

# Triple bridge of mechanical circulatory support to heart transplantation listing: A case report

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## Abstract

A 60-year-old male patient presented to an outside hospital with severe cardiogenic shock. A triple bridge of mechanical circulatory support was utilized to transition him to heart transplantation listing. Initially, coronary artery disease was percutaneously treated and Impella 2.5 was used as mechanical circulatory support for 5 days followed by the second Impella 2.5 for 4 days. Venous-arterial extracorporeal membrane oxygenation support was deployed for 16 days. This was exchanged for HeartWare ventricular assist device support as the third stage of mechanical circulatory support to heart transplantation listing. The patient experienced acute renal failure which was managed by continuous renal replacement therapy then intermittent hemodialysis with eventual complete recovery of the renal function. He was discharged home 56 days after HeartWare ventricular assist device implantation with stable hemodynamic, intact neurologic status and fully recovered renal function. Currently, the patient is listed for heart transplantation.

## Keywords

Mechanical circulatory support, heart transplantation, triple bridge, Impella, extracorporeal membrane oxygenation, HeartWare ventricular assist device

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## Introduction

Over the past 10 years, mechanical circulatory support (MCS) therapy has transformed care of patients with end-stage heart failure.<sup>1–5</sup> MCS is indicated in severe cardiogenic shock and end-stage heart failure; multiple MCS devices are currently available for use and may have varying indications based on the clinical scenario. It is uncommon for more than two consecutive MCS devices to be used in the same patient. We report a rare case of a patient who required staged support of cardiogenic shock using three different MCS devices (Impella 2.5-to-extracorporeal membrane oxygenation (ECMO)-to-HeartWare ventricular assist device (HVAD)) as a bridge to heart transplantation (HTx) listing.

## Case description

A 60-year-old man presented to an outside hospital with inferior wall ST-segment elevation myocardial infarction and significant hemodynamic instability. His electrocardiogram (ECG)

was remarkable for ST elevations in the inferior leads and reciprocal changes in the precordial leads. He underwent an emergent coronary angiogram and was found to have total occlusion of the left circumflex artery (LCx), which was the dominant vessel, and 70%–80% stenosis of the mid-left anterior descending (LAD) artery. The right coronary artery was small, non-dominant and did not have any significant focal stenosis. His left ventricular ejection fraction (LVEF) was 35%. Percutaneous coronary intervention (PCI) with stenting of the LCx was performed, following which the patient did well and was successfully extubated a day later. Unfortunately, on the third day, he

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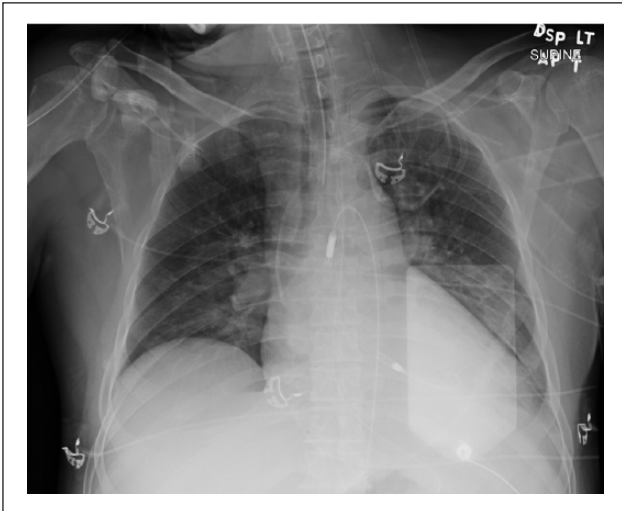
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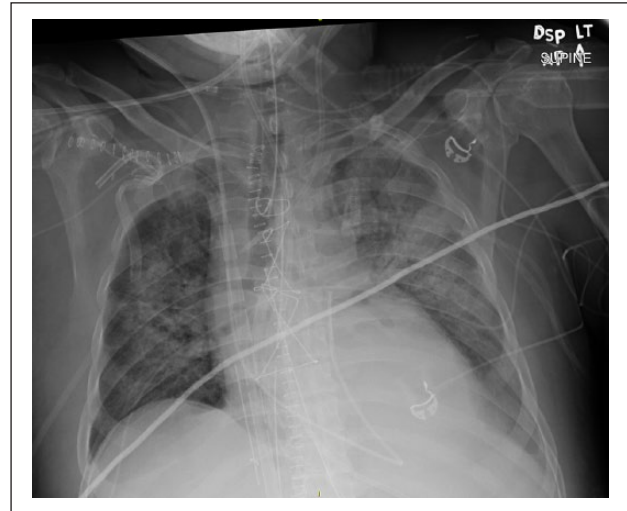
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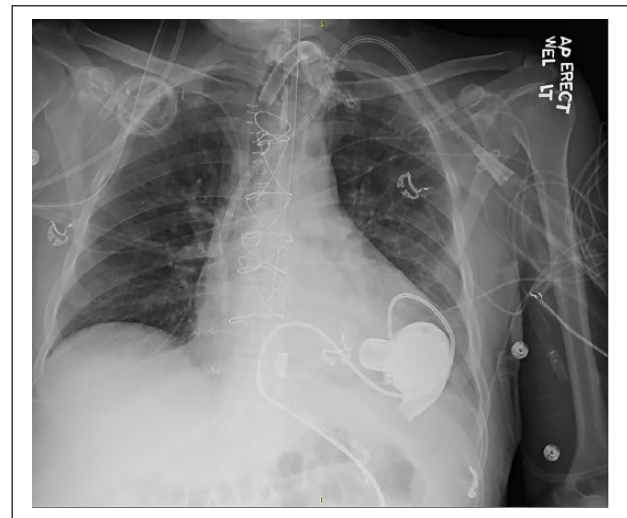


**Figure 1.** Chest radiograph reveals the Impella 2.5 device positioned into the left ventricle.



**Figure 2.** Chest radiograph reveals the central cannulation for the VA ECMO support.

became hypotensive and hypoxic due to severe flash pulmonary edema, which mandated reintubation and initiation of inotropic support therapy. A repeat coronary angiogram was performed and patency of the LCx stent was ensured. Due to severe cardiogenic shock, an Impella 2.5 device (ABIOMED Inc., Danvers, MA, USA) was deployed through the femoral artery (Figure 1). On the seventh day, the patient was transferred to our institution for advanced management where he was maintained on Impella support and dobutamine infusion therapy. His hemodynamic status gradually improved over 5 days with the mean arterial pressure stabilizing around 60mmHg and LVEF at 39%, which allowed successful weaning of the Impella. On the 12th day, he was taken to the catheterization lab for percutaneous treatment of the LAD lesion. During the procedure, he became profoundly hypotensive with ECG changes showing elevated ST segment and another Impella 2.5 device was placed to facilitate PCI. Four days after placement of the second Impella, the patient developed fever. As a result of this and the time-limitations in using Impella, transition to a more durable device was considered essential. However, due to concerns about permanent left ventricular assist device (LVAD) implantation with a possible underlying infection, veno arterial ECMO was considered to be the best option to continue support while an infection was being ruled out. Levitronix CentriMag biventricular assist device (BiVAD) support (Abbott, Abbott Park, IL, USA) was not a good option either due to impaired respiratory function and repeated episodes of flash pulmonary edema. Peripheral ECMO cannulation through the right axillary artery was attempted but it was unsuccessful due to the small-sized and fragile artery. Hence, ECMO support was established via central cannulation and left ventricle (LV) vent was placed through the right superior pulmonary vein and connected to the inflow cannula in a Y-shaped fashion to unload the LV. ECMO support was continued for 15 days during which the circuit was changed once due to



**Figure 3.** Chest radiograph reveals the HVAD implanted into the apex of the left ventricle.

thrombus formation in the circuit (Figure 2). In the interval, he also underwent tracheostomy and evacuation of a pericardial effusion. He developed a concurrent acute renal failure managed by continuous renal replacement therapy and intermittent hemodialysis followed by complete recovery of the renal function. His fever eventually resolved and multiple pan-cultures were reported to be negative. Following this, his neurologic status was confirmed to be intact and respiratory function improved while on ECMO and he was deemed a candidate for HTx. After 15 days of ECMO support, a HVAD (Medtronic, Minneapolis, MN, USA) was implanted and ECMO was discontinued (Figure 3). The patient was listed for HTx and discharged home 56 days after HVAD implantation with fully recovered kidney function, intact neurologic status, and stable hemodynamics. A written informed consent was obtained from

the patient for his anonymized information to be published in this article.

## Discussion

In management of patients with end-stage heart failure, MCS has played a pivotal role as a bridge to transplantation option.<sup>6–8</sup> The remarkable advancement in device technologies demonstrated a tremendous impact and reshaped the traditional way these patients were being managed.<sup>9–11</sup>

Our patient had a successful outcome with the use of triple bridge of MCS to facilitate management of severe heart failure in various stages. The first MCS stage was established with two sequential Impella 2.5 devices. The first Impella 2.5 was emergently deployed to stabilize the patient's hemodynamic status during the cardiogenic shock while the second one was deployed to facilitate the second PCI (protected PCI). It is worth mentioning that the Impella device was very crucial in supporting the patient hemodynamic during the emergent phase and played a pivotal role in saving his life. The subsequent two devices, ECMO and then HVAD, were utilized based on the clinical indications and contraindications at that moment of time.

Staged circulatory support has been previously reported by other authors as a strategy of bridging to transplantation. El-Sayed Ahmed et al.<sup>12</sup> at the Texas Heart Institute described using three consecutive stages of MCS utilizing ECMO support for 5 days followed by CentriMag BiVADs for 39 and then escalated to CardioWest (SynCardia Inc, Tucson, AZ, USA) temporary total artificial heart (TAH-t) for 107 days as a bridge to simultaneous heart and kidney transplantation. In another report, Schenk et al.<sup>13</sup> reported utilizing three consecutive stages of MCS (ECMO, BiVADs, and TAH-t) as a bridge to HTx. Hollander et al.<sup>14</sup> from Stanford Medical Center utilized VA ECMO for 14 days followed by Impella 5.0 for 10 days and then LVAD (HeartMate II) for management of a pediatric patient with dilated cardiomyopathy before HTx.

To the best of our knowledge, this is the only reported case in the literature where the three specific devices, Impella, ECMO, and HVAD, have been used in the same patient in a staged approach for mechanical support of acute heart failure and subsequent bridge to HTx listing in adult.

## Conclusion

Combination of MCS devices used in a sequential manner can be lifesaving depending on the clinical situation. Transition to an alternative MCS device should be considered if one specific device is contraindicated or has a time-limitation. In our patient, Impella 2.5 support was lifesaving and escalation to ECMO and then HVAD was successful in bridging our patient to HTx listing.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

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## Informed consent

A written informed consent was obtained from the patient for his anonymized information to be published in this article.

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