(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 1 , Page No: 636-644
January-February 2023

IJMSCR

Study Of Echocardiographic Profile Of Patients With Heart Failure In A Tertiary Care Hospital

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: Heart failure is a clinical syndrome characterized by typical symptoms (e.g., dyspnea, fatigue) that may be accompanied by signs (e.g., elevated JVP, pulmonary crackles, oedema) caused by structural and/or functional cardiac abnormality, leading to reduced cardiac output and/or elevated intracardiac pressures at rest or during stress.

Objectives: To assess echocardiographic profile in outpatients and inpatients presented with heart failure.

Methodology: After institutional ethics committee approval and written informed consent from participants, a cross sectional study was conducted in outpatient and inpatient department of tertiary care hospital over a period of one and half years on 50 patients with clinical diagnosis of heart failure. Results were analyzed and compared.

Results: The majority (70%) of study participants were in the age range of 51 to 60. In the current study, majority of individuals (58%) had preserved ejection fraction. Reduced EF was found in 42% of research participants. Reduced EF was present in 57.1% and 50% of study patients with HTN and DM, respectively. Patients with high PASP, 60.7% of research participants nevertheless had preserved ejection fraction. Reduced EF was present in 82.4% of study subjects with global hypokinesia.

Conclusion: It is evident from the present study that risk factors play an important role in the progress of HF. Hence, proper management of risk factors are required to limit the progress. Cardiac imaging is indispensable in the management of HF.

Keywords: Heart Failure, Hypertension, Diabetes Mellitus, Ejection Fraction

Introduction

Heart failure is a clinical syndrome characterized by typical symptoms (e.g., dyspnea, ankle swelling, fatigue) that may be accompanied by signs (e.g., elevated jugular venous pressure, pulmonary crackles, peripheral oedema) caused by a structural and/or functional cardiac abnormality, leading to a reduced cardiac output and/or elevated intracardiac pressures at rest or during stress [1].

In developed countries, the prevalence of known heart failure is generally estimated at 1% to 2% of the general adult population [2-5]. India's economic development, industrialization and urbanization have been accompanied by transitions that contribute to the increase in the overall risk of HF. CVD is currently the leading cause of death in India and its prevalence is projected to rise [6-8].

Although HF once was thought to arise primarily in the setting of a reduced left ventricular (LV) ejection fraction (EF), epidemiologic studies have shown that

approximately one-half of patients who develop HF have a normal or preserved EF (EF 40–50%).

Accordingly, HF patients are now broadly categorized into one of two groups: HF with reduced EF (commonly referred to as systolic failure) or HF with a preserved EF (commonly referred to as diastolic failure) [9, 10].

Heart failure with preserved ejection fraction (HFpEF) is a clinical syndrome in which patients have signs and symptoms of HF as the result of high left ventricular (LV) filling pressure despite normal or near normal LV ejection fraction (LVEF; ≥50 percent) [11-14].

Most patients with HFpEF also display normal LV volumes and an abnormal diastolic filling pattern (i.e., diastolic dysfunction) [12, 15, 16]. Patients without signs and symptoms of HF but who have evidence of diastolic dysfunction on echocardiography do not meet the criteria for HFpEF.

Heart failure with reduced ejection fraction (HFrEF), also called systolic heart failure is when the ejection fraction is ≤ 40% [17]. Patients with HFrEF may present with a variety of signs and symptoms, although none are entirely sensitive or specific to the diagnosis.

Evaluation of symptoms suggestive of HF currently demands physicians to valuate various parameters including imaging and laboratory data and the electrocardiogram (ECG). Besides a standard examination that includes an ECG, imaging information, such as echocardiography or magnetic resonance imaging, is seen as gold standard in diagnosis of HF [1].

Echocardiography is an essential investigation in patients with suspected heart failure.An echocardiogram provides assessment of cardiac chamber size and structure, ventricular function, valvular function and key hemodynamic parameters. Echocardiography has the unmatched ability to combine safety and ease of application with the depth of diagnostic and prognostic information it provides in patients with HF [18].

The ongoing technological advancements in the form of big data analytics and miniaturization and digitalization of echocardiography promise to further expand the role of echocardiography as the diagnostic modality of choice in various forms of HF and in various clinical settings [19]. In view of this, the current study was undertaken to assess the echocardiographic profile in outpatients and inpatients presented with heart failure and to investigate how patients with HFpEF compare with patients with HFrEF.

Materials And Methods

Study design: Hospital based Cross-sectional Observation study

Study duration: 18 months

Study area: Rajarajeswari Medical College and Hospital, Bangalore.

Source of data: Patients with clinical diagnosis of Heart failure attending the OPD/IPD of department of general medicine, RRMCH, Bangalore.

Estimation of sample size:

On the basis of statistics obtained from Department of Medicine, RRMCH, an average of 3 cases per month fitting the criteria of the study with study duration of 18 months, we can expect to have N=54. Based on this population size, using YAMANE equation, for a known population size, sample size (n) equal to

$n = N/1+Ne^2$

n=sample size N=population size e= margin of error (for 95% of confidence level, margin error =0.05)

n=54/1+54*0.05*0.05 = 54/1.35 = 47.57

Therefore, after approximating, the sample size of the study participants was fixed at 50.

Inclusion criteria

1. Patients more than 18 years of age and willing to give consent with
2. Acute de novo heart failure
3. chronic heart failure

Exclusion criteria

1. Patients with septicaemia-related heart Failure

Ethical issues and ethical committee clearance [annexure-1]

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The ethical issues were discussed and approved by the Institutional Ethics Committee of Rajarajeswari Medical college and Hospital, Bangalore.

Written informed consent was taken prior to the recruitment of patients into the study & relevant details regarding the purpose, investigations to be carried out, study procedure& potential hazards of the study were explained to the patients in their own language. Confidentiality was maintained. ICMR guidelines were strictly adhered to, during the conduct of the study.

Informed Consent [Annexure-1]

Patients were explained about the study procedure and importance of the study in their own language of understanding and written informed consent was taken from them.

Methods Of Data Collection: Case Record Form (Crf)Annexure-2]

Patients with clinical diagnosis of Heart failure attending the OPD/IPD of department of general medicine, RRMCH, Bangalore were included in the study. Clearance from the institutional ethical committee was taken before starting the study. Study participants were included in the study by Purposive Sampling technique.

The study participants with clinical diagnosis of Heart failure were included in the study, till the sample size was reached. Written informed consent was taken from the study participants before collecting the data. A pre-tested, semi-structured questionnaire was used to collect information on socio-demographic variables and history of heart failure by interview method. Patients were examined, investigated and evaluated for heart failure.

Relevant Laboratory and radiological investigations were done. Investigations included: Basic blood estimations, 12-lead electrocardiography (ECG), Chest X-ray, 2 Echocardiography, Biomarker N-terminal pro–B-type natriuretic peptide. The findings were documented.

Statistical Analysis:

The data was collected and compiled in MS Excel. Descriptive statistics has been used to present the data. To analyse the data SPSS (Version 26.0) was used. Significance level was fixed as 5% ($\alpha = 0.05$. Qualitative variables are expressed as frequency and percentages and Quantitative variables are expressed as Mean and Standard Deviation. To compare the proportions between groups, chi-square test was used. To compare mean values between groups, ANOVA test was used.

Results

44% of the study participants were found to have high pulmonary artery systolic pressure with 32% of the study participants having global hypokinesia on echocardiography. 24% and 18% of study participants had systolic dysfunction and diastolic dysfunction respectively (Table 1).

Majority of the study participants had preserved ejection fraction in the present study (58%). 42% of the study participants were found to have reduced ejection fraction (Table 2).

52.8% of the study participants with Fatigue, generalized weakness had reduced ejection fraction. 65.4%% of the study participants with dyspnoea on exertion had reduced ejection fraction. 58.3% of the study participants with PND and 46.2% of the study participants with orthopnea had reduced ejection fraction. The association was not found to be statistically significant between the signs and symptoms of the study participants and the ejection fraction (Table 3).

60.7% of the study participants with high pulmonary artery systolic pressure had preserved ejection fraction. 82.4% of the study participants with global hypokinesia had reduced ejection fraction. 100% of the study participants with segmental hypokinesia had preserved ejection fraction. 58.3% of the study participants with systolic dysfunction had reduced ejection fraction. 66.7% of the study participants with diasystolic dysfunction had reduced ejection fraction. The association was found to be statistically significant between the presence of high pulmonary artery systolic pressure, global hypokinesia of the study participants and the ejection fraction status (Table 4).

77.8% and 42.1% with LVDD grading of 1 and 2 respectively had reduced EF. 100% each of study participants with LVDD grading of 3 and 4 respectively had preserved EF. The association was found to be statistically significant between the LVDD grading and the ejection fraction status of the study participants (Table 5).

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Table 1: Distribution of the Study Participants According to their Echocardiographic Profile

Echocardiographic Profile	Frequency N	Percentage %
High Pulmonary Artery Systolic Pressure	22	44.0
Global Hypokinesia	16	32.0
Segmental Hypokinesia	3	6.0
Systolic Dysfunction	12	24.0
Diastolic Dysfunction	9	18.0

Table 2: Distribution of the Study Participants According to their Ejection Fraction Status

Ejection Fraction	Frequency N	Percentage %
Preserved	21	42.0
Reduced	29	58.0

Table 3: Clinical Profile Based on Ejection Fraction

Clinical Profile	Preserved EF	Reduced EF	P value
Fatigue, generalized weakness	17 (47.2%)	19 (52.8%)	0.190
Dyspnoea on exertion	9 (34.6%)	17 (65.4%)	0.208
Weight gain with poor appetite	4 (50%)	4 (50%)	0.451
PND	5 (41.7%)	7 (58.3%)	0.624
Orthopnoea	7 (53.8%)	6 (46.2%)	0.247
Paraesthesia	2 (100%)	-	0.171

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Swelling of feet	18 (48.6%)	19 (51.4%)	0.099
Puffiness of face	8 (47.1%)	9 (52.9%)	0.412
Puffiness of eyes	2 (66.7%)	1 (33.3%)	0.379

Table 4: Echocardiographic Profile Based on Ejection Fraction

Echocardiographic Profile	Preserved EF	Reduced EF	P value
High Pulmonary Artery Systolic Pressure	17 (60.7%)	11 (39.3%)	**0.003**
Global Hypokinesia	6 (17.6%)	28 (82.4%)	**0.000**
Segmental Hypokinesia	-	3 (100%)	0.186
Systolic Dysfunction	5 (41.7%)	7 (58.3%)	0.624
Diastolic Dysfunction	3 (33.3%)	6 (66.7%)	0.423

Table 5: Left Ventricular Diastolic Dysfunction Grading Based on Ejection Fraction

LVDD Grade	Preserved EF	Reduced EF	P value
Grade 1	6 (22.2%)	21 (77.8%)	**0.004**
Grade 2	11 (57.9%)	8 (42.1%)	
Grade 3	3 (100%)	0	
Grade 4	1 (100%)	0	

Discussion

In the present study, Majority of the study participants belonged to the age group 51-60 years (30%) of age. The mean age of the study participants was found to be 57.08± 11.679. In a study done by Arora H et al. [20], the mean age of the study participants Was found to be 62.7 ± 13.6. Also, in a study done by Sharma SK et al. [21], the mean age of the study participants was found to be 63.3 ± 14.4, which is comparable to the findings of the Present study.

Ejection fraction of the study participants:

In the present study, Majority of the study participants had preserved ejection fraction in the present study (58%). 42% of the study participants

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were found to have reduced ejection fraction. In a study done by Ganapathi S et al. [23], The proportions of patients who had hfref and hfpef were 26.9% and 57.7%, which is comparable with the findings of the present study.

In the present study, The Mean ejection fraction among the study participants were found to be 41.04±14.042. The mean LVEF of the study participants with preserved ejection Fraction and reduced ejection fraction was found to be 55.95±6.430 and 30.24±5.289respectively. The association was found to be statistically significant between LVEF and the ejection fraction status of the study participants. In a study done by Okonko DO et al. [22], the mean EF was found to be 32 ± 9 which is comparable with the findings of the present study. In a study done by Sharma SK et al. [21], the mean EF was found to be 38 ± 12 and 72% of study participants had Ejection fraction in the range of < 44, which is comparable with the findings of the present study. In a study done by Chopra VK et al. [24], the mean LVEF was found to be 30.0 ± 6.6% among subjects with reduced EF, which is comparable with the findings of the present study. In a study done by Chen JS et al. [25], the mean LVEF in the group with reduced EF and preserved EF was found to be 30.78 ± 5.34 and 61.45 ± 4.90 respectively, which is similar to the findings of the present study.

Lvdd grading in heart failure

In the present study, 77.8% and 42.1% with LVDD grading of 1 and 2 respectively had reduced EF. 100% each of study participants with LVDD grading of 3 and 4 respectively had preserved EF. The association was found to be statistically significant between the LVDD grading and the ejection fraction status of the study participants. In a study done by Jain M et al. [26] on study participants with preserved ejection fraction, 55.04% patients had grade 1 diastolic dysfunction, 39.03% patients had grade 2, and 5.91% patients had grade 3 or grade 4 diastolic dysfunction. This is in contrast to the findings of the present study. This could be attributed to the difference in the inclusion criteria between the 2 studies as the latter study included only patients with preserved ejection fraction, hence the difference.

Echocardiographic profile in heart failure

In the present study, 44% of the study participants were found to have high pulmonary artery systolic pressure with 32% of the study participants having global hypokinesia on echocardiography. 24% and 18% of study participants had systolic dysfunction and diastolic dysfunction respectively. On analysing the echocardiographic profile of the study participants based on the ejection fraction status, 60.7% of the study participants with high pulmonary artery systolic pressure had preserved ejection fraction. 82.4% of the study participants with global hypokinesia had reduced ejection fraction. 100% of the study participants with segmental hypokinesia had preserved ejection fraction. 58.3% of the study participants with systolic dysfunction had reduced ejection fraction. 66.7% of the study participants with diasystolic dysfunction had reduced ejection fraction. The association was found to be statistically significant between the presence of high pulmonary artery systolic pressure, global hypokinesia of the study participants and the ejection fraction status.

The pathophysiology of PH-LHD is thought to be a continuum, where the initial transmission of elevated left-sided filling pressures into the pulmonary circulation is followed by superimposed components, such as pulmonary vasoconstriction, decreased nitric oxide availability and desensitisation to natriuretic peptide-induced vasodilatation. This process leads to pulmonary vascular remodelling including thickening of the alveolar-capillary membrane, medial hypertrophy, intimal and adventitial fibrosis and small vessel luminal occlusion [27].

LV dilatation, indicated by increased end-diastolic or end-systolic LV internal dimension, is associated with an increased risk of HF [28]. Ventricular dilatation may represent an initial response of the failing heart to restore stroke volume (Frank-Starling mechanism) [29]. The concomitant increase in myocardial oxygen consumption and wall Stress, however, may counteract this compensatory response [30] and create an afterload mismatch [31]. Increased LV mass also is associated with an increased risk of HF [32]. The plausible mechanism by which increased LV mass might increase the risk of HF is elucidated in the previous section on electrocardiographic LVH.

Asymptomatic LV systolic dysfunction, evidenced by visual assessment of LV contractile performance and wall motion [33] and by decreased fractional

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shortening at the endocardium or at the midwall [32], is associated with an increased likelihood of overt HF.

LV diastolic filling impairment, indicated by elevated Doppler peak Ewave or high and low Doppler E-wave/A-wave ratios [32], also has been associated with incident HF.

Increased LV mass and reduced contractile function act synergistically to predict HF [32]. Activation of neurohormonal pathways, along with cellular and molecular changes in cardiac myocytes and extracellular matrix, may be involved in the progression of subclinical cardiac structural and functional changes to overt HF [34,35].

Conclusion

It is evident from the present study that the risk factors play an important role in the progress of heart failure. Hence, proper management of risk factors are required to limit the progress. Cardiac imaging is indispensable in the management of HF.

Echocardiography is the most widely used test for this purpose and the most versatile in terms of providing clinically relevant information. In addition to providing information on EF, echocardiography provides information on LV volume, diastolic function, RV function, hemodynamics, and valvular regurgitation that has important prognostic and therapeutic implications. However, although analogous measurements are obtainable from multiple modalities, the data they provide are often discordant, especially LV volumes. These inconsistencies arise from inherent differences in the temporal, contrast, and spatial resolution of the techniques, and extreme caution should be applied in the comparison of measurements between modalities.

Echocardiography is important at every stage of HF, but recent developments in the assessment of LV strain are especially important to the recognition of the preclinical phases of nonischaemic HF. Ongoing research is needed to refine applications in this setting, especially by assembling evidence of prognostic and therapeutic implications.

Limitations

Sub-optimal sample size.

The sampling technique of convenience sampling technique was employed for the study, which is not a true representation of the general population.

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