
| Pa sys, mmHg | 45 |
| Furosemide, mg/day | 240 |
| Inotropes | Single dose of levosimendan 12.5 mg |

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**Figure 1** Device position in the thoracic X-ray. Impella RP® is a three-dimensional catheter-based percutaneous microaxial pump, which consists of a 23F pump head containing the electric motor, axial blood pump, and outflow cannula, mounted on an 11F catheter. This device is especially designed for use as a right ventricular assist device. Implantation is performed under a fluoroscopic guidance, where after the percutaneous puncture of the femoral vein, the inflow pump is placed in the vena cava inferior (IVC), and the outflow pump is positioned across the tricuspid and pulmonary valves into the pulmonary artery (PA). The correct position was verified in the chest X-ray. The Impella RP® is able to provide flow up to >4 L/min with a maximum use of 14 days.
are not necessarily sustainable. For example, the application of this device can be performed as a bridging method in the treatment of RV failure to prepare for LVAD implantation, but the data regarding this approach are still sparse.

**Conflict of interest**

Dirk Westermann has received speaker honorarium from Abiomed.

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