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Prolonged left ventricular unloading prior to revascularization in cardiogenic shock associated with complete ventricular recovery☆☆☆

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ABSTRACT

The use of percutaneous mechanical circulatory support (MCS) in high-risk coronary intervention and cardiogenic shock is associated with improved ability to obtain complete revascularization. However, whether prolonged left ventricular unloading and mechanical circulatory support prior to coronary revascularization in acute myocardial infarction patients improves outcomes is unclear. We report a case in which a patient with acute anterior myocardial infarction and cardiogenic shock received prolonged left ventricular mechanical unloading for 24 h prior to revascularization, and ultimately this resulted in a limited myocardial infarct and complete restoration of left ventricular function.

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1. Introduction

Percutaneous mechanical circulatory support (MCS) devices are increasingly being used to provide hemodynamic support in patients with cardiogenic shock and to enable high-risk percutaneous coronary interventions (PCI) and complex ventricular arrhythmia ablations [1]. For high risk PCI, the Prospective Randomized Clinical Trial of Hemodynamic Support with Impella 2.5™ versus Intra-Aortic Balloon Pump in Patients Undergoing High-Risk Percutaneous Coronary Intervention: the PROTECT II Study showed that the Impella 2.5 (Abiomed, Danvers, MA) percutaneous left ventricular assist device (pLVAD) provided superior hemodynamic support compared to an intra-aortic balloon pump (IABP) [2]. Similarly, in the ISAR-SHOCK trial, in which patients presenting with acute myocardial infarction (AMI) complicated by cardiogenic shock were studied, an Impella 2.5 provided superior hemodynamic support compared to an IABP [3]. While pLVADs provide superior cardiac output and cardiac index compared to the use of an IABP, the effect of these MCS devices on mortality, infarct size, or ejection fraction in patients presenting with AMI and cardiogenic shock remains unknown.

Preclinical studies with the TandemHeart (CardiacAssist, Pittsburgh, PA) MCS device have shown that left ventricular unloading with a

pLVAD in the setting of prolonged ischemia can reduce infarct size in animal models; however, the clinical relevance of MCS devices in sustaining myocardial viability in humans during prolonged ischemia is not as clear [4]. Mechanisms of myocardial cell injury begin immediately after coronary artery occlusion and it has been felt that there is only a narrow window of time for recanalization before permanent myocardial damage [5]. Herein, we present a case of prolonged acute myocardial ischemia and cardiogenic shock in whom early and prolonged left ventricular unloading ultimately resulted in clinical recovery and restoration of ventricular function.

2. Case presentation

A 51-year-old woman with a history of chronic kidney disease and hypertension was brought to a community hospital due to the sudden onset of chest pain and dyspnea. Initial electrocardiography (Fig. 1) revealed anterior ST segment elevation with reciprocal inferolateral ST segment depression. Due to evolving respiratory distress and repeated episodes of nonsustained ventricular tachycardia, the patient required endotracheal intubation. Emergent angiography revealed moderate left main and severe 3-vessel coronary artery disease with an occluded left anterior descending (LAD) artery (Figs. 2–3). Due to hemodynamic instability, an IABP was placed and, after an unsuccessful attempt at percutaneous revascularization of the LAD (felt to be chronic or subacutely occluded), only the ramus intermedius branch was treated with balloon angioplasty. The patient was referred for surgical revascularization, but was felt to be of inoperable risk due to poor surgical targets and her high-risk presentation. Worsening hemodynamic instability led the cardiologist to exchange her IABP for a pLVAD (Impella CP) and the patient

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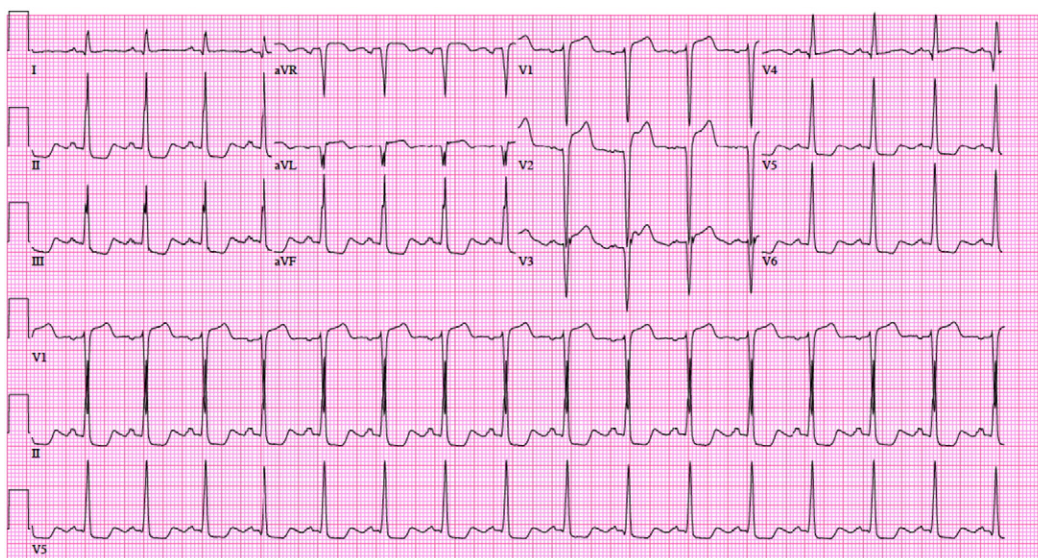


Fig. 1. Presenting electrocardiogram with ST segment elevations noted in the anterior leads and reciprocal ST segment depressions in the inferolateral leads.

was transferred to our center for surgical VAD or cardiac transplantation evaluation.

Upon transfer, the patient was hemodynamically stable with the Impella CP in place and without the need for concomitant inotropic support. Two-dimensional echocardiography showed an ejection fraction of 15% and her peak Troponin T value was 9.31 ng/mL. The heart team reviewed options of surgical revascularization, surgical LVAD placement as a bridge to transplantation, and percutaneous revascularization. The concern for anterior wall viability required further investigation but due to her tenuous status and pLVAD dependence, options were limited. Viability with myocardial contrast echocardiography (MCE) was pursued, which was consistent with anterior wall perfusion and viability (Video 1).

Given evidence of viability in the LAD territory and significant surgical risk, the heart team concluded that complex, multivessel PCI should be pursued. She underwent PCI to her LAD, left circumflex, and left main coronary arteries initially, followed by right coronary artery PCI in a subsequent session after weaning from the Impella CP. The staged approach was carried out to avoid contrast-induced nephropathy in the setting of chronic kidney disease (Videos 2–4 (pre and post PCI)). Two-month and

one-year follow-up echocardiography revealed ejection fractions of 57% and 69% (Video 5 (pre and two-month post echo)), respectively with no residual wall motion abnormalities and she was completely asymptomatic with excellent exercise tolerance.

3. Discussion

This case highlights a number of important points for a patient who urgently and successfully underwent a CHIP (complex, high-risk indicated procedure) coronary intervention. This patient, who presented with cardiogenic shock and acute myocardial infarction with a subtotaly occluded LAD and severe disease in the non-culprit left circumflex, ramus intermedius, right coronary and left main arteries had a presentation mortality of >75% [6]. Due to the initial inability to recanalize the LAD and hemodynamic instability from cardiogenic shock, Impella CP hemodynamic support was initiated. Given a 24-h delay prior to successful LAD recanalization, residual anterior wall viability was confirmed by an MCE study in the coronary care unit while the patient was intubated and receiving pLVAD support. Subsequently, complete percutaneous revascularization resulted in complete recovery of left ventricular function.

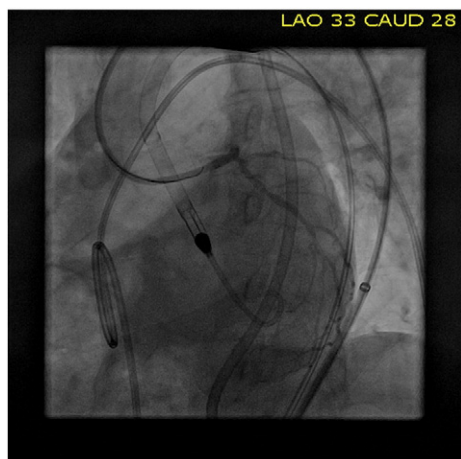


Fig. 2. Initial left coronary angiogram in the anterior–posterior (AP) caudal projection. Notable for distal left main stenosis, left anterior descending artery occlusion, and critical lesions in the ramus intermedius branch as well as the proximal and mid left circumflex artery.

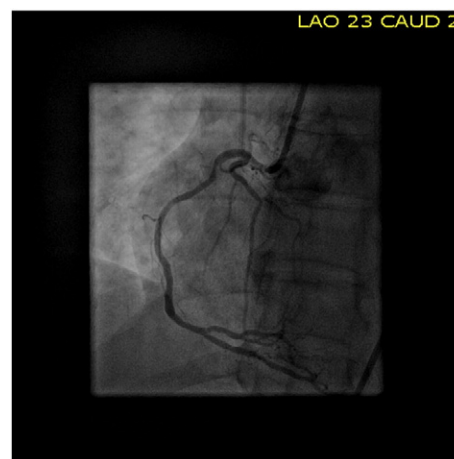


Fig. 3. Initial right coronary angiogram in the left anterior oblique projection. Notable for significant stenosis in the proximal segment of the right coronary artery.

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