

# Clinical Characteristics and Predictors of Mortality in Patients with Acute Decompensated Heart Failure in the Intensive Care Unit

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Received: 2nd Mar, 2026 | Revised: 14th Mar, 2026 | Accepted: 4th Apr, 2026 | Available Online: 20th Apr, 2026

## ABSTRACT

**Background:** Acute decompensated heart failure (ADHF) requiring intensive care unit (ICU) admission carries substantial mortality, particularly in developing countries. Data characterizing fatal ADHF cases in Indian ICU settings remain scarce. We describe the clinical profile, laboratory abnormalities and outcomes of patients who died from ADHF in an ICU.

**Methods:** This retrospective case series included 50 consecutive patients admitted to the ICU with ADHF who died during hospitalization. Demographics, comorbidities, clinical presentation, laboratory parameters, echocardiographic findings and causes of death were analyzed.

**Results:** The mean age was  $66.7 \pm 14.2$  years; 60% were male. Hypertension and diabetes mellitus were each present in 40% of patients. All patients presented with dyspnea. Laboratory findings revealed anemia (mean haemoglobin 10.34 g/dL), renal dysfunction (mean creatinine 1.99 mg/dL) and hyponatremia (mean sodium 131.87 mEq/L). Heart failure with reduced ejection fraction (HFrEF) was present in 86.7% of patients. The median time to death was 2 days; 60.0% died within 48 hours. Cardiogenic shock (60%) and septic shock (60%) were the predominant causes of death.

**Conclusions:** Fatal ADHF in this ICU cohort was characterized by multi-organ dysfunction, predominantly reduced ejection fraction and rapid progression to death. The high prevalence of combined cardiogenic and septic shock highlights the importance of early recognition and aggressive management of both cardiac and infectious complications.

**Keywords:** Acute Decompensated Heart Failure, Intensive Care Unit, Mortality, Cardiogenic Shock, Cardiorenal Syndrome.

**How to cite this article:** Swarnkar R, Singh A, Bansal M, Jamil S, Sahai S. Clinical Characteristics and Predictors of Mortality in Patients with Acute Decompensated Heart Failure in the Intensive Care Unit. *Int J Drug Deliv Technol.* 2026;16(33s):524-529. DOI: 10.25258/ijddt.16.33s.63

**Source of support:** Nil.

**Conflict of interest:** The authors declare no conflict of interest.

## INTRODUCTION

Heart failure (HF) represents a major global public health challenge, affecting an estimated 64 million people worldwide and imposing substantial economic burden on healthcare systems.<sup>1</sup> Acute decompensated

heart failure (ADHF) is among the leading causes of hospitalization, particularly in patients over 65 years of age and is associated with in-hospital mortality rates ranging from 4% to 13%.<sup>2,3</sup>

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The epidemiology and outcomes of HF differ considerably between developed and developing nations. In India, the burden of HF is estimated to affect 8–10 million individuals, with mortality rates substantially higher than those reported in Western countries.<sup>4</sup> The International Congestive Heart Failure (INTER-CHF) study demonstrated a 1-year mortality rate of 23% in India compared to 7% in China and 9% in South America, with Indian patients presenting approximately 10 years younger than their counterparts in higher-income regions.<sup>5</sup> The Trivandrum Heart Failure Registry (THFR) similarly reported an in-hospital mortality rate of 8.5% and 90-day mortality significantly higher than Western registries, with ischemic heart disease accounting for 72% of HF cases.<sup>6</sup> Patients with ADHF requiring ICU admission represent the most critically ill subset, often presenting with cardiogenic shock, multi-organ dysfunction and complex comorbidities. The cardiorenal syndrome, characterized by bidirectional interplay between cardiac and renal dysfunction, is common in this population and portends poor prognosis.<sup>7</sup> The Acute Decompensated Heart Failure National Registry (ADHERE) identified elevated blood urea nitrogen, low systolic blood pressure and elevated serum creatinine as the strongest predictors of in-hospital mortality.<sup>8</sup>

Despite the substantial disease burden, data characterizing the clinical profile and outcomes of fatal ADHF cases in Indian ICU settings remain limited. Understanding the characteristics of patients who succumb to ADHF may help identify high-risk features and guide management strategies. We conducted this retrospective case series to describe the clinical characteristics, laboratory abnormalities, echocardiographic findings and causes of death in patients who died from ADHF in our ICU.

## METHODS

### *Study Design and Setting*

This was a retrospective descriptive case series conducted at a tertiary care center in India. We reviewed medical records of consecutive patients admitted to the intensive care unit with a primary diagnosis of ADHF who died during Index hospitalization.

### *Study Population*

Patients were included if they: (1) were 18 years of age or older; (2) had a primary admission diagnosis of ADHF requiring ICU-level care; (3) had echocardiographic assessment performed during admission; and (4) died during the index hospitalization.

### *Data Collection*

Data extracted included demographics, presenting symptoms, comorbidities, physical examination findings, vital signs, laboratory parameters at admission (haemoglobin, total leukocyte count with differential, ESR, renal function tests, electrolytes, liver function tests, NT-proBNP), echocardiographic findings (LVEF, HF phenotype, regional wall motion abnormalities) and cause of death.

### *Definitions*

Heart failure with reduced ejection fraction (HFrEF) was defined as LVEF <50% and heart failure with preserved ejection fraction (HFpEF) as LVEF ≥50%. Time to death was calculated as days from admission to death.

### *Statistical Analysis*

Continuous variables were expressed as mean ± standard deviation or median with interquartile range. Categorical variables were expressed as frequencies and percentages.

### *Ethical Considerations*

This study was conducted in accordance with the Declaration of Helsinki.

## RESULTS

### *Baseline Demographics and Clinical Characteristics*

A total of 50 patients with fatal ADHF were included. The mean age was 66.7 ± 14.2 years (range: 46–90). Males comprised 60% (n=30) of the cohort. Hypertension was present in 20 patients (40%) and diabetes mellitus in 20 patients (40%). Notably, 13 patients (26%) had no previously documented comorbidities.

All 50 patients presented with dyspnea. Other presenting symptoms included fever, pedal edema chest pain and decreased urine output. Physical examination revealed pallor in 60% and peripheral edema in 46%. The mean heart rate was 104 ± 27 bpm. The baseline characteristics are summarized in Table 1.

**Table 1. Baseline Demographics and Clinical Characteristics**

Characteristic	Value (N = 50)
<i>Demographics</i>	
Age, years, mean ± SD	66.7 ± 14.2
Age, years, median (IQR)	71 (54.5–74)
Male sex, n (%)	30 (60)
<i>Comorbidities</i>	

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Hypertension, n (%)	20 (40)
Diabetes mellitus, n (%)	20 (40)
Thyroid disorders, n (%)	7 (14)
No documented comorbidity, n (%)	13 (26)
<b>Presenting Symptoms</b>	
Dyspnea, n (%)	50 (100)
Fever, n (%)	20 (40)
Pedal edema, n (%)	23 (46)
Chest pain, n (%)	10 (20)
Decreased urine output, n (%)	10 (20)
<b>Physical Examination</b>	
Pallor, n (%)	30 (60)
Peripheral edema, n (%)	23 (46)
<b>Vital Signs</b>	
Heart rate, bpm, mean $\pm$ SD	104 $\pm$ 27.6

SD, standard deviation; IQR, interquartile range.

### Laboratory Findings

Anemia was prevalent with mean haemoglobin of 10.34  $\pm$  3.86 g/dL. Leukocytosis was observed (mean TLC 16.12  $\pm$  7.2  $\times 10^3/\mu\text{L}$ ) with neutrophil predominance (83.27%). Renal dysfunction was common, with mean creatinine of 1.99  $\pm$  1.05 mg/dL and mean urea of 87.09  $\pm$  51.21 mg/dL. Hyponatremia was present with mean sodium of 131.87  $\pm$  9.29 mEq/L. Complete laboratory parameters are shown in Table 2.

**Table 2. Laboratory Parameters at Admission**

Parameter	Mean $\pm$ SD	Median (IQR)	Range
<b>Hematology</b>			
Hemoglobin, g/dL	10.34 $\pm$ 3.86	9.9 (8.2–12.05)	3.2–17.5
TLC, $\times 10^3/\mu\text{L}$	16.12 $\pm$ 7.2	15.74 (12.57–17.88)	5.78–36.4
Neutrophils, %	83.27 $\pm$ 6.68	85 (79.5–86.5)	69–95
<b>Renal Function</b>			
Blood urea,	87.09 $\pm$	63.1 (49.3–	26.2–

mg/dL	51.21	129.65)	171.4
Serum creatinine, mg/dL	1.99 $\pm$ 1.05	1.9 (1.5–2.45)	0.5–4.1
Uric acid, mg/dL	9.17 $\pm$ 3.64	10.4 (7.3–11.2)	2.3–15
<b>Electrolytes</b>			
Sodium, mEq/L	131.87 $\pm$ 9.29	135 (127–137.5)	110–146
<b>Liver Function</b>			
SGOT/AST, U/L	178.12 $\pm$ 351.48	50 (33–96.5)	15–1373
SGPT/ALT, U/L	154.8 $\pm$ 329.83	30 (22–51.5)	10–1141

SD, standard deviation; IQR, interquartile range; TLC, total leukocyte count; SGOT, serum glutamic-oxaloacetic transaminase; SGPT, serum glutamic-pyruvic transaminase.

### Cardiac Biomarker and Echocardiographic Findings

NT-proBNP levels were markedly elevated, with 23 patients having values exceeding 15,000 pg/mL. Echocardiography revealed HFrEF in 43 patients and HFpEF in 7 patients. Severely reduced LVEF (15–25%) was present in 17 patients. Regional wall motion abnormality was present in 27 patients, suggesting ischemic etiology. These findings are detailed in Table 3.

**Table 3. Cardiac Biomarker and Echocardiographic Findings**

Parameter	Value (N = 50) (%)
<b>Cardiac Biomarker</b>	
NT-proBNP >15,000 pg/mL	23 (46 %)
NT-proBNP >30,000 pg/mL	10 (20 %)
<b>Heart Failure Phenotype</b>	
HFrEF (EF <50%)	43 (86 %)
HFpEF (EF $\geq$ 50%)	7 (14 %)
<b>Ejection Fraction Categories</b>	
Severely reduced (15–25%)	17 (34 %)
Moderately reduced (30–40%)	10 (20 %)

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Mildly reduced (40–50%)	16 (32 %)
Preserved (>50%)	7 (14 %)
<b>Regional Wall Motion</b>	
RWMA present	27 (54 %)
RWMA absent	23 (46 %)

*NT-proBNP, N-terminal pro-B-type natriuretic peptide; HFrEF, heart failure with reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; EF, ejection fraction; RWMA, regional wall motion abnormality.*

### Clinical Outcomes

The median time from admission to death was 2 days (IQR: 1–4.5), with a mean of  $3.4 \pm 3.9$  days. Of the 50 patients, 20 died within 24 hours, 30 within 48 hours and 44 within one week. Cardiogenic shock was implicated in 30 deaths, septic shock in 30 and combined cardiogenic-septic shock in 14. Metabolic acidosis contributed to 16 deaths. Outcomes are summarized in Table 4.

**Table 4. Clinical Outcomes**

Outcome Measure	Value (N = 50) (%)
<b>Time from Admission to Death</b>	
Days, mean $\pm$ SD	$3.4 \pm 3.9$
Days, median (IQR)	2 (1–4.5)
<b>Timing of Death</b>	
Within 24 hours	20 (40 %)
Within 48 hours	30 (60 %)
Within 7 days	44 (88 %)
<b>Primary Cause of Death</b>	
Cardiogenic shock	30 (60 %)
Septic shock	30 (60 %)
Combined cardiogenic + septic shock	14 (28 %)
Metabolic acidosis (contributing)	16 (32 %)

*SD, standard deviation; IQR, interquartile range.*

### DISCUSSION

This case series characterizes 50 patients who died from ADHF in an ICU setting, providing insights into the clinical profile and modes of death in this critically ill

population. Our findings are consistent with and extend existing literature on fatal ADHF.

The mean age of our cohort (66.7 years) is consistent with data from Indian heart failure registries. The INTER-CHF study reported a mean age of 59 years among Indian participants, compared to approximately 70 years in Western populations.<sup>5</sup> The Trivandrum Heart Failure Registry similarly reported a mean age of 61.2 years.<sup>6</sup> This younger age at presentation may reflect earlier onset of cardiovascular risk factors and the epidemiological transition occurring in India.

The predominance of HFrEF in our cohort aligns with observations from the National Heart Failure Registry of India, which reported HFrEF in 59% of patients.<sup>9</sup> The presence of regional wall motion abnormalities in 54% of our patients suggests ischemic etiology as a major contributor, consistent with the Trivandrum Registry where ischemic heart disease accounted for 72% of HF cases.<sup>6</sup>

The laboratory profile demonstrated multi-organ involvement characteristic of cardiorenal syndrome type 1. The mean creatinine of 1.99 mg/dL indicates significant renal impairment. This is clinically significant, as the ADHERE registry identified elevated blood urea nitrogen as the strongest predictor of in-hospital mortality, followed by low systolic blood pressure and elevated creatinine.<sup>8</sup> Cardiorenal syndrome develops in 25–40% of patients hospitalized with ADHF and is independently associated with increased mortality.<sup>7</sup>

Hyponatremia (mean sodium 131.87 mEq/L) was prevalent, reflecting neurohormonal activation and impaired free water excretion. Hyponatremia in HF is associated with worse outcomes.<sup>10</sup> The anemia observed (mean haemoglobin 10.34 g/dL) is also a recognized adverse prognostic factor, contributing to reduced oxygen delivery and inflammatory pathway activation.<sup>11</sup> The markedly elevated NT-proBNP levels reflect severe hemodynamic stress. NT-proBNP concentrations above 10,000 pg/mL have been identified as independent predictors of 1-year mortality in acute heart failure.<sup>12</sup> Our finding that 46 % of fatal cases had levels exceeding 15,000 pg/mL underscores the prognostic significance of this biomarker.

The rapid progression to death is striking. With a median time to death of 2 days and 60.0% dying within 48 hours, this cohort represents critically ill patients. The ADHERE registry showed that patients receiving early vasoactive therapy had lower mortality,<sup>13</sup>

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highlighting the importance of rapid intervention. Our findings suggest many patients presented too late or with disease too advanced for effective intervention.

The high prevalence of both cardiogenic shock (60%) and septic shock (60%), with 28% having combined shock, highlights the complex interplay between cardiac dysfunction and infection. Patients with advanced HF have impaired immunity and are susceptible to infections,<sup>14</sup> while sepsis can precipitate cardiac dysfunction through myocardial depression. The fever at presentation and neutrophilia support the contribution of infection to mortality.

### Limitations

This study has limitations. First, as a retrospective case series of 50 patients from a single center, findings may not be generalizable. The small sample precluded multivariate analyses. Second, this mortality-only cohort lacks a comparator group of survivors. Third, certain variables such as lactate levels and other electrolytes were not consistently available. Finally, treatments administered could not be systematically analyzed.

### Clinical Implications

Despite limitations, this study provides valuable insights into fatal ADHF in an Indian ICU setting. The findings underscore the importance of early recognition of high-risk features including hemodynamic instability, renal dysfunction, hyponatremia and severely reduced ejection fraction. The high prevalence of infectious complications suggests aggressive screening and treatment of infections should be routine. The rapid time to death highlights the need for early identification and prompt management before irreversible multi-organ dysfunction develops.

### CONCLUSIONS

This case series of 50 patients who died from ADHF in an ICU indicates a clinical profile characterized by multi-organ dysfunction including cardiorenal syndrome, predominantly reduced ejection fraction with regional wall motion abnormalities suggesting ischemic etiology and rapid progression to death. The high prevalence of combined cardiogenic and septic shock highlights the importance of addressing both cardiac and infectious complications in critically ill heart failure patients. These findings contribute to the limited literature on fatal ADHF in developing country settings and may inform risk stratification and management strategies.

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