Case Report

Pheochromocytoma-Induced Reverse Takotsubo Cardiomyopathy Leading to Fulminant Pulmonary Edema: Successful Intervention with an Impella CP® Percutaneous Ventricular Assist Device

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Abstract

Takotsubo cardiomyopathy (TTC) can lead to severe but reversible heart failure, which necessitates apt management of acute hemodynamic instability. We report the case of a 42-year-old woman who developed reverse-TTC secondary to a pheochromocytoma. While being persistently hypertensive, she decompensated into fulminant pulmonary edema, and was managed successfully with placement of an Impella® percutaneous ventricular assist device (pVAD). Through a rare variant of TTC, this case highlights the role of pVAD’s in supporting severe left ventricular dysfunction that is otherwise refractory to medical therapy.

ABBREVIATIONS

TTC: Takotsubo Cardiomyopathy; Pvd: Percutaneous Ventricular Assist Device; ECG: Electrocardiogram; CAD: Coronary Artery Disease; LV: Left Ventricle; LVEF: Left Ventricular Ejection Fraction; IABP: Intra-Aortic Balloon Pump; S⁰₂: Peripheral Capillary Oxygen Saturation; S⁰₂: Central Venous Oxygen Saturation; PEEP: Positive End-Expiratory Pressure; Fio²: Fraction of Inspired Oxygen

INTRODUCTION

Takotsubo cardiomyopathy (TTC), also known as apical-balloononing syndrome or stress cardiomyopathy is a syndrome characterized by transient left ventricular (LV) dysfunction, electrocardiogram (ECG) changes that mimic an acute myocardial infarction (MI), and elevated myocardial enzymes in the absence of obstructive coronary artery disease (CAD) [1]. Although its pathogenesis is not fully understood, catecholamine excess has been implicated as a cause [2,3].

CASE PRESENTATION

A 42-year-old woman with a history of hypertension was transferred to our tertiary care cardiac center for primary percutaneous coronary intervention, in the setting of an anterior ST-elevation myocardial infarction. She initially presented to a local emergency room with retrosternal chest tightness and dyspnea while at church. Electrocardiogram (ECG) revealed ST-elevation in leads V1-V3 with reciprocal changes in the inferior and lateral leads (Figure 1). Her initial troponin I was 0.99 μg/L. Upon arrival to our Heart Investigation Unit, the patient deteriorated into fulminant pulmonary edema. Her vitals were: oxygen saturation (SpO₂) of 49% on 100% FiO₂, heart rate of 52 beats/minute, and a persistently elevated blood pressure of 162/111 mm Hg, which was maintained throughout her angiogram. She was promptly intubated and mechanically ventilated. Pinky frothy sputum could be seen in the endotracheal tube.

Coronary angiogram revealed only slight luminal...
irregularities consistent with mild coronary artery disease (CAD) (Figure 2A, 2B). Left ventricular (LV) angiogram demonstrated a reverse Takotsubo cardiomyopathy, with a kinesis of the basal and mid-segments, but preserved contractility of the apical segment (Figure 2C, 2D; Supplementary Video 1). Her LV ejection fraction (LVEF) was visually estimated at 10% and there were no signs of mitral regurgitation. Her left ventricular end diastolic pressure was 35 mmHg. The ascending aorta and root were within normal limits.

Over the first hour at our center, the patient was given metolazone (5 mg) and started on infusions of dobutamine (5 mcg/kg/min), nitroglycerin (50 mcg/min), and furosemide (160 mg IV bolus with subsequent infusion at 20 mg/hour). An intra-aortic balloon pump (IABP) was placed and she was mechanically ventilated with 100% FiO₂ at a PEEP of 16 cm H₂O. Despite these interventions, her SₐO₂ remained at 67%, central venous oxygen saturations (ScwO₂) were 24%, and she was not producing any urine.

Given the deteriorating LV function and fulminant pulmonary edema with poor response to medical therapy, a decision was made to insert an Impella CP® percutaneous ventricular assist device (pVAD). The Impella was placed across the aortic valve (Figure 3A) three hours after arrival in the Heart Investigation Unit, and a continuous flow rate of 3.2 L/min was initiated.

**Figure 1** ECG on initial presentation.

**Figure 2** Mages from coronary (A, B) and left ventricular (C, D) angiography. Coronary angiogram demonstrates mild coronary artery disease (CAD) without any obstructive lesions in the left anterior descending artery (A) and right coronary artery (B). Left ventricular angiogram, during diastole (C) and systole (D), reveals a reverse Takotsubo contractile pattern, with wall akinesis in the basal and mid segments, but preserved motility in the apical portion.
The patient's $S_{pO2}$ rapidly improved to 97% with a mean arterial pressure of 85 mm Hg. She was then transferred to the cardiovascular intensive care unit (ICU).

The patient's ICU stay was complicated by ischemic hepatitis, anemia, thrombocytopenia, and acute renal failure requiring continuous renal replacement therapy and subsequent hemodialysis. Her systolic BP occasionally spiked to pressures in the 200 – 250 mm Hg range, which were treated with labetalol and nitroglycerin infusions. Despite these acute complications, the patient began improving quickly from a cardiac standpoint. 48 hours after Impella insertion, her serum lactate was 1.6mmol/L (trending downwards from a peak 7.3 mmol/L) and her $S_{pO2}$ increased to 71% (Table 1). Chest radiographs showed improvement in pulmonary edema (Figure 3B) and cardiac contractility recovered with an LVEF of 55% on transthoracic echocardiogram. The Impella was then removed without complication. The endocrinology service was consulted for query pheochromocytoma, but further workup was not possible until several weeks later due to acute anuria.

The patient was discharged home after 18 days in hospital on amlodipine, labetolol, and prazosin. Her biweekly hemodialysis was discontinued at 3 months post-discharge after her renal function recovered fully. She later underwent laparoscopic resection of a right suprarenal mass, which was confirmed by pathology to be a pheochromocytoma. Six months after initial presentation, the patient is doing well, normotensive and off all medications.

**DISCUSSION**

Takotsubo cardiomyopathy (TTC) is often precipitated by a physically or emotionally stressful event, but it can also occur secondary to pheochromocytomas [1-4]. The classical LV contractile pattern of TTC is characterized by apical and mid segment akinesis, with preservation of basal systolic function. A reverse TTC pattern has been reported more rarely, with hypokinesis of the basal and mid segments, but preserved or hyper dynamic apical contractility [4].

Within the context of pulmonary edema from pheochromocytoma-induced reverse TTC, only one report has previously described the successful use of an Impella to support the associated severe LV dysfunction, but in a postpartum patient that developed cardiogenic shock [5]. Other case reports have had positive outcomes with extracorporeal membrane oxygenation [4,6]. To the best of our knowledge, we present the first successful use of an Impella in a persistently hypertensive patient, with fulminant and refractory pulmonary edema.

Our patient responded poorly at first to a combination of medical therapy, mechanical ventilation, and IABP support. However, after Impella insertion, $S_{pO2}$ rapidly improved to >95% from a persistently low saturation of ~70%, and other indices of cardiac performance followed a positive trajectory thereafter (Table 1, Figure 3A, 3B). We hope that the encouraging outcome in this rare variant of TTC contributes further to the understanding of Impella® pVAD’s as a feasible intervention to support severe LV dysfunction in similar scenarios.

**REFERENCES**


![Chest radiograph images immediately after Impella insertion (A) and 48 hours later, once the Impella was removed (B). Initially, the chest radiograph displays extensive bilateral pulmonary edema and appropriate placement of the Impella across the aortic valve (A). After the impella was removed 48 hours later, radiographic findings demonstrate significant resolution of the pulmonary edema (B).](image-url)