

## Successful Management of Refractory Heart Failure and Multi-Organ Dysfunction in a Patient with CRT-D and Acute Pulmonary Edema: A Case Report

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Received: 15 December 2024 / Accepted: 7 January 2025 / Published online: 20 January 2025

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### Abstract

**Introduction:** Heart failure with reduced ejection fraction (HFrEF) is a progressive condition often complicated by acute decompensations that require advanced medical interventions. Cardiac resynchronization therapy with a defibrillator (CRT-D) has significantly improved outcomes in patients with severe heart failure. However, challenges persist when faced with acute events such as pulmonary edema, pneumonia, and multi-organ dysfunction syndrome. Multidisciplinary, intensive care unit (ICU)-based management is critical for these complex cases.

This case report presents the successful management of a 61-year-old female patient with a history of severe HFrEF and implanted CRT-D. Despite severe hypoxemia, hypotension, and metabolic acidosis, a multidisciplinary approach—including mechanical ventilation, intra-aortic balloon pump (IABP), continuous renal replacement therapy (CRRT), and transfusion—enabled recovery. The patient was admitted to the ICU with acute pulmonary edema, pneumonia, and multi-organ dysfunction syndrome, characterized by severe hypoxemia, hypotension, and metabolic acidosis. Over three weeks, the patient regained hemodynamic stability, renal function, and respiratory independence.

This case demonstrates the potential for recovery in patients with severe heart failure complicated by acute pulmonary edema and multi-organ dysfunction when treated with an integrated, multidisciplinary approach.

**Conclusion:** Advanced critical care strategies, including mechanical ventilation, intra-aortic balloon pump support, and continuous renal replacement therapy, were essential in stabilizing the patient. The outcome underscores the value of personalized, team-based critical care in managing life-threatening complications in heart failure patients with CRT-D.

**Keywords:** Heart failure, HFrEF, CRT-D, APE, MOD, IABP, CRRT, multidisciplinary management.

### Introduction

Heart failure with reduced ejection fraction (HFrEF) is a progressive condition affecting millions worldwide and is a

leading cause of hospitalization and mortality [1]. Advanced therapies, including CRT-D, have been shown to improve cardiac function and reduce hospitalizations in selected patients [1, 2].

However, these individuals remain vulnerable to acute decompensation due to infections, arrhythmias, or other triggers [2]. Such episodes often lead to multi-organ failure and require a complex, multidisciplinary approach.

Here, we present a unique case of a patient with advanced HFrEF who overcame severe pulmonary edema, refractory hypotension, and multi-organ dysfunction.

Despite prolonged ICU care and the occurrence of complications, including a femoral artery hematoma, the patient's full recovery is a testament to the resilience of critical care protocols and the human body under expert management, instilling a sense of hope in the audience.

Original article, no submission or publication in advance or in parallel

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### Case Presentation: Patient History and Initial Presentation

A 61-year-old woman with a history of severe HFrEF and an ejection fraction (EF) of 15–20% underwent CRT-D implantation two years prior. Her past medical history included a prolonged ICU stay one year earlier for multi-organ failure, secondary to severe heart failure decompensation, during which she developed sacral decubitus ulcers. She had since recovered to baseline functional status and was maintained on optimal guideline-directed medical therapy for heart failure.

She presented to the emergency department with acute shortness of breath, productive cough, and altered mental status. Her family could not distinguish between a psychotic attack or cardiac problems because she was under treatment for psychiatric disorders.

On examination, her respiratory rate was 35 breaths per minute, oxygen saturation (SpO<sub>2</sub>) was 40–60% on room air, and she exhibited diffuse bilateral crackles on auscultation.

Their blood pressure was 78/50 mmHg, and she had cold extremities with a delayed capillary refill, indicative of cardiogenic shock.

### Laboratory and Imaging Findings

Arterial blood gas analysis showed severe metabolic acidosis with a pH of 6.98, partial pressure of carbon dioxide (PaCO<sub>2</sub>) of 62 mmHg, bicarbonate (HCO<sub>2</sub><sup>-</sup>) of 16 mmol/L, and lactate of 6.5 mmol/L. Chest X-ray revealed diffuse bilateral pulmonary infiltrates consistent with pulmonary edema. Echocardiography demonstrated an EF of 15% with severe global hypokinesis and elevated left ventricular end-diastolic pressure. (Fig. 1)

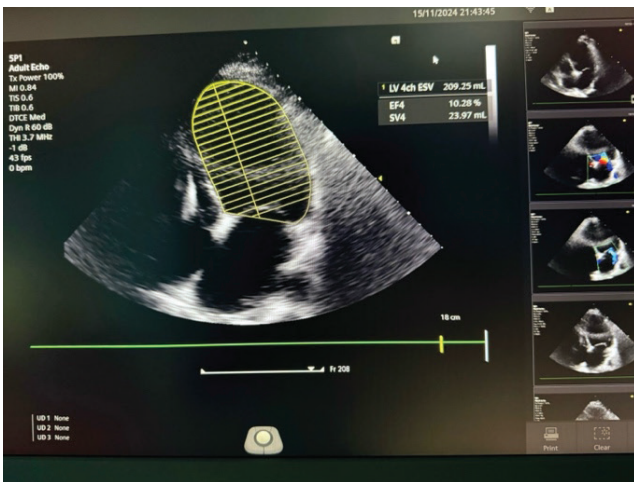


Figure 1. Echocardiography in admission shows low EF with severe global hypokinesis.

### Initial laboratory tests revealed:

- White blood cell count: 18,000/μL
- Hemoglobin: 9.8 g/dL
- Creatinine: 2.8 mg/dL (baseline: 1.2 mg/dL)
- Blood urea nitrogen: 68 mg/dL
- Potassium: 5.6 mmol/L

### Management

The patient was started on high-flow oxygen therapy and intravenous (IV) diuretics, but her oxygen saturation and urine output continued to decline. CPAP was initiated, and IV inotropic support with dobutamine (5 μg/kg/min) was administered, but these measures failed to improve hemodynamics. She was intubated and placed on mechanical ventilation.

### Intra-Aortic Balloon Pump Support

To stabilize refractory hypotension, an IABP was inserted via the right femoral artery. Within 12 hours, mean arterial pressure improved to 65 mmHg, urine output increased to 50 mL/hour, and lactate levels decreased to 3.2 mmol/L [3]. However, after 48 hours of IABP support, when vital parameters were under typical values and IABP support was not needed, vascular complications developed.

### Complication and Management

Upon removal of the IABP, the patient developed a large hematoma at the femoral artery insertion site, leading to recurrent hypotension (blood pressure 70/45 mmHg), atrial fibrillation (AF), severe anemia (hemoglobin 6.7 g/dL), and oligoanuria. Duplex ultrasonography confirmed a pseudoaneurysm at the femoral artery. She was transfused with three units of packed red blood cells and underwent vascular compression therapy [4].

### Renal Support and Recovery

Due to worsening metabolic acidosis and persistent oligoanuria, CRRT with Prismaflex was initiated. Over five days, serum creatinine decreased to 1.6 mg/dL, urine output improved to 1,000 mL/day, and metabolic parameters normalized [5]. Inotropic agents were gradually weaned, and she was extubated on day 10.

### Outcome

After extubation, the patient, with normal vital parameters, was neurologically not responding well, developing muscular weakness and severe fatigue. However, with close monitoring in the ICU, enteral hypercaloric nutrition through

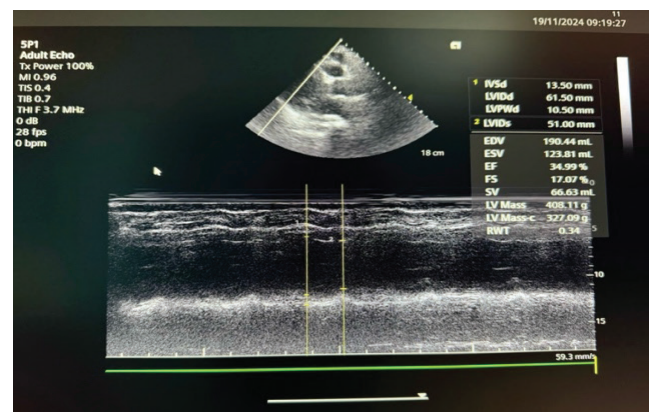


Figure 2. Echocardiography of the patient 1 day before discharge.

NG tube feeding, and a daily intensive physiotherapy program, she showed steady improvement. By day 15, she had regained hemodynamic stability, full renal function, mobility, and muscle strength, leaving the audience feeling optimistic about the patient's recovery. After three weeks, she was discharged from the ICU to a general ward. At discharge, echocardiography showed an EF of 30-35 %, and she was tolerating oral heart failure medications. (Fig.2)

## Discussion

This case exemplifies the challenges and strategies in managing advanced heart failure with multi-organ dysfunction. Key insights include:

### **IABP for Hemodynamic Support:**

IABP is a valuable bridge therapy for refractory cardiogenic shock, improving coronary perfusion and systemic hemodynamics [3]. While complications such as vascular injury are standard, vigilant monitoring and prompt intervention minimize adverse outcomes.

### **CRRT for Acute Kidney Injury:**

CRRT effectively managed volume overload, uremia, and acid-base derangements in this critically ill patient. Early initiation in the setting of oliguria and metabolic acidosis may have prevented irreversible renal injury [5].

### **Transfusion and Vascular Complication Management:**

The femoral artery hematoma posed a significant challenge, exacerbating hypotension and anemia. Timely transfusion and vascular intervention were critical to restoring hemodynamic stability and preventing further complications [4].

### **Multidisciplinary Approach:**

The coordination of cardiology, nephrology, vascular surgery, and intensive care teams facilitated the complex decision-making required in this case [6, 7].

## Conclusion

This case highlights the potential for recovery in patients with advanced HFrEF and severe complications through aggressive and well-coordinated critical care. The successful outcome underscores the importance of hemodynamic support, renal replacement therapy, and multidisciplinary management in improving outcomes for this high-risk population.

**COI Statement:** This paper has yet to be submitted in parallel, presented fully or partially at a meeting, podium, or congress, published, or submitted for consideration beforehand.

This research received no specific funding from public, commercial, or non-profit sectors. The authors

declare that they, their relatives, or next of kin have no financial relationships with external companies that could be considered relevant or minor.

**Disclosure:** The authors declared no conflict of interest. No funding was received for this study.

## Abbreviations

*HFrEF*- Heart Failure with Reduced Ejection Fraction; *CRT-D* - Cardiac Resynchronization Therapy with a Defibrillator; *ICU* - Intensive Care Unit; *IABP* - Intra-Aortic Balloon Pump; *CRRT* - Continuous Renal Replacement Therapy; *APE* - Acute Pulmonary Edema; *MOD* - Multi-Organ Dysfunction; *EF* - Ejection Fraction; *HCO<sub>2</sub><sup>-</sup>* - Bicarbonate; *PaCO<sub>2</sub>* - Partial Pressure of Carbon Dioxide; *SpO<sub>2</sub>* - Oxygen Saturation; *TTE* - Transthoracic Echocardiography; *CPAP* - Continuous Positive Airway Pressure;

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