

Clinical Presentation, Management and Outcome of Heart Failure Patients

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ABSTRACT

Background: Heart failure is a major public health issue with rising hospitalizations and high mortality. This study was conducted to assess the clinical presentation, management and outcome of heart failure patients presenting to a tertiary care hospital.

Methods: A prospective, observational study was conducted at a tertiary cardiac center in Nepal over a period of six months among admitted patients aged 18 years and above with heart failure. Data on demographics, etiology, treatment, and outcomes were collected via structured interviews, chart review, clinical observation, phone calls and follow-up. Etiologies were defined per standard criteria and patients were categorized according to the clinical and echocardiographic diagnosis.

Results: Among 1523 patients included, the mean age of the cohort was 61.5 ± 14.9 years, and 62.0 % were male. Coronary artery disease (65.8%) was the most common etiology, followed by idiopathic dilated cardiomyopathy (15.0%) and rheumatic heart disease (7.2%). Acute coronary syndrome (39.9%) was the primary aggravating factor. Guideline-directed medical therapy use included Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker (68.5%), Beta-blockers (66.1%), and Mineralocorticoid Receptor Antagonists (61.2%); however, the use of Sodium-Glucose Cotransporter-2 inhibitors was low (15.2%). Device therapy was rare (0.26%). The overall mortality rate was 12.7%, comprising 4.7% in-hospital mortality and 7.9% 90-day mortality.

Conclusions: Coronary artery disease is the commonest etiology, with Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker as the commonest prescription, followed by Beta-blockers and Mineralocorticoid Receptor Antagonists, with device therapy being rare, with an overall mortality of 12.7%.

Keywords: Coronary artery disease; dilated cardiomyopathy; guideline-directed medical therapy; heart failure.

INTRODUCTION

Heart failure (HF) is a clinical syndrome caused by cardiac abnormalities, confirmed by elevated natriuretic peptides and/or congestion.¹ HF hospitalizations may increase by 50% in 25 years,² and five-year mortality is around 67%, as shown in the Framingham Heart Study (FHS) and Cardiovascular Health Study (CHS) cohorts.³ Dilated cardiomyopathy is the most common cause.⁴ In 2021, HF was a top cause of admissions and cardiac mortality at Nepal's Shahid Gangalal National Heart Centre (SGNHC).⁵ However, in Nepal, comprehensive,

real-world data on the clinical profiles, treatment patterns and short-term outcomes of hospitalized HF patients remain scarce. To address this gap, the primary objective of this study is to comprehensively describe the clinical presentation, etiologies, management strategies, in-hospital complications, and 90-day post-discharge outcomes (including mortality and readmission) of patients admitted with acute or decompensated HF at the SGNHC in Kathmandu, Nepal.

METHODS

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This prospective observational study was conducted at Shahid Gangalal National Heart Centre (SGNHC), a national referral tertiary cardiac center in Kathmandu, Nepal, between May and November 2022. It included patients admitted to the Department of Cardiology who met the universal definition of heart failure—namely, symptoms and/or signs arising from a structural and/or functional cardiac abnormality, supported by at least one of the following: (1) elevated natriuretic peptide levels, or (2) objective evidence of cardiogenic pulmonary or systemic congestion confirmed through diagnostic modalities such as imaging or hemodynamic measurement.

Ethical approval was obtained from the Institutional Review Committee (IRC No. 10-2022). Enrolled patients were typically symptomatic at the time of presentation, obtaining written informed consent was considered impractical; verbal consent was therefore obtained from all participants prior to enrollment. Data were securely stored and accessible only to the research team.

All patients aged 18 years and above admitted to the Department of Cardiology with symptoms of heart failure, irrespective of ejection fraction, with or without clinical signs, during the study period, were included. Patients admitted with a diagnosis of constrictive pericarditis and pulmonary diseases causing symptoms were excluded.

Face-to-face interviews using structured questionnaires, review of clinical charts and clinical observation methods were used for data collection. The baseline parameters included demographic factors (age, gender etc.), and lifestyle behaviors (smoking status defined as never smoked, having smoked in the past (No quantity was inquired) and currently smoking and alcohol and tobacco consumption was also similarly defined), and clinical conditions such as hypertension (defined by a self-reported diagnosis, systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, or use of antihypertensive medication) and diabetes (defined by a self-reported diagnosis, fasting blood glucose [FBG] ≥ 7 mmol/L, or HbA1c $> 6.5\%$). Also, data related to comorbidities, including coronary artery disease (CAD), past health history, and history of hospitalization for HF were collected. Clinical parameters included blood pressure, heart rate at admission, New York Heart Association (NYHA) class at presentation, and past medical history. Laboratory investigations included serum creatinine (mg/dL), complete blood count (including hemoglobin, g/L), serum sodium and potassium, thyroid profile, iron profile, and N-terminal

pro-B-type natriuretic peptide (NT-proBNP). The mode of presentation during admission, presenting symptoms, clinical phenotype, electrocardiogram (ECG) and echocardiographic findings were also collected in this study. The other variables of the study were in-hospital management (pharmacologic and non-pharmacologic), referral history and precipitating factors for heart failure.

We defined different disease etiologies according to specific scientific criteria. Patients specifically diagnosed with Heart Failure with mildly reduced Ejection Fraction (HFmrEF) or Heart Failure with preserved Ejection Fraction (HFpEF) were placed in those categories. We classified patients with other cardiac diseases by disease etiology and subsequent left ventricular ejection fraction (LVEF). Aggravating factors, comorbidities, and the mode of presentation were based on patient self-report and were not verified against external sources, such as medical records or clinical assessments.

The patients were followed up in three months using phone calls. The outcome variables for this study were duration of stay (in days), in-hospital mortality, NYHA classification at discharge, renal function at discharge, and 90-day clinical outcome. Patients lost to follow-up were excluded from the outcome analyses.

The data were analyzed using IBM SPSS version 26. We presented continuous data as mean and standard deviation, and categorical data as frequencies (percentages).

RESULTS

We stratified baseline characteristics by LVEF. The cohort had a mean age of 61.5 ± 14.9 years (18-97 years) and was predominantly male (62.0%). CAD was the most common etiology (65.8%) across all groups. Heart failure with reduced ejection fraction (HFrEF; LVEF $\leq 40\%$) was the most common presentation (55.7%). Current tobacco users numbered 72 (4.7%), while 161 (10.6%) were previous tobacco users. In terms of smoking, 205 (13.5%) were current smokers and 637 (41.8%) had a smoking history. No patient was admitted with hypertensive heart disease, as shown in [Table 1](#). One patient was diagnosed with Arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) with LVEF $\leq 40\%$. Similarly, one patient was diagnosed with carditis and LVEF $\leq 40\%$. Eleven patients were admitted with pericardial effusion and LVEF $\geq 50\%$. Two patients were admitted with Primary Pulmonary Arterial

Hypertension and LVEF $\geq 50\%$.**Table 1. Baseline Demographics and Clinical Characteristics by LVEF Group.**

Demographic characteristics	Total (N=1523)	LVEF $\leq 40\%$ (n=848, 55.7%)	LVEF 41-49% (n=352, 23.1%)	LVEF $\geq 50\%$ (n=323, 21.2%)
Age, years (mean $\pm$ SD)	61.48 $\pm$ 14.9	62.34 $\pm$ 14.8	61.0 $\pm$ 13.6	59.8 $\pm$ 16.3
Male Sex (n %)	944 (62.0)	556 (65.6)	228 (64.8)	160 (49.5)
HFpEF (n %)	27 (1.8)	0 (0)	0 (0)	27 (8.3)
HFmrEF (n %)	16 (1.1)	0 (0)	16 (4.6)	0 (0)
Clinical profile (mean $\pm$ SD)				
Creatinine at admission (mg/dl)	1.1 $\pm$ 0.7	1.2 $\pm$ 0.7	1.6 $\pm$ 0.8	1.0 $\pm$ 0.6
Estimated glomerular filtration rate (eGFR) (mL/min/1.73 m ²)	75.7 $\pm$ 28	72.0 $\pm$ 27	80.9 $\pm$ 27	79.7 $\pm$ 28
Sodium at admission (mEq/L)	136.6 $\pm$ 4.7	136.5 $\pm$ 4.8	136.8 $\pm$ 4.6	136.9 $\pm$ 4.3
Potassium at admission (mEq/L)	4.1 $\pm$ 0.5	4.1 $\pm$ 0.5	4.1 $\pm$ 0.4	4.1 $\pm$ 0.5
NT-Pro BNP at admission (pg/ml)	12159.1 $\pm$ 10430.3	14345.7 $\pm$ 10725.9	8638.1 $\pm$ 9436.2	8110.3 $\pm$ 8253.1
Heart Rate (beats per minute)	89.32 $\pm$ 24.0	90.98 $\pm$ 24.4	85.4 $\pm$ 22.4	89.2 $\pm$ 24.5
Systolic Blood Pressure (mmHg)	124.74 $\pm$ 26.9	122.08 $\pm$ 25.9	129.66 $\pm$ 28.9	126.33 $\pm$ 26.4
Diastolic Blood Pressure (mmHg)	79.62 $\pm$ 16.1	78.94 $\pm$ 18.8	81.77 $\pm$ 18.8	79.03 $\pm$ 15.3
Etiological profile (n %)				
Coronary Artery Disease	1002 (65.8)	549 (64.7)	296 (84.1)	157 (48.6)
Dilated Cardiomyopathy	228 (15.0)	228 (26.9)	0 (0)	0 (0)
Congenital heart disease	18 (1.2)	6 (0.7)	3 (0.9)	9 (2.8)
Rheumatic Heart Disease	109 (7.2)	26 (3.1)	20 (5.7)	63 (19.5)
Non-Rheumatic Valvular Heart Disease	76 (5.0)	22 (2.6)	13 (3.7)	41 (12.7)
Prior heart valve surgery	24 (1.6)	7 (0.8)	4 (0.7)	13 (4.0)
Peripartum Cardiomyopathy	6 (0.4)	6 (0.7)	0 (0)	0 (0)
Hypertrophic Cardiomyopathy	8 (0.5)	7 (0.8)	0 (0)	1 (0.3)

Acute coronary syndrome (ACS) (39.9%) was the most frequent aggravating factor for heart failure admission across all LVEF groups, followed by accelerated hypertension (11.1%) and arrhythmia (9.2%). Hypertension (38.7%) and Diabetes Mellitus (25.7%) were the most prevalent comorbidities. A history of previous heart failure hospitalization was noted in 14.5% of patients, with the highest rate in the LVEF $\leq 40\%$ group (15.9%). Atrial fibrillation was noted in 5.4%,

thyroid disease in 4.1% and congenital heart disease in 0.4%, as illustrated in [Table 2](#).

Table 2. Aggravating Factors and Comorbidities Among Patients by LVEF.

Factors	Total (N=1523)	LVEF ≤40% (n=848)	LVEF 41-49% (n=352)	LVEF ≥50% (n=323)
	N (%)	n (%)	n (%)	n (%)
ACS	607 (39.9)	314 (37.0)	176 (50)	117 (36.2)
Accelerated HTN	170 (11.1)	93 (10.9)	37 (10.5)	40 (12.4)
Arrhythmia	140 (9.2)	69 (8.1)	17 (4.8)	54 (16.7)
Acute Infections	75 (4.9)	53 (6.3)	6 (1.7)	16 (5.0)
Increased Fluid/Salt intake	37 (2.4)	28 (3.3)	2 (0.6)	7 (2.2)
Drug Non-compliance	20 (1.3)	10 (1.2)	2 (0.6)	8 (2.5)
Thyrotoxicosis	3 (0.2)	3 (0.4)	0 (0)	0 (0)
Comorbidities				
	N (%)	n (%)	n (%)	n (%)
Hypertension	590 (38.7)	315 (37.1)	151 (42.9)	124 (38.4)
History of Diabetes Mellitus	391 (25.7)	229 (27.0)	91 (25.9)	71 (22.0)
Ischemic Heart Disease (IHD)/CAD	361 (23.7)	215 (25.4)	89 (25.3)	57 (17.6)
History of Hospitalization for Heart failure	221 (14.5)	135 (15.9)	18 (5.1)	68 (21.1)
History of Chronic Obstructive Pulmonary Disease (COPD)	121 (7.9)	59 (7.0)	17 (4.8)	45 (13.9)
Atrial Flutter/Fibrillation	83 (5.4)	43 (5.1)	6 (1.7)	34 (10.5)
History of Chronic Kidney Disease (CKD)	47 (3.1)	33 (3.9)	5 (1.4)	9 (2.8)
Thyroid Disease	62 (4.1)	32 (3.8)	13 (3.7)	17 (5.3)
Pulmonary Disease	22 (1.4)	15 (1.8)	1 (0.3)	6 (1.9)
Hepatic Dysfunction	17 (1.1)	13 (1.5)	2 (0.6)	2 (0.6)
History of Stroke	15 (1.0)	8 (0.9)	1 (0.3)	6 (1.9)
Obesity	11 (0.7)	8 (0.9)	2 (0.6)	1 (0.3)
Congenital Heart Disease (CHD)	6 (0.4)	4 (0.5)	0 (0)	2 (0.6)

The majority of patients (58.7%) presented with acute de novo heart failure, a pattern that was most common in the LVEF 41-49% group (75.3%). The most frequent presenting symptoms were pulmonary congestion (63.4%) and angina (62.8%). Notably, 81.4% of patients were in sinus rhythm at admission, while 12.1% had atrial fibrillation, with a higher prevalence in the LVEF ≥50% group (21.1%). Left Bundle Branch Block (LBBB) was noted in 2.2%, among which Sinus Rhythm with LBBB in ECG was present in 28 (1.8%) and Atrial Fibrillation with LBBB was noted in 5 (0.3%), as presented in [Table 3](#).

Table 3. Mode of Presentation, Initial Findings, In-Hospital Management and Discharge Parameters by LVEF.

Characteristics	Overall (N=1523)	LVEF ≤40% (n=848)	LVEF 41-49% (n= 352)	LVEF ≥50% (n=323)
Mode of presentation n (%)				
Acute De Novo Heart Failure	894 (58.7)	472 (55.7)	265 (75.3)	178 (55.1)
Acute Decompensated Heart Failure	629 (41.3)	376 (44.3)	87 (24.7)	145 (44.9)
Presenting Symptoms n (%)				
Pulmonary Congestion	966 (63.4)	563 (66.4)	161 (45.7)	242 (74.9)
Angina	957 (62.8)	502 (59.2)	284 (80.7)	171 (52.9)
Pedal Edema	203 (13.3)	137 (16.2)	15 (4.3)	51 (15.8)
Palpitation	184 (12.1)	93 (11.0)	36 (10.2)	55 (17.0)
Syncope/ Presyncope	61 (4.0)	35 (4.1)	9 (2.6)	17 (5.3)
Weight Gain	8 (0.5)	5 (0.6)	0 (0)	3 (0.9)
ECG Findings n (%)				
Sinus	1239 (81.4)	704 (83.0)	300 (85.2)	235 (78.9)
Atrial Fibrillation	184 (12.1)	91 (10.7)	25 (7.1)	68 (21.1)
Atrioventricular (AV) Block	44 (2.9)	16 (1.9)	18 (5.1)	10 (3.1)
Ventricular Tachycardia (VT)/ Ventricular Fibrillation (VF)	17 (1.1)	15 (1.7)	0 (0)	0 (0)
LBBB* n (%)	33 (2.2)	22 (2.6)	6 (1.7)	5 (1.5)
Non-pharmacological Management n (%)				
Cardio-pulmonary Resuscitation (CPR)	46 (3.0%)	29 (3.4%)	12 (3.4%)	5 (1.6%)
Continuous Positive Airway Pressure (CPAP)/ Bilevel Positive Airway Pressure (BIPAP)	3 (0.2%)	1 (0.1%)	1 (0.3%)	1 (0.3%)
Invasive Mechanical Ventilation (MV)	17 (1.1%)	10 (1.2%)	3 (0.9%)	4 (1.3%)
Discharge Investigations (mean ± SD)				
Creatinine (mg/dl)	1.1±0.8	1.18±0.8	1.0±0.7	1.1±0.8
Estimated glomerular filtration rate (eGFR) (mL/min/1.73 m ²)	74.7±26	71.0±25	79.4±26	78.9±28
Sodium (mEq/L)	137.0±3.9	136.48±4.8	137.3±3.9	137.0±3.6
Potassium (mEq/L)	4.1±0.4	4.1±0.5	4.0±0.4	4.1±0.5

*LBBB includes: Sinus rhythm with LBBB (28 overall; 17, 6, 5 by group) and Atrial fibrillation with LBBB (5 overall; 5, 0, 0 by group).

Most patients (68.8%) were admitted in NYHA functional class III and class IV, whereas most of the patients (84.2%) were discharged in NYHA class I and II.

Regarding the in-hospital management, seventeen patients (1.1%) required invasive mechanical ventilation, while 3 (0.2%) received non-invasive mechanical ventilation. No dialysis was performed at our center because patients needing dialysis were referred to other facilities, as dialysis was unavailable during the study period. Eight patients

(0.5%) were referred to other centers, including 4 (0.5%) with LVEF $\leq 40\%$, 2 (0.6%) with an LVEF of 41-49%, and 2 (0.6%) with an LVEF of $\geq 50\%$.

Pharmacological treatment patterns revealed significant variations based on etiology and LVEF. In patients with CAD and LVEF $\leq 40\%$, the use of foundational Guideline-Directed Medical Therapy (GDMT) was moderate. However, the use of Sodium-Glucose Cotransporter-2 inhibitors (SGLT2i) was notably low (14.8%) in this group. Hypothyroidism was common among these patients, with 60 patients (6.0%) receiving thyroxine. Amiodarone was prescribed to 21 patients (2.1%), and Eplerenone was prescribed to just 1 patient (0.1%). The use of newer therapies, such as Angiotensin Receptor/Neprilysin Inhibitor (ARNI) and ivabradine, was absent. Device therapy was infrequent, with only 4 Implantable Cardioverter-Defibrillator (ICD) implantations (0.3%) in the LVEF $\leq 40\%$ group during the study period, as illustrated in [Table 4](#).

Etiology-specific treatment for patients with Dilated Cardiomyopathy (DCM) showed higher uptake of Mineralocorticoid Receptor Antagonists (MRAs) (75.0%), non-MRA diuretics (96.5%) and SGLT2i (37.7%) compared to other groups. Forty-five patients (22.8%) received digoxin. Twelve patients (5.3%) were prescribed thyroxine. Amiodarone was prescribed to 8 patients (3.5%).

Patients with HFmrEF were treated with SGLT2i in only

18.7% of the population. Two patients (13.3%) with atrial fibrillation were prescribed digoxin, and two patients (13.3%) received thyroxine. Amiodarone was prescribed to one patient (6.7%). Patients with HFpEF received non-MRA diuretics in 88.9%. Three patients (11.5%) with atrial fibrillation were prescribed digoxin.

Among patients with heart failure and congenital heart disease, six patients (33.3%) with atrial fibrillation were prescribed digoxin, and six patients (33.3%) received Sildenafil. Digoxin use was highest in patients with non-rheumatic valvular heart disease and rheumatic heart disease (19.5-42.3%).

Regarding patients with pericardial effusion, five were diagnosed with tubercular pericarditis and treated with Antitubercular therapy (ATT); one had post-valve surgery and was treated with pericardiocentesis; two had thyroid disorders and were treated with thyroxine; one had chronic kidney disease and was treated with pericardiocentesis; and one had Chronic Obstructive Pulmonary Disease (COPD). Two cases had unknown causes; one resulted in in-hospital mortality, and the other was diagnosed with carcinoma during follow-up.

Two patients (100%) with primary pulmonary arterial hypertension were treated with sildenafil, and one (50%) was treated with an endothelin receptor antagonist.

A total of 751 patients (49.7%) underwent coronary angiography, with 12 (1.6%) showing normal coronaries.

Table 4. Guideline-Directed Medical Therapy by Primary Etiology and LVEF Heart Failure Pharmacotherapy for Key Etiologies

Patient Condition		ACEi/ARB	Beta-Blocker	MRA	SGLT2i
	n	n (%)	n (%)	n (%)	n (%)
Overall	1523	1043 (68.5)	1007 (66.1)	932 (61.2)	231 (15.2)
Dilated Cardiomyopathy	228	158 (69.3)	140 (61.4)	171 (75.0)	86 (37.7)
Coronary Artery Disease					
LVEF $\leq 40\%$	549	409 (74.5)	414 (75.4)	384 (69.9)	81 (14.8)
LVEF 41-49%	296	235 (79.4)	204 (68.9)	142 (48.0)	34 (11.5)
LVEF $\geq 50\%$	157	123 (78.3)	113 (72.0)	42 (26.8)	14 (8.9)
HFmrEF	16	14 (87.5)	10 (62.5)	14 (87.5)	3 (18.7)
HFpEF	27	15 (55.5)	8 (29.6)	14 (51.8)	3 (11.1)
Non-Rheumatic Valvular Heart Disease	76	38 (50.0)	33 (43.4)	53 (69.7)	8 (10.5)
Rheumatic Heart Disease	109	28 (25.7)	54 (49.5)	73 (67.0)	1 (0.9)

Adjunctive and Etiology-Specific Therapies

Patient Condition	n	Digoxin n (%)	Vasodilators n (%)	Anticoagulants n (%)
Overall	1523	142 (9.3)	337 (22.1)	401 (26.3)
Rheumatic Heart Disease	109	38 (34.9)	3 (2.8)	23 (21.1)
Non-Rheumatic Valvular Heart Disease	76	19 (25.0)	2 (2.6)	14 (18.4)
Prior Heart Surgery	24	11 (45.8)	0 (0.0)	18 (75.0)
Atrial Fibrillation	184	68 (37.0)	0 (0.0)	108 (58.7)

A total of 1239 (81.4%) patients were followed up at 90 days. The all-cause mortality rate was 12.7%, comprising 4.7% in-hospital mortality and 7.9% 90-day mortality among discharged patients. Mortality was highest in the LVEF $\leq$ 40% group (10.0% during follow-up). (Table 5)

Cardiogenic shock (61.1% of in-hospital deaths) was the leading cause of mortality. The mean hospital stay was 6.2 ± 3.8 days, with no significant differences across LVEF groups. (Table 5)

During the 90-day follow-up, 56 (3.7%) had a second admission for heart failure, with the highest readmission rate in the LVEF $\leq$ 40% group (4.8%), followed by 5 (1.4%) for LVEF 41-49% and 10 (3.2%) for the LVEF $\geq$ 50% group. Among the patients with a second admission, 3 (0.4%) with LVEF $\leq$ 40% and 1 (0.3%) with LVEF $\geq$ 50% had a third admission, respectively.

Table 5. Clinical Outcome, Length of Hospital Stay and Causes of In-Hospital Death Stratified by LVEF

Clinical outcome n (%)	Overall (N=1523)	LVEF $\leq$ 40% (n=848)	LVEF 41-49% (n= 352)	LVEF $\geq$ 50% (n=323)
In-Hospital Death	72 (4.7)	48 (5.7)	17 (4.8)	7 (2.2)
Discharged Alive	1451 (95.3)	800 (94.3)	335 (95.2)	316 (97.8)
90-Day Mortality (post-discharge),	121 (7.9)	85 (10.0)	13 (3.7)	23 (7.1)
Alive at 90 Days,	1046 (68.7)	563 (66.4)	255 (72.4)	228 (70.6)
Lost to Follow-up,	284 (18.6)	152 (17.9)	67 (19.0)	65 (20.1)
Total Mortality (In-Hosp + 90-Day),	193 (12.7)	133 (15.7)	30 (8.5)	30 (9.3)
Length of Stay, days (mean $\pm$ SD)				
Total Hospital Stay	6.2 ± 3.8	6.2 ± 3.7	6.0 ± 3.1	6.4 ± 4.7
Coronary Care Unit (CCU)	2.1 ± 2.9	2.3 ± 3.2	2.3 ± 3.0	2.0 ± 2.6
General Ward	4.7 ± 3.2	4.8 ± 3.4	4.4 ± 3.1	4.8 ± 3.6
Cause of In-Hospital Death, n (%)				
Cardiogenic Shock	44 (2.9)	30 (3.5)	9 (2.6)	5 (1.5)
Cardiac Arrest	9 (0.6)	5 (0.6)	4 (1.1)	0 (0.0)
Septic Shock	8 (0.5)	4 (0.5)	2 (0.6)	2 (0.6)
VT/VF	4 (0.3)	2 (0.2)	2 (0.6)	0 (0.0)
Pulmonary Edema	5 (0.3)	5 (0.6)	0 (0.0)	0 (0.0)
Other (Hemorrhagic Stroke (1), Fulminant Myocarditis (1))	2 (0.1)	2 (0.2)	0 (0.0)	0 (0.0)

Regarding the etiology-based mortality risk, patients with congenital heart disease suffered the highest in-hospital (22.2%) and 90-day (36.4%) mortality rates. Those with DCM also had high post-discharge mortality (14.9%), as shown in Table 6.

Table 6. Etiology-Specific Mortality Rates

Etiology	n	In-Hospital Mortality		90-Day Mortality (post-discharge)	
		n (% of Total in-hospital deaths)	n (% within Etiology Group)	n (% of Total post-discharge deaths)	n (% within Etiology Group)
Coronary Artery Disease	1002	44 (61.1)	4.4	60 (49.6)	7.7
Dilated Cardiomyopathy	228	11 (15.3)	4.8	26 (21.5)	14.9
Rheumatic Heart Disease	109	8 (11.1)	7.3	13 (10.8)	15.9
Valvular Heart Disease	76	2 (2.8)	2.6	9 (7.4)	18.0
Congenital Heart Disease	18	4 (5.5)	22.2	4 (3.3)	36.4
HFpEF	27	1 (1.4)	3.7	5 (4.1)	23.8
HFmrEF	16	0 (0.0)	0.0	3 (2.5)	25.0
Pericardial Effusion	11	1 (1.4)	9.1	0 (0.0)	0.0
Prior Heart Surgery	24	1 (1.4)	4.2	1 (0.8)	4.8
Total	-	72 (100)	-	121 (100)	-

DISCUSSION

This study details the profile of HF patients at a tertiary center in Nepal, revealing a distinct epidemiological profile characterized by a younger patient population, a high burden of CAD and RHD, moderate adherence to foundational therapies, significant gaps in advanced care, and mortality rates comparable to other regional registries.

Our cohort's mean age (61.5 years) aligned with Indian⁶ and pan-Asian registries⁷ but was younger than East Asian and older than some Southeast Asian populations, reflecting regional disparities in life expectancy and healthcare access.⁸ Male predominance (62.0%), consistent with Indian studies^{6,9-11} but less pronounced than in other Asian registries, may indicate either a true epidemiological difference or systemic under-diagnosis of HF in women.^{7,8,12}

Etiologically, our findings mirror the regional dominance of CAD (65.8%), underscoring its central role in HF prevention strategies for Nepal.^{6,8-12} The prevalence of idiopathic dilated cardiomyopathy (15%) was consistent with reports from India and China,^{6,8,10,11} while non-rheumatic valvular heart disease (14.1%) was similar to rates in Korea, Southeast Asia, and China.^{8,12,13} Notably, RHD (8.9%) was more prominent than in India and the Philippines,^{6,8} highlighting the persistent burden of preventable diseases. In stark contrast to Western registries, where hypertension is a primary etiology,¹⁴⁻¹⁶ it functioned primarily as a comorbidity (38.7%) or aggravating factor in our cohort, similar to other Asian populations.^{6,12,13} The most common precipitating factor

was acute coronary syndrome (39.9%), aligning with the Korean Heart Failure study.¹² Collectively, these etiological patterns confirm the primacy of ischemic heart disease across Asia while revealing critical regional variations in the burden of RHD and hypertensive heart disease, reflecting different stages of epidemiological transition.

The distribution of HF types revealed a higher proportion of HF with LVEF $\leq$ 40% (55.7%) than in Japan, Thailand, and Malaysia, but less than in Korea and India.^{8-13,17} The prevalence of HF with LVEF 41-49% (23.1%) was higher than in several regional comparators,^{8,9,11,17,18} while HF with LVEF $\geq$ 50% (21.2%) was more common than in India but less so than in Malaysia, Japan, and Western cohorts.^{8,9,11,17}

Comorbidity profiles also demonstrated distinct patterns. The prevalence of diabetes (25.7%) was lower than in most other Asian registries,^{6-12,17,18} while hypertension (38.7%) was comparable to the ASIAN-HF registry but lower than other benchmarks.^{7,8} A notably lower rate of chronic kidney disease (CKD) was observed, likely due to referral bias, as advanced CKD patients may be managed at specialized nephrology centers.^{6,8,9,11,12} Similarly, the prevalence of CAD, stroke/Transient Ischemic Attack (TIA), and Chronic Obstructive Pulmonary Disease (COPD)/asthma as comorbidities was lower than or aligned with specific regional reports.^{6,8,11,17,19}

Clinical presentation was marked by a high rate of acute de novo HF admission (58.7%), within the range reported in India and Korea.^{6,9,11,12} The prevalence of atrial fibrillation (12.1%) and LBBB (2.2%) was lower

than in East Asian and Western registries,^{7,8,10-12,19-22} while ventricular tachycardia/ventricular fibrillation (1.1%) was higher than in Korea.¹²

We observed moderate utilization of foundational GDMT. Angiotensin-converting enzyme inhibitor/angiotensin receptor blocker (ACEi/ARB) use (68.5%) lagged behind China and Western registries but exceeded rates in India and Thailand.^{6-8,10,12,16,23-25} Beta-blocker use (66.1%) surpassed several Asian registries^{6,10,12} but remained below top benchmarks.^{7,8,16,18,23,24} MRA prescribing (61.2%) was higher than in many Asian and Western registries,^{6-8,10,12,16,23,24} though lower than in China.⁸

Critical gaps were evident in advanced therapies. The use of SGLT2 inhibitors was low (15.2%), and no patients received ARNI or ivabradine, reflecting significant therapeutic lag, likely due to drug unavailability during the study period.^{7,9-11} Device therapy utilization was exceedingly low (0.3%), starkly highlighting the Asia-Pacific treatment gap and significant access barriers, despite a 14.3% uptake among eligible patients with LBBB.^{7-9,12,26} The use of other supportive therapies, such as digoxin (9.3%), inotropes (5.2%), and vasodilators (22.3%), was generally lower than in regional comparators.^{6-8,12} While coronary angiography was performed in nearly half the patients (49.7%), a higher rate than in India,⁶ the need for advanced life support (mechanical ventilation: 1.1%; renal replacement therapy: 0%) was markedly lower, possibly due to referral patterns and the unavailability of certain services at our center.^{8,12}

In-hospital (4.7%) and 90-day (7.9%) mortality rates were within the spectrum reported across Asia, being comparable to Korea,^{8,12} lower than several reports from India and Japan,^{6,8-10,27,28} but higher than in China and Taiwan.^{8,27,29} The finding of moderate outcomes despite significant care gaps is critical; it suggests that the younger age of the cohort may be temporarily offsetting the negative prognostic impact of suboptimal therapy—a precarious situation that could deteriorate as the population ages. The leading cause of death was cardiogenic shock, differing from Indian data, where sudden cardiac death is more prominent.^{9,30} The average hospital stay (6.2 days) was intermediate, shorter than in Korea and Japan but longer than in Western registries.^{8,12,15,23,28}

As a single-center, hospital-based study, this study has an inherent selection bias that limits the generalizability of its findings. Data on medication doses, adherence, and procedures such as Percutaneous Coronary Intervention

(PCI) and Coronary Artery Bypass Grafting (CABG) were not systematically captured. Although the follow-up rate was good (81.4%), it was not complete, and this could bias the 90-day mortality estimate. Despite limitations, this study is a crucial step toward understanding HF in Nepal and provides data regarding HF presentation and management.

CONCLUSIONS

Coronary artery disease is the commonest etiology, with Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker as the commonest prescription, with approximately one tenth mortality. It was noteworthy that device therapy and SGLT 2 inhibitors are less used

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CONFLICT OF INTEREST

The authors declare no competing interest.

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