Section: Medicine

Original Research Article

PROFILE OF PATIENTS OF HEART FAILURE AND BNP LEVELS

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Abstract

Background: Heart failure (HF), affecting over 23 million globally, is exacerbated by aging, lifestyle diseases, and poses significant health and economic burdens. Advances in classification and biomarkers like BNP, alongside diagnostic tools like echocardiography, are critical in managing and differentiating HF types to improve outcomes. The aim of this study was to explore heart failure patients' clinical features, risk factors, and compare BNP levels between HFrEF and HFpEF cases. **Materials and Methods:** This single-center, cross-sectional study at a tertiary care hospital in Navi Mumbai involved 110 adults diagnosed with heart failure according to Framingham criteria from June 2021 to December 2022, after obtaining ethical clearance and informed consent. Patients were screened for heart failure symptoms, with exclusions for recent cardiac surgery or non-cardiac causes of symptoms, and underwent examinations, 2D ECHO classification into HFrEF or HFpEF, and comprehensive lab tests, with data analyzed using SPSS and presented through statistical summaries. **Result:** The study found the most common age group among heart failure patients was 61-70 years (33.7%), with a majority being male (55.5%). NYHA Class III symptoms were prevalent in 62.7% of patients, with arterial hypertension (52.7%) being the top comorbidity. Ischemic heart disease (47.3%) emerged as the leading risk factor, and Heart Failure with Reduced Ejection Fraction (HFrEF) accounted for 58.2% of cases. Complications like respiratory infections were common, leading to a 10.9% mortality rate, predominantly caused by sepsis. Statistical analysis showed significant differences in age, NYHA classification, comorbidities, and BNP levels between survivors and non-survivors, indicating a need for targeted interventions. **Conclusion:** Heart failure incidence peaks in individuals over 60, primarily due to ischemic heart disease and hypertension, with HFrEF more prevalent than HFpEF and BNP levels crucial for early diagnosis and treatment.

INTRODUCTION

Heart failure (HF) is increasingly recognized as a major public health issue, with over 23 million people affected worldwide. This condition, characterized by the heart's inability to pump blood efficiently, leads to urgent hospital admissions and is a leading cause of morbidity and mortality.[1] The prevalence of HF is rising globally due to factors such as aging populations, increasing rates of obesity, diabetes, and hypertension, along with better survival rates following myocardial infarction. Epidemiological data highlight the significant burden of HF, particularly among those over 65 years of age, despite advancements in treatment improving survival. Heart failure (HF) poses a significant public health issue globally, particularly in nations with aging populations, where managing the condition—including diagnosis, treatment, and prevention of re-hospitalization—presents substantial challenges. Frequent hospital readmissions not only place a significant financial burden on healthcare systems but also adversely affect patients' quality of life.[2] Early prediction of a patient's clinical trajectory using evidence-based management strategies is crucial for improving care in acute HF cases.[3] Risk stratification remains difficult, yet the use of natriuretic peptides like B-type natriuretic peptide (BNP) for diagnosing acute HF is well-established, serving as a key prognostic tool for both short- and

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long-term outcomes.[4] BNP levels, recognized by major cardiology guidelines as vital for diagnosing HF, assessing disease severity, and guiding treatment decisions, also play a role in cardiovascular remodeling and volume homeostasis. Serial monitoring of BNP levels can provide incremental prognostic information and assist in evaluating therapeutic response.[5] Changes in BNP during hospital stay and post-discharge are indicative of patient outcomes and can guide timely treatment adjustments. This study focuses on the prognostic value of BNP levels shortly after discharge to predict mortality in hospitalized HF patients, highlighting the need for ongoing evaluation beyond the acute care setting.[6,7]

The introduction of a universal definition and classification of HF, including the categorization by ejection fraction (HFrEF, HFmrEF, HFpEF), aims to better standardize diagnosis and treatment. Echocardiography remains the gold standard for HF diagnosis, but the high costs and limitations in certain patient populations have led to the increased use of natriuretic peptides (NPs) as crucial biomarkers for diagnosis, prognosis, and treatment monitoring. The differentiation between HF types, particularly HFpEF and HFrEF, is significant, as it influences the approach to management and highlights the need for targeted research to address the challenges in diagnosis and treatment of HFpEF.[8]

Aim: To investigate the characteristics and B-type Natriuretic Peptide (BNP) levels in patients with heart failure.

Objectives

1. To examine the clinical characteristics of patients with heart failure (HF).
2. To identify and analyze risk factors contributing to the development of HF.
3. To compare and analyze BNP levels between patients with Heart Failure with Reduced Ejection Fraction (HFrEF) and those with Heart Failure with Preserved Ejection Fraction (HFpEF).

MATERIALS AND METHODS

This study, designed as a single-center, cross-sectional, observational investigation, was carried out in the Department of Medicine at a tertiary care teaching hospital in Navi Mumbai. Ethical clearance was obtained from the Institutional ethics committee before the commencement of the research. The current study was conducted from June 2021 through December 2022All participants provided written informed consent before their participation in the study. The study included 110 consecutive adults who were diagnosed with heart failure following the Framingham criteria. Written informed consent was obtained from all participants prior to their inclusion in the study.

The study included patients with signs and symptoms of heart failure as defined by the Framingham criteria, were older than 18 years of age from both sexes, and had 2D echocardiogram results indicative of heart failure. Eligibility also required patients to be willing to provide voluntary signed consent for participation in the study. Conversely, the study excluded individuals who had recently undergone cardiac surgeries (such as CABG or valve repair), those with chest wall injuries (either blunt or penetrating), patients presenting non-cardiac causes of dyspnea, edema, and fatigue, anyone younger than 18 years of age, and patients unwilling to give voluntary signed consent for the study.

Patients presenting with heart failure symptoms in the Department of Medicine, Medical OPD, Emergency, or Cardiology wards were screened for the study. Those meeting the inclusion and exclusion criteria were enrolled after providing informed consent. Consecutive heart failure patients underwent general and systemic examinations, with left ventricular ejection fraction (LVEF) assessed via 2D ECHO to categorize them into HFrEF (LVEF <40%) or HFpEF (LVEF >50%) groups. Comprehensive laboratory tests including CBC, serum urea, creatinine, electrolytes, HbA1c, and brain natriuretic peptide levels were conducted. Patient data, encompassing socio-demographic information, clinical history, examination findings, and test results, were documented in semi-structured forms. Follow-ups on clinical outcomes were conducted at regular intervals.

Data from 110 patients were collected and statistically analyzed using SPSS. Quantitative data were summarized using mean and standard deviation, while qualitative data were displayed using frequency and percentage tables. Graphs were utilized for visual representation of the results as needed. Statistical analyses were conducted using suitable software, such as MS Excel and IBM SPSS Statistics version 26.0. The level of significance was set at 5%. All p-values less than 0.05 were treated as significant.

RESULTS

The [Table 1] indicates distribution of study subjects according to age and gender. The study's subjects were predominantly older adults, with the largest age groups being 61-70 years (33.7%) and over 70 years (29.1%), and a mean age of 61.49 years. Males comprised 55.5% and females 44.5% of the participants.

The [Table 2] indicates the distribution of study subjects according to the clinical parameters included in the study. The result show most subjects in NYHA Class III (62.7%) and IV (37.3%). Common co-morbidities included arterial hypertension (52.7%), diabetes (30%), coronary artery disease (26.4%), and chronic atrial fibrillation (25.4%), with smoking (30.9%) and alcohol consumption (8.2%) as prevalent habits. Ischemic heart disease was the most noted risk factor (47.3%), followed by valvular heart disease (22.7%). Regarding ejection fraction, 58.2%

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had reduced ejection fraction (HFrEF), while 41.8% had preserved ejection fraction (HFpEF). Complications were led by respiratory infection (24.5%), and survival rate was high at 89.1%, with sepsis being the leading cause of death (33.3%).

The laboratory findings [Table 3] for heart failure patients indicated average HbA1c levels at 5.52% (SD= 0.82), suggesting relatively good glucose control. The average Urea level was at 63.88 mg/dl (SD =17.79), and average creatinine levels was found to be 1.47 mg/dl (SD= 0.29), indicating renal function status. The average Sodium levels were lower than normal, averaging at 131.41 mEq/L (SD =20.4), while the average potassium levels were within normal range, averaging at 4.56 mEq/L (SD=0.65). Haemoglobin levels were on average 12.74 mg/dl (SD=2.88), showing varying degrees of anemia among the patients. BNP levels, which are indicative of heart failure severity, averaged at 277.36 pg/mL (SD=173.3), highlighting the presence of significant cardiac stress among the study participants.

The [Table 4] indicates comparison of various study parameters according to the outcome. The results revealed significant differences between survivors and non-survivors of heart failure. Non-survivors were older, with an average age of 71.92 years compared to 60.21 years for survivors, and this difference was statistically significant ($p<.05$). Although gender did not significantly affect outcomes ($p>.05$), NYHA classification did, with a higher proportion of non-survivors in Class IV ($p<.05$). Risk factors such as coronary artery disease (CAD) and chronic atrial fibrillation were more prevalent among non-survivors, indicating their potential impact on mortality. Laboratory results showed higher levels of urea, creatinine, and potassium in non-survivors ($p<.05$), highlighting renal function's role in heart failure outcomes. B-type Natriuretic Peptide (BNP) levels were also significantly higher in non-survivors ($p<.05$), highlighting its prognostic value. Complications including respiratory infection, atrial fibrillation, and dialysis were more common in non-survivors, further delineating the complex challenges faced by these patients ($p<.05$). These findings highlight the importance of age, clinical severity, comorbid conditions, and renal function, Complications and BNP (pg/mL) levels in predicting the outcomes of heart failure patients.

The [Table 5] indicates analysis of the relationship between laboratory tests and the odds ratio (OR) for non-survivors in heart failure patients revealed significant correlations. Elevated urea levels (>40 mg/dL) were associated with a 42% increased odds of non-survival, with an OR of 1.42 (95% CI: 1.26–1.60, $p<0.05$). A creatinine level above 1.4 mg/dL increased the odds by 70% (OR: 1.7, 95% CI: 0.10–2.50, $p<0.05$). High potassium levels (>5mEq/L) were linked with a 65% increased odds of non-survival (OR: 1.65, 95% CI: 0.16-2.74, $p<0.05$). Lastly, BNP levels exceeding 100 pg/mL resulted in a 55% increased odds of non-survival (OR: 1.55, 95% CI: 1.17–2.05, $p<0.05$), highlighting the importance of these laboratory parameters as prognostic indicators in heart failure patients.

Table 1: Distribution of study subjects according to Age and gender

Variable		Frequency	Percentage
Age	18-30	3	2.70%
	31-40	5	4.50%
	41-50	14	12.70%
	51-60	19	17.30%
	61-70	37	33.70%
	>70	32	29.10%
	Mean ± SD	61.49 ± 13.88	
Gender	Male	61	55.50%
	Female	49	44.50%

Table 2: Distribution of study subjects according to Clinical parameters

Variable		Frequency	Percentage
NYHA Class	Class III	69	62.70%
	Class IV	41	37.30%
Co-morbidities	Arterial hypertension	58	52.70%
	Diabetes	33	30%
	CAD	29	26.40%
	Chronic Atrial Fibrillation	28	25.40%
	COPD	14	12.70%
Habits	Smoking	34	30.90%
	Alcohol consumption	9	8.20%
Risk factors	Ischemic Heart Disease	52	47.30%
	Valvular Heart Disease	25	22.70%
	Hypertensive Heart Disease	13	11.80%
	Dilated Cardiomyopathy	12	10.90%
	Cor pulmonale	2	1.80%
	HHD +IHD	10	9.10%
	VHD + AF	18	16.40%
Ejection Fraction findings	Reduced Ejection Fraction (HFrEF) (EF<40%)	64	58.20%
	Preserved Ejection Fraction (HFpEF) (EF ≥50%)	46	41.80%

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Complications	Respiratory infection	27	24.50%
	Atrial fibrillation	5	4.50%
	Unstable angina	3	2.70%
	Dialysis	3	2.70%
	Bradycardia	2	1.80%
	Acute myocardial infarction	2	1.80%
	Pulmonary thromboembolism	2	1.80%
Outcome	Survivors (Discharged)	98	89.10%
	Non survivors	12	10.90%
Cause of Death	Sepsis	4	33.30%
	Renal failure	3	25%
	Acute MI	2	16.70%
	Cardiac failure	2	16.70%
	Cerebrovascular accident	1	8.30%

Table 3: Laboratory findings of patients of heart failure

Parameters	Mean	SD
HbA1c (%)	5.52	0.82
Urea (mg/dl)	63.88	17.79
Creatinine (mg/dl)	1.47	0.29
Sodium (mEq/L)	131.41	20.4
Potassium (mEq/L)	4.56	0.65
Haemoglobin (mg/dl)	12.74	2.88
BNP (pg/mL)	277.36	173.3

Table 4: Comparison of study parameters according to outcome

Parameters		Survivors (n=98)		Non survivors (n=12)		p Value
		N	%	N	%	
Age (years)		60.21 ± 13.89		71.92 ± 8.76		<0.05
Gender	Male	53	54.10%	8	66.70%	>0.05
	Female	45	45.90%	4	33.30%	
NYHA Class	Class III	64	65.30%	5	41.70%	<0.05
	Class IV	34	34.70%	7	58.30%	
Risk factor and addiction	Arterial hypertension	51	52.10%	7	58.30%	>0.05
	Diabetes	30	30.60%	3	25%	>0.05
	CAD	24	24.50%	5	41.70%	<0.05
	Chronic Atrial Fibrillation	23	23.50%	5	41.70%	<0.05
	COPD	12	12.20%	2	16.70%	>0.05
	Smoking	32	32.60%	2	16.70%	<0.05
	Alcohol consumption	8	8.20%	1	8.30%	>0.05
Laboratory and Echocardiography findings	HbA1c (%)	5.55 ± 0.79		5.25 ± 0.97		>0.05
	Urea (mg/dl)	60.55 ± 14.78		91.08 ± 17.51		<0.05
	Creatinine (mg/dl)	1.40 ± 0.22		1.98 ± 0.24		<0.05
	Sodium (mEq/L)	131.31 ± 20.67		132.25 ± 18.86		>0.05
	Potassium (mEq/L)	4.47 ± 0.58		5.36 ± 0.63		<0.05
	Haemoglobin (mg/dl)	12.77 ± 2.98		12.52 ± 1.86		>0.05
	BNP (pg/mL)	203.17 ± 155.44		286.45 ± 173.90		<0.05
	LVEF (%)	39.14 ± 16.07		39.92 ± 19.56		>0.05
Complications	Respiratory infection	20	20.40%	7	58.30%	<0.05
	Atrial fibrillation	2	2.10%	3	25%	<0.05
	Unstable angina	2	2.10%	1	8.30%	<0.05
	Dialysis	1	1.10%	2	16.70%	<0.05
	Bradycardia	1	1.10%	1	8.30%	>0.05
	Acute myocardial infarction	1	1.10%	1	8.30%	<0.05
	Pulmonary thromboembolism	1	1.10%	1	8.30%	<0.05
BNP (pg/mL)		379.59 ± 156.91		135.13 ± 52.27		<0.05

Table 5: Relation of laboratory tests to odds ratio for Non survivors

Parameters	OR	95% CI	p Value
Urea >40 mg/dL	1.42	1.26–1.60	<0.05
Creatinine >1.4 mg/dL	1.7	0.10–2.50	<0.05
Potassium >5mEq/L	1.65	0.16 - 2.74	<0.05
BNP >100 pg/mL	1.55	1.17–2.05	<0.05

DISCUSSION

The primary objective of this study was to analyze the clinical profile of heart failure (HF) patients, focusing on demographic details, associated comorbidities, B-type Natriuretic Peptide (BNP) levels, and various risk factors contributing to the development of HF. The majority of HF patients in this study were over 60 years old, with about 70% falling into this age group, aligning with findings from the Framingham study. The mean age of participants was 61.49 ± 13.88 years, consistent with

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other research indicating a higher occurrence of HF in older populations.[9,10] The study also observed a slightly higher proportion of male patients (56%) compared to female patients (44%), which is in line with previous studies suggesting a male predominance in HF patients.[11–13] Furthermore, the study categorized patients into NYHA Class III (62.7%) and Class IV (37.3%), reflecting significant physical limitations and symptoms even at rest, highlighting the severe impact of HF on patients' daily activities.[14]

Comorbidities played a crucial role in the clinical profile of HF patients, with hypertension being the most common, followed by diabetes, coronary artery disease (CAD), chronic atrial fibrillation, and chronic obstructive pulmonary disease (COPD). The study's findings on the prevalence of hypertension and diabetes as comorbidities corroborate with other research, emphasizing their significant role in HF pathogenesis.[15–18] Lifestyle factors such as smoking and alcohol consumption were also noted, with ischemic heart disease being the predominant risk factor for HF development.[19,20]

Solanki Y et al reported in his study conducted among 100 heart failure patients that the ischemic heart disease was leading cause for heart failure (47%), valvular heart disease in (23%) and hypertensive heart disease in (12%).[21] L Dubey et al in their study showed ischemic heart disease as cause of heart failure in (36.5%), valvular heart disease in (25.5%) and hypertensive heart failure in (8.6%).[22] Additionally, the study found a significant difference in left ventricular ejection fraction (LVEF) percentages between HF patients with reduced ejection fraction (HFrEF) and those with preserved ejection fraction (HFpEF), underscoring the diverse manifestations of HF.

The laboratory findings were compared among survivors and non survivors. Raised levels of Urea (mg/dl), Creatinine (mg/dl), Sodium (mEq/L), Potassium (mEq/L), BNP (pg/mL) were noted in non survivors whereas the Haemoglobin (mg/dl) level was decreased among the patients who could not survive. These findings are in accordance with the findings of other studies by Otsuka T et al, and Khan, M. et al.[19,20]

The mean BNP (pg/ml) level among HFrEF was significantly higher as compared to the mean BNP (pg/ml) level among HFrEF. Similar findings were reported in several studies. Maisel et al. 4 concluded HFrEF patients who present with acute decompensated heart failure had the BNP levels, generally between 600–1000 pg/ml.[21] Less severe HFpEF patients who were more compensated, were found to have lower BNP levels, generally between 100 and 600 pg/ml.[22] Meijers W et al,[23] found similar results in a study conducted among 157 heart failure patients in which the levels of BNP in HFpEF group were [107 pg/ml] and in HFrEF group were [296 pg/ml]. Veena V et al,[24] also observed highly significanct difference in the BNP levels among patients of HFpEF group and HFrEF group. The median BNP levels observed were 291.1 ng/ml among HFpEF group and 2091.1 ng/ml among HFrEF group. Thus it was observed that BNP levels in the HFrEF group were significantly higher than that in the HFpEF group.

The study's mortality rate of 10.9% and the causes of death, including sepsis and renal failure, further indicate the severe outcomes associated with HF, especially in older patients and those with significant comorbidities and higher NYHA classes.

CONCLUSION

The incidence of heart failure is notably higher in individuals over 60 years, with ischemic heart disease as the principal risk factor and hypertension as the leading comorbidity. Heart Failure with Reduced Ejection Fraction (HFrEF) is more common than with Preserved Ejection Fraction (HFpEF), and Brain Natriuretic Peptide (BNP) levels provide a cost-effective method for diagnosing heart failure, underscoring the importance of early detection and treatment to improve outcomes.

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