

Case Report

# Impella Implantation as a Bridge to Surgery for Repair of Aorto-Right Ventricular Fistula Following Prosthetic Valve Endocarditis: A Case Report

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## Abstract

For patients with cardiogenic shock, delaying surgery with mechanical circulatory support is reported to yield better outcomes than emergency surgery. We report on an 82-year-old man diagnosed with vertebral osteomyelitis with concomitant infective endocarditis. Chest radiographs revealed a growing abscess, which resulted in an aorto-right ventricular fistula. Providing Impella support allowed for hemodynamic stabilization prior to surgery. The patient had an uneventful postoperative course and reported to be well in a follow-up 1 year later. Impella support can be used as a bridge to surgery for repairing fistulous tract formation in patients in cardiogenic shock.

## Keywords

aorto-cardiac fistula; bridge to surgery; cardiogenic shock; delayed surgery; Impella; infective endocarditis; vertebral osteomyelitis

## Introduction

Several studies have reported the application of Impella (Aboimed, Danvers, MA, USA) as a bridge to cardiac surgery in patients with cardiogenic shock [1–3]. In such patients, delayed surgery after hemodynamic stabilization by mechanical circulatory support is known to yield better outcomes than emergency surgery. Herein, we report the case of a patient with cardiogenic shock due to aorto-right ventricular (RV) fistula secondary to prosthetic aortic valve endocarditis, who received Impella CP support as a bridge tool for delayed and successful surgical repair. The CARE checklist was used when writing this case report **Supplementary Table 1**.

## Case Report

An 82-year-old man was admitted to a local hospital with lower back pain. The patient had a history of two aortic valve replacement (AVR) surgeries: AVR with Epic 19 mm (Abbott, Chicago, IL, USA) for symptomatic aortic stenosis 10 years ago and redo AVR with Solo Smart 23 mm (LivaNova PLC, London, UK) 3 years ago due to prosthetic valve dysfunction. On admission, the patient's temperature was 38.1 °C, and laboratory data showed a marked inflammatory response. *Enterococcus faecalis* was isolated from blood cultures, and antibiotic treatment was initiated. The patient was referred to our institution for further examination and treatment.

Diffusion-weighted imaging revealed high-intensity lesions at the L3/4 and L4/5 vertebral disks (Fig. 1). Transthoracic echocardiography (TTE) revealed vegetation below the aortic prosthetic valve with preserved valvular function. Transesophageal echocardiography (TEE) revealed vegetations attached to the right- and non-coronary cups and an abscess within the sub-aortic interventricular septum (Fig. 2). The patient was diagnosed with vertebral osteomyelitis (VO) with concomitant infective endocarditis (IE). In particular, surgical intervention was considered for prosthetic valve endocarditis (PVE); however, because the patient refused aggressive treatment, intravenous antibiotics based on the culture results were continued. On the 7th day of hospitalization, repeated blood cultures were positive, and TTE revealed a growing abscess within the interventricular septum. However, surgical intervention was avoided due to the patient's will and a trend of diminishing inflammatory response.

On the 25th day of hospitalization, the patient reported shortness of breath at rest. Chest radiographs revealed severe pulmonary congestion (Fig. 3). TTE revealed that a growing abscess resulted in an aorto-RV fistula, moderately dilated RV, and pulmonary hypertension (Fig. 4A). Finally, the patient approved the need for surgical intervention. We decided to initiate veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and provide Impella CP support



**Fig. 1.** Diffusion-weighted imaging reveals high-intensity lesions at the L3/4 and L4/5 vertebral disks (arrowheads).

to stabilize the hemodynamics and improve pulmonary congestion prior to surgical repair of the fistula. One day after the start of VA-ECMO and Impella support, respiratory status became stable and catecholamine administration was discontinued. Serum lactate elevation remained relatively low (maximum 1.67 mmol/L), and other laboratory result also showed that end-organ dysfunction was limited; therefore, urgent surgery was performed. After median sternotomy, VA-ECMO was switched to cardiopulmonary bypass with additional venous cannulation of the superior vena cava, and Impella CP was decannulated before intracardiac manipulation. Reflecting the third open heart operation, hard adhesions within the mediastinum obstructed the room for aortic cross-clamping; thus, distal aortic reconstruction was performed under circulatory arrest. Intraoperative findings showed that the fistula on the aortic valve annulus communicated with the RV (Fig. 4B). Following debridement of the infected tissue, closure of the aorto-RV fistula using bovine pericardial patches and aortic root replacement with Freestyle 23 mm (Medtronic, Minneapolis, MN, USA) was performed. Although intraoperative bleeding control involved difficulty in reflecting generalized sep-

sis, the patient returned to the intensive care unit without any circulatory assist device.

The patient had an uneventful postoperative course with intravenous antibiotic therapy and was transferred to a local hospital on the 15th postoperative day. Postoperative TTE revealed a competent prosthetic valve and no residual fistula. One year after the operation, the patient underwent outpatient clinical monitoring and was reported to be well.

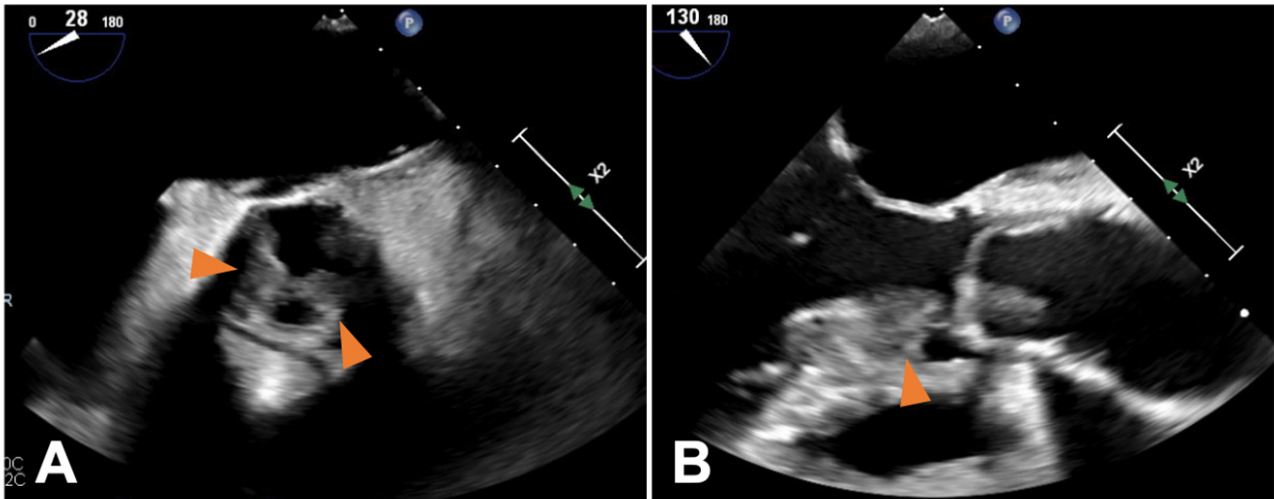
## Discussion

Herein, we describe a case of VO with concomitant IE. The incidence of these co-infections is not rare and is reported to be approximately 20–27% [4,5]. Its pathogenesis indicates that sepsis associated with IE causes vertebral arterial embolism, which results in VO, or that bacteremia in a compromised status causes VO, which secondarily induces IE. A previous study reported that, in patients with VO, higher mortality was associated with concomitant IE [6]. In this case, using TTE and TEE to examine IE co-infection on admission may allow early diagnosis and treatment. In patients diagnosed with VO, it is important to promptly rule out possible IE co-infections.

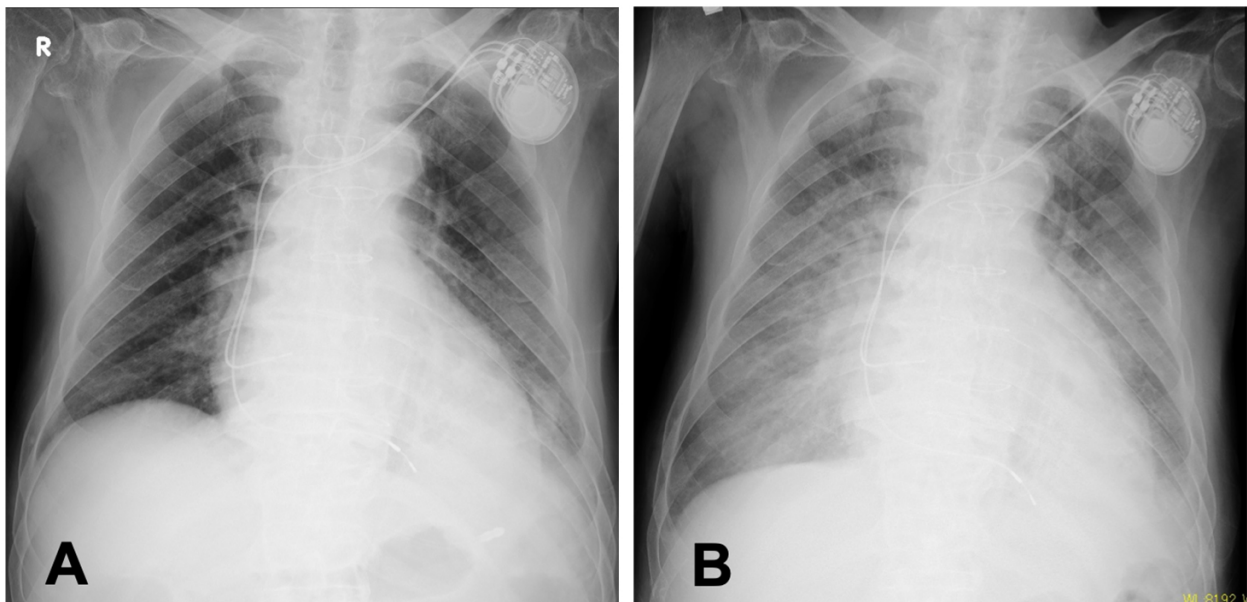
PVE is associated with significant morbidity and mortality [7]. In addition, persistent positive blood cultures after the initiation of antibiotic treatment doubles the risk of death [8]. In high-risk patients, early surgical intervention is recommended. Our patient experienced acute cardiorespiratory deterioration induced by an aorto-RV fistula formation during non-surgical treatment. Although this therapeutic strategy was based on the patient's will, our experience unintentionally highlighted the superiority of earlier surgical intervention in cases of PVE with perivalvular abscess or refractoriness to antibiotic treatment.

To the best of our knowledge, this is the first report on the use of Impella as a bridge to surgery in patients in cardiogenic shock by fistulous tract formation following PVE. In this case, delayed surgery after hemodynamic stabilization resulted in successful surgical repair and an uneventful postoperative course, even though the patient was in a high-risk preoperative status. In fact, the operation was completed without any circulatory assist device, perioperative catecholamine administration was relatively low, and intubation duration was not prolonged.

While mechanical device insertion should be cautious in cases of suspected floating vegetation on the annulus area, Impella may be a useful mechanical circulatory support device for cases of organic vulnerability in the aortic annulus. The Impella is placed across the aortic valve; a certain distance exists from the valve annulus to both the inlet in the left ventricular outflow tract and the outlet in the ascending aorta. Thus, axial-flow in "tunnel channel" ensures increased blood flow without a strain to the aortic valve annulus. In patients with fragile annuli, such as



**Fig. 2. Transesophageal echocardiography findings.** (A) vegetations that were attached to the right- and non-coronary cups (arrowheads), and (B) an abscess within the sub-aortic interventricular septum (arrowhead).



**Fig. 3. Chest radiography findings.** (A) on the admission day and (B) when the patient stated shortness of breath at rest on the 25th day of hospitalization.

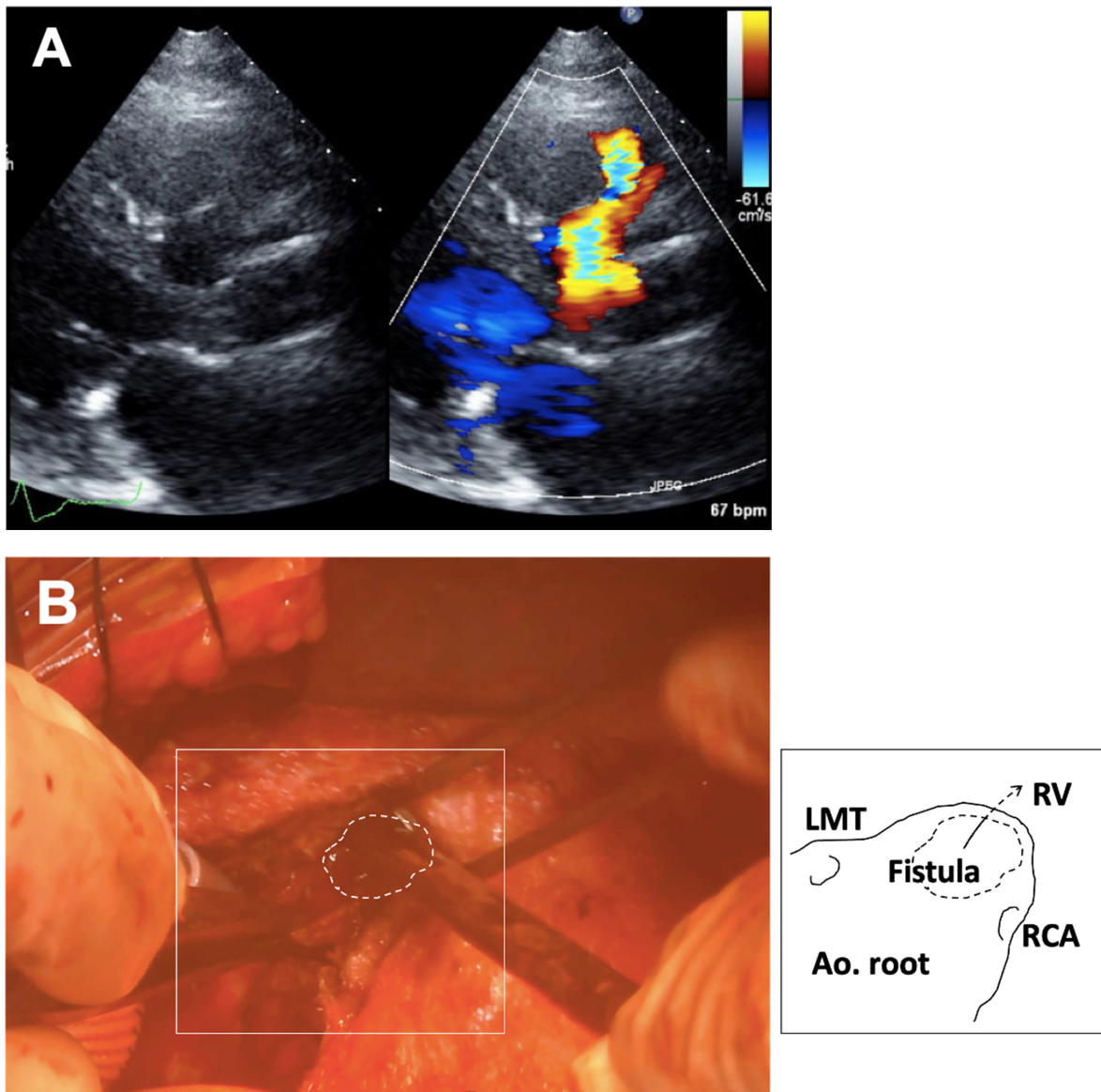
perivalvular abscesses associated with IE, this structural feature of Impella would prevent damage to the aortic root tissue.

The optimal duration of mechanical circulatory support before surgery in patients with cardiogenic shock remains under debate [1]. Prolonged Impella support may increase device-related adverse events and complicate perioperative management. Additionally, for patients with systemic infections, mechanical device implantation should be as short as possible. In this case, Impella CP was activated for only 1 day before the operation along with the support of VA-ECMO; however, this minimum duration was suf-

ficient to improve the preoperative condition. In cases of limited end-organ function damage, even a short duration of Impella support would be beneficial without the occurrence of complications.

### Availability of Data and Materials

Data supporting the conclusions are included in the article.



**Fig. 4. Examination findings after clinical deterioration and intraoperative findings.** (A) Transthoracic echocardiography reveals that a growing abscess resulted in an aorto-right ventricular fistula. (B) Intraoperative photograph. The fistula on the aortic valve annulus (dotted line) communicates to the right ventricular. LMT, Left main trunk; RV, Right ventricular; RCA, Right coronary artery; Ao. root, Aortic root.

### Author Contributions

All authors designed and gave the main idea of this case report. MN wrote the manuscript. MT and HK conducted a control and critical review of the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

### Ethics Approval and Consent to Participate

This study was approved by the Asahikawa Medical University and conforms to the provisions of the Declaration of Helsinki, number 21086. Written informed consent was obtained from the families of the patient for scientific activity including publication of this case report.

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## Conflict of Interest

The authors declare no conflict of interest.

## Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.59958/hsf.5519>.

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