HEART FAILURE WITH PRESERVED EJECTION FRACTION CLINICAL PROFILE RISKFACTOR ANALYSIS ECHO EVALUATION

Dissertation submitted to
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For the award of the degree
M.D. (GENERAL MEDICINE) BRANCH - I

GOVT. STANLEY MEDICAL COLLEGE & HOSPITAL

CHENNAI

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CERTIFICATE

This is to certify that this dissertation entitled "**HEART FAILURE WITH PRESERVED EJECTION FRACTION: CLINICAL PROFILE, RISKFACTOR ANALYSIS, AND ECHO EVALUATION**" submitted by **Dr RAKESH PINNINTI** to the Tamilnadu Dr. M.G.R medical university is in partial fulfillment of the requirement for the award of M.D. DEGREE BRANCH –I (General Medicine) and is a bonafide RESEARCH work carried by her under direct supervision and guidance.

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DECLARATION

I solemnly declare that the dissertation entitled "HEART FAILURE WITH PRESERVED EJECTION FRACTION CLINICAL PROFILE, RISKFACTOR ANALYSIS, AND ECHO EVALUATION'' was done by me at Government Stanley Medical College & hospital during 2010- 2011 under the guidance and supervision of Prof Dr. K.H.NOORUL AMEEN M.D..

This dissertation is submitted to the Tamilnadu Dr. M.G.R medical university in partial fulfillment of the requirement for the award of M.D. DEGREE (BRANCH-I) in General Medicine.

Place: Chennai

Date: Dr. RAKESH PINNINTI

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CONTENTS

INTRODUCTION

INTRODUCTION

Heart failure is one of the leading causes of hospitalizations in both developed as well as developing nations.

Regardless of the definition used, the prevalence of HF increases steeply with age, Prevalence is 1% between the ages of 50 and 59 years, progressively increasing to >10% over age of 80 years[1,2].

Heart Failure is generally described as a clinical syndrome associated with impaired left ventricular (LV) contractility and cavity dilation.

“HF with preserved LVEF”, or “diastolic heart failure (DHF),” is thought to be due to abnormalities in the diastolic properties of the LV , Diastolic heart failure (DHF) is responsible for almost nearly 50% of all patients with heart failure & is frequently referred as heart failure with normal ejection fraction of left ventricle (HFNEF)[3].

This form of heart failure may result in long run heart failure with reduced ejection fraction. The recent advances in understanding of diastolic ECHO characters & biomarkers for heart failure resulted in modification of protocol for the diagnosis of HFNEF and recent update to diagnostic criteria.

Although such hearts contract normally, relaxation (diastole) is abnormal. Such abnormality in cardiac relaxation is more pronounced during periods of exertion & exercise as cardiac output cannot adequately increase due to increased filling pressures of left ventricle.

Due to this high filling pressure there are resultant pulmonary congestion, dyspnoea, and edema features that appear similar in presentation to regular systolic dysfunction.

Unfortunately, unlike heart failure due to systolic dysfunction, diastolic heart failure has been studied in few clinical trials, so there is little evidence to guide the care of patients with this condition.

Physiological principles used in the treatment of such patients include the control of blood pressure, heart rate, myocardial ischemia, and blood volume.

Although diastolic dysfunction is thought to be the only mechanism responsible for the development of heart failure with a preserved ejection fraction, community based studies suggest that additional mechanisms such as increased vascular & ventricular stiffness may also be responsible.

AIM OF THE STUDY

AIM OF THE STUDY

1) To do an observational study analysing the

   a) Clinical presentation,

   b) Risk factor profile,

   c) Diagnostic evaluation with Echocardiograph correlation of Heart failure with normal/preserved ejection fraction.

2) To understand the variability of several ECHO characteristics with increasing diastolic dysfunction.

3) To find a relation between several anthropometry measurements & increasing diastolic dysfunction.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Heart failure (HF) can be defined as the inability of the myocardium to sustain adequate cardiac output to maintain tissue perfusion and oxygenation requirements while maintaining normal filling pressures[1].

Three major mechanisms that are implicated in the patho-physiology of chronic heart failure[3]:

a) Impaired myocardial contractility- 'systolic dysfunction'

b) Inadequate or impaired filling of the cardiac chambers- 'diastolic dysfunction'.

c) Nonphysiologic changes in cardiac volume, mass, and geometry- 'pathological remodelling'.

Patients with chronic HF can be divided into two broad categories, classified on the basis of characteristic changes in cardiovascular structure and function[26, 27]:

a) Systolic heart failure (SHF), which is characterized by abnormalities in systolic function (i.e., reduced left ventricular ejection fraction [LVEF]) often with progressive chamber dilation and eccentric remodeling.

b) Diastolic heart failure (DHF), which is characterized by normal LV volume, concentric remodeling, normal LV chamber systolic properties, and abnormalities in diastolic function [7,16,25,26,28,29].

SHF and DHF are distinct syndromes, not a continuous spectrum of disorders. Patients with SHF may have evidence of diastolic dysfunction, particularly during periods of symptomatic decompensation [45, 49, 50, 51]

Framingham Criteria for Congestive Heart Failure[1]

Diagnosis of CHF requires the simultaneous presence of at least 2 major criteria or 1 major criterion in conjunction with 2 minor criteria.

Major criteria:

- Paroxysmal nocturnal dyspnea
- Neck vein distention
- Rales
- Radiographic cardiomegaly (increasing heart size on chest radiography)
- Acute pulmonary edema
- S3 gallop
- Increased central venous pressure (>16 cm H2O at right atrium)
- Hepatojugular reflux
- Weight loss >4.5 kg in 5 days in response to treatment

Minor criteria:

- Bilateral ankle edema
- Nocturnal cough
- Dyspnea on ordinary exertion
- Hepatomegaly
- Pleural effusion
- Decrease in vital capacity by one third from maximum recorded
- Tachycardia (heart rate>120 beats/min.)

Minor criteria are acceptable only if they cannot be attributed to another medical condition (such as pulmonary hypertension, chronic lung disease, cirrhosis, ascites, or the nephrotic syndrome).

The Framingham Heart Study criteria are 100% sensitive and 78% specific for identifying persons with definite congestive heart failure[1, 52].

Diastolic heart failure (DHF) is a clinical syndrome in which patients have symptoms and signs of HF, normal or near normal left ventricular (LV) ejection-fraction (EF), and evidence of diastolic dysfunction (eg, abnormal left ventricular filling and elevated filling pressures) [4,6]

This condition has been labelled diastolic heart failure (DHF) or **"Heart failure with normal ejection fraction" (HFNEF)** [5]. In such patients, diastolic dysfunction is the underlying cause of the congestive failure[1, 6].

It is important to note that the ACC/AHA criteria for DHF do *not* require an echocardiographic diagnosis of DD. It has been argued that, since the echocardiographic characteristics of DD are potentially difficult to interpret and user-dependent, the simple syndrome of HF with preserved LVEF should be sufficient to establish the diagnosis of DHF[7]

PREVALENCE AND DEMOGRAPHICS —

The prevalence of diastolic heart failure increases with age[6]. This was illustrated in a review in which the estimated prevalence of diastolic heart failure among patients with HF was 15, 33, and 50 percent at ages less than 50, 50 to 70, and more than 70 years, respectively[1, 6, 8].

DHF is more common in women than men have diastolic heart failure [8].

Among patients with normal ejection fraction, 79 percent were women, while among those with decreased ejection fraction, 49 percent were women[8].Asymptomatic diastolic dysfunction is much more common than symptomatic disease[9].

Patients with diastolic dysfunction[10]:

a) More likely to be older, female, and hypertensive[10]

b) Less likely to have had a prior myocardial infarction[10]

c) Less likely to be receiving an angiotensin converting enzyme inhibitor or angiotensin II receptor blocker[10].

d) Lower in-hospital mortality (3 vs 4 %) but similar ICU and hospital length of stay[10].

ETIOLOGY —

The major causes of DHF are the following[6]:

a) Chronic hypertension with left ventricular hypertrophy (LVH)[46] ; a hypertensive hypertrophic cardiomyopathy with LVEF above 75 percent has been described in elderly adults with HF[47]

b) Hypertrophic cardiomyopathy (HCM)

c) Aortic stenosis with a normal LVEF[48]

d) Coronary heart disease

e) Restrictive cardiomyopathy, which can be idiopathic or caused by infiltrative disease

Basic Physiology[31-39]

Phases of Diastole

The timing of Diastole begins with the Aortic valve closure and terminates with mitral valve closure. Diastole is further divided into four phases

1. *Isovolumetric relaxation:* This is the period of cardiac cycle between the end of LV systolic ejection (i.e. aortic valve closure) and the opening of the Mitral valve, during this phase the volume of LV is maintained constant while LV pressure keeps falling rapidly. This is the phase of rapid active LV relaxation, with a lower, variable contribution of elastic recoil of the contracted fibers

2. *LV rapid filling:* This the period of cardiac cycle when the LV pressure falls below left atrial pressure and there is mitral valve opening. During this phase there is accelerated flow of blood into LV which reaches maximum velocity, directly related to magnitude of atrio-ventricular pressure. This phase reflect the complex interaction between LV active relaxation and visco-elastic properties of the LV(i.e. compliance)

3. *Diastasis:* This is the phase of continued blood flow into the LV, even after left atrial and LV pressures are almost equal, with left atrium representing a passive conduit, and the amount of blood flow depending on LV pressure (i.e. diastolic compliance)

4. *Atrial systole*: This phase of cardiac cycle is the period of left atrial contractionand ends with mitral valve closure. LV compliance, pericardial resistance, atrial force, artio-ventricular synchronicity have an influence on this phase.

Isovolumic relaxation (time between aortic valve closure and mitral valve opening) and three phases of left ventricular filling: rapid early filling, diastasis and late filling, from atrial contraction

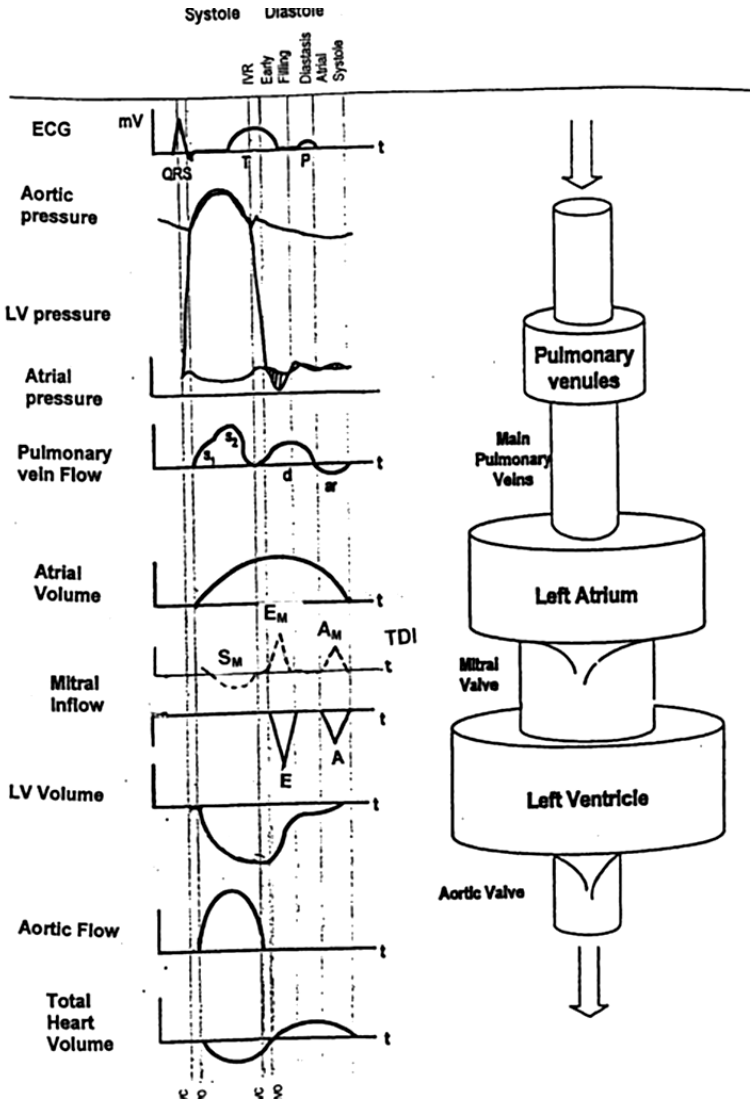


Figure 1[30]

Electrical, pressure, flow (Doppler), tissue (Doppler), and volume events during systole and diastole. IVR= isovolumic relaxation; LV=left ventricle; MVVC=mitral valve closed; AVO=aortic valve open; AVC=aortic valve closed; MVO=mitral valve open; TDI=tissue Doppler. (Modified from Jaski BE. Basics of Heart Failure: A Problem Solving Approach. Boston: Kluwer Academic Publishers, 2000)[30]

Systolic versus diastolic HF [6, 41-44]

Characteristic	Diastolic Heart Failure	Systolic Heart Failure
Age	Frequently elderly	All ages, typically 50–70 yr
Sex	Frequently female	More often male
Left ventricular ejection fraction	Preserved or normal, approximately 40% or higher	Depressed, approximately 40% or lower
Left ventricular cavity size	Usually normal, often with concentric left ventricular hyper-trophy	Usually dilated
Left ventricular hypertrophy on electrocardiography	Usually present	Sometimes present
Chest radiography	Congestion with or without cardiomegaly	Congestion and cardiomegaly
Gallop rhythm present	Fourth heart sound	Third heart sound
Coexisting conditions		
Hypertension	+++	++
Diabetes mellitus	+++	++
Previous myocardial infarction	+	+++
Obesity	+++	+
Chronic lung disease	++	0
Sleep apnea	++	++
Long-term dialysis	++	0
Atrial fibrillation	+ (usually paroxysmal)	+ (usually persistent)

* A single plus sign denotes "occasionally associated with," two plus signs "often associated with," three plus signs "usually associated with," and a zero "not associated with."

Figure 2[40]

Systolic versus Diastolic HF [3, 45]

Figure 3: Kaplan-Meier survival curves for patients with DHF (black) and SHF (green) over the year after first hospital admission for HF [21]

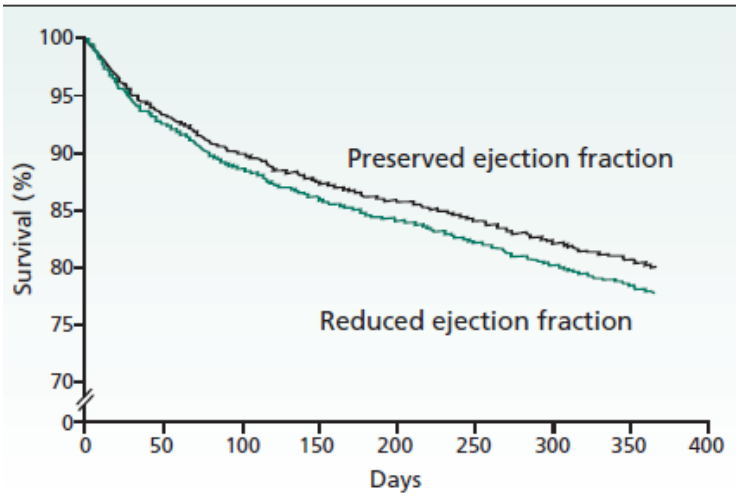
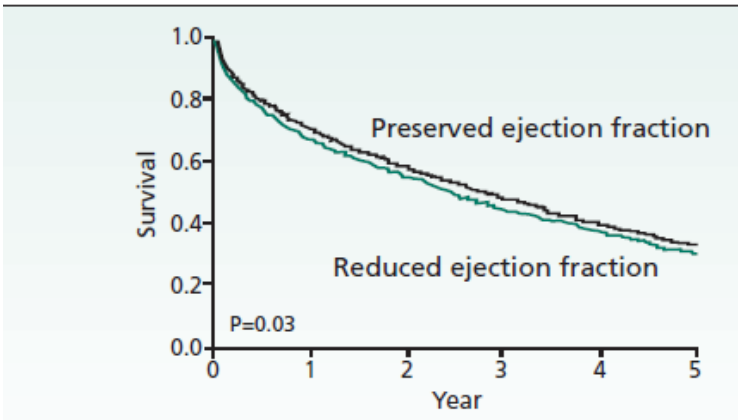


Figure 3 [45]

Figure 4: Kaplan-Meier survival curves for patients with DHF (black) and SHF (green) over 5 years[22]



No. at risk						
Reduced ejection fraction	2424	1637	1350	1049	813	604
Preserved ejection fraction	2166	1537	1270	1001	758	574

Figure 4 [3]

Systolic versus Diastolic HF

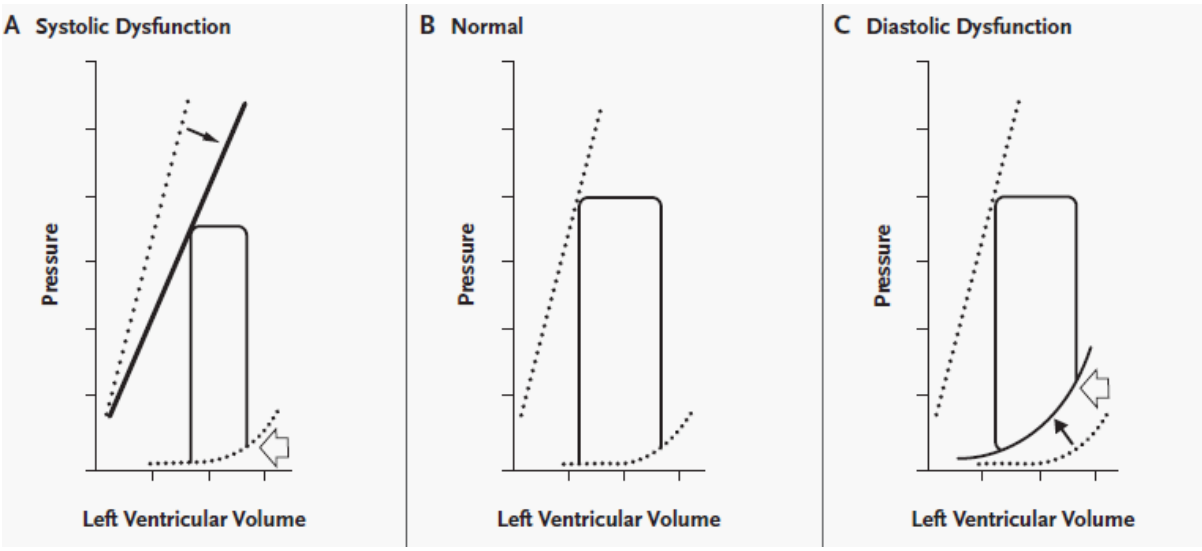


Figure 5: Left Ventricular Pressure–Volume Loops in Systolic and Diastolic Dysfunction[25].

In systolic dysfunction, left ventricular contractility is depressed, and the end-systolic pressure–volume line is displaced downward and to the right (Panel A, black arrow); as a result, there is a diminished capacity to eject blood into the high-pressure aorta. In diastolic dysfunction, the diastolic pressure–volume line is displaced upward and to the left (Panel C, black arrow); there is diminished capacity to fill at low left-atrial pressures. In systolic dysfunction, the ejection fraction is depressed, and the end-diastolic pressure is normal (Panel A, open arrow); in diastolic dysfunction, the ejection fraction is normal and the end-diastolic pressure is elevated (Panel C, open arrow) [25].

Systolic versus Diastolic HF

Characteristics of Diastolic Heart Failure as Compared with Those of Systolic Heart Failure [19-24]

Characteristic	Diastolic Heart Failure	Systolic Heart Failure
Clinical features		
Symptoms (e.g., dyspnea)	Yes	Yes
Congestive state (e.g., edema)	Yes	Yes
Neurohormonal activation (e.g., brain natriuretic peptide)	Yes	Yes
Left ventricular structure and function		
Ejection fraction	Normal	Decreased
Left ventricular mass	Increased	Increased
Relative wall thickness†	Increased	Decreased
End diastolic volume	Normal	Increased
End diastolic pressure	Increased	Increased
Left atrial size	Increased	Increased
Exercise		
Exercise capacity	Decreased	Decreased
Cardiac output augmentation	Decreased	Decreased
End diastolic pressure	Increased	Increased

Table 1

Cellular mechanisms of diastolic dysfunction

Diastolic dysfunction is caused by one or more of the following abnormalities in cardiac structure:

a) Hypertrophy

b) Fibrosis

c) Infiltrative diseases

d) Pericardial constriction

e) Myocardial edema

Functional cellular abnormalities of myocyte relaxation can also cause diastolic dysfunction, which is reversible and transient [6]. Causes of impaired myocyte relaxation include:

a) Ischemia and/or hypoxia

b) Cellular calcium overload and/or ATP depletion

c) Certain cardiovascular drugs, eg, digitalis

d) The hypertrophy process itself which alters the contractile and metabolic phenotype.

There is a highly positive correlation between end-diastolic calcium levels and diastolic relaxation abnormalities.

The duration of diastole is prolonged in most models of congestive heart failure, a change that correlates with a prolongation of the intracellular calcium transient [18].

In hypertrophic cardiomyopathy, systolic function is normal or hyperdynamic, but diastolic relaxation may become so abnormally slow that complete relaxation between contractions is prevented. At rapid heart rates, this can produce elevated end-diastolic calcium levels and mechanical dysfunction resulting from fusion of the prolonged calcium transients and contractions.

Diastolic dysfunction in DHF/HFNEF

In DHF, abnormalities in diastolic function form the dominant patho-physiologic basis for the development of HF.

The major abnormalities in LV diastolic function that contribute to the development of DHF include [7, 16, 17]:

a) Slowed, delayed and incomplete myocardial relaxation

b) Impaired rate and extent of LV filling

c) Shift of filling from early to late diastole

d) Decreased early diastolic suction/recoil

e) Increased LA pressure during the early filling

f) Increased passive stiffness

g) decreased distensibility of the LV Impaired ability to augment cardiac output during exercise

h) Impaired ability to augment relaxation during exercise

i) Inability to utilize the Frank-Starling mechanism during exercise

j) Increased diastolic LV, LA, pulmonary venous pressure at rest and/or during exercise.

Decompensated DHF may be caused by both cardiovascular and non-cardiovascular factors (and "triggers" Uncontrolled hypertension Increased salt and water intake and/or retention Tachyarrhythmias, CKD, Anemia).

Diagnosis of Diastolic Heart Failure/HFNEF

Three obligatory conditions need to be satisfied for the diagnosis of HFNEF:

a) Presence of signs or symptoms of congestive heart failure;

b) Presence of normal or mildly abnormal LV systolic function, and

c) Evidence of diastolic LV dysfunction.

Following diagnostic criteria proposed for Diastolic Dysfunction:

a) Vasan and Levy Criteria[15]

b) Zile Criteria[4]

c) European Criteria

Vasan and Levy Criteria [15]

Vasan and Levy stated that the diagnosis of CHF is clinical and should not be made on the basis of LV EF,Q and they indicated that the requirement of a normal EF for the diagnosis of heart failure would inevitably lead to an underestimation of the prevalence of heart failure.

They then developed criteria for definite, probable, and possible diastolic heart failure:

'Definite' diastolic heart failure required definitive evidence of heart failure, normal or mildly abnormal LV EF, and evidence of abnormal LV relaxation, filling, diastolic distensibility, or diastolic stiffness (they require cardiac catheterization for the assessment of diastolic function) [15].

Vasan and Levy make the diagnosis of **'probable'** diastolic heart failure if catheterization evidence of diastolic dysfunction is not available and **'possible'** diastolic heart failure if the EF was not measured near the time of the patient's presentation with heart failure (i.e. within 72 hours of the heart failure event) [15].

A diagnosis of possible diastolic heart failure may be 'upgraded' to probable if the setting is typical for diastolic dysfunction[15].

Vasan and Levy Criteria for Diastolic Heart Failure [15]

Table 2: Criteria for 'Definite' DHF [15]

Criterion	Objective Evidence
Definitive evidence of CHF	Includes clinical symptoms and signs, supporting laboratory tests (such as chest X-ray), and a typical clinical response to treatment with diuretics, with or without documentation of elevated LV filling pressure (at rest, on exercise, or in response to a volume load) or a low cardiac index
AND	
Objective evidence of normal LV systolic function in proximity to the CHF event	LV EF ≥0.50 within 72 h of CHF event
AND	
Objective evidence of LV diastolic dysfunction	Abnormal LV relaxation/filling/distensibility indices on cardiac catheterization

Table 3: Criteria for 'Probable' DHF [15]

Criterion	Objective Evidence
Definitive evidence of CHF	Includes clinical symptoms and signs, supporting laboratory tests (such as chest X-ray), and a typical clinical response to treatment with diuretics, with or without documentation of elevated LV filling pressure (at rest, on exercise, or in response to a volume load) or a low cardiac index
AND	
Objective evidence of normal LV systolic function in proximity to the CHF event	LV EF ≥0.50 within 72 h of CHF event
BUT	
Objective evidence of LV diastolic dysfunction is lacking	No conclusive information on LV diastolic function

Table 4: Criteria for 'Possible' DHF [15]

Criterion	Objective Evidence
Definitive evidence of CHF	Includes clinical symptoms and signs, supporting laboratory tests (such as chest X-ray), and a typical clinical response to treatment with diuretics, with or without documentation of elevated LV filling pressure (at rest, on exercise, or in response to a volume load) or a low cardiac index
AND	
Objective evidence of normal LV systolic function, but not at the time of the CHF event	LV EF ≥0.50
AND	
Objective evidence of LV diastolic dysfunction is lacking	No conclusive information on LV diastolic function

Table 5: Criteria for diastolic HF according to the European Society of Cardiology [14]

Signs and symptoms of HF	Effort dyspnoea, Hortopnoea, III-IV tones, Pulmonary rales
Normal or mildly reduced LV systolic function	EF ≥ 45 % e LVIDDi > 3.2 $cm \cdot m^{-2}$
Evidence of abnormalities LV of relaxation/filling and/or distensibility	IVRT $_{<30\ years}$ > 92 ms, $_{30-50\ years}$ > 100 ms, $_{>50\ years}$ > 105 msc E/A<1 + DT>220 ms + S/D<1.5 $_{<50\ years}$ E/A<0.5 + DT>280 msec + S/S>2.5 $_{>50\ years}$

DT = deceleration time of E velocity, E/A = ratio of early diastolic velocity to atrial velocity, EF = ejection fraction, HF = heart failure, IVRT = isovolumic relaxation time, LV = left ventricular, LVIDDi = left ventricular internal diastolic diameter index, S/D = ratio of systolic to diastolic velocity of venous pulmonary veins

Table 6: Doppler echocardiographic patterns of current echocardiographic tools in relation to the grading of LV diastolic dysfunction [13]

Parameter	Normal pattern	Pattern of abnormal relaxation (Grade I)	Pseudonormal pattern (Grade II)	Restrictive patterns (Grades III-IV)
E/A	>1	<1	1 – 2	≥2
DT (ms)	160 – 210	>220	150 – 200	<150
IVRT (ms)	70 – 90	>95	60 – 95	<60
S/D	1.3 – 1.5	1.6 – 2.0	<1	0.40 – 0.60
AR (m/sec)	0.22 – 0.32	0.21 – 0.28	≥0.35	≥0.25
E_m (cm/sec)	>8	<8	<8	<5
Vp (cm/sec)	>55	<45	<45	<35
E/E_m	< 8			> 16
E/Vp				> 2.5

AR = Atrial retrograde velocity, DT = Deceleration time, E/A = Transmitral E/A ratio, E/E_m = Transmitral early diastolic velocity to myocardial early diastolic velocity of lateral mitral annulus by Tissue Doppler, E_m = myocardial early diastolic velocity by Tissue Doppler at lateral mitral annulus, IVRT = Isovolumic relaxation time, = Systolic velocity to diastolic velocity ratio by pulmonary veins assessment, Vp = Velocity propagation

Zile Criteria [4]

Recognizing the difficulties inherent in the assessment of the diastolic properties of the heart, Zile et al tested the hypothesis that measurements of the LV relaxation and passive stiffness were not necessary to make the diagnosis of diastolic heart failure 4.

Doppler Criteria for Classification of Diastolic Function[11, 12]

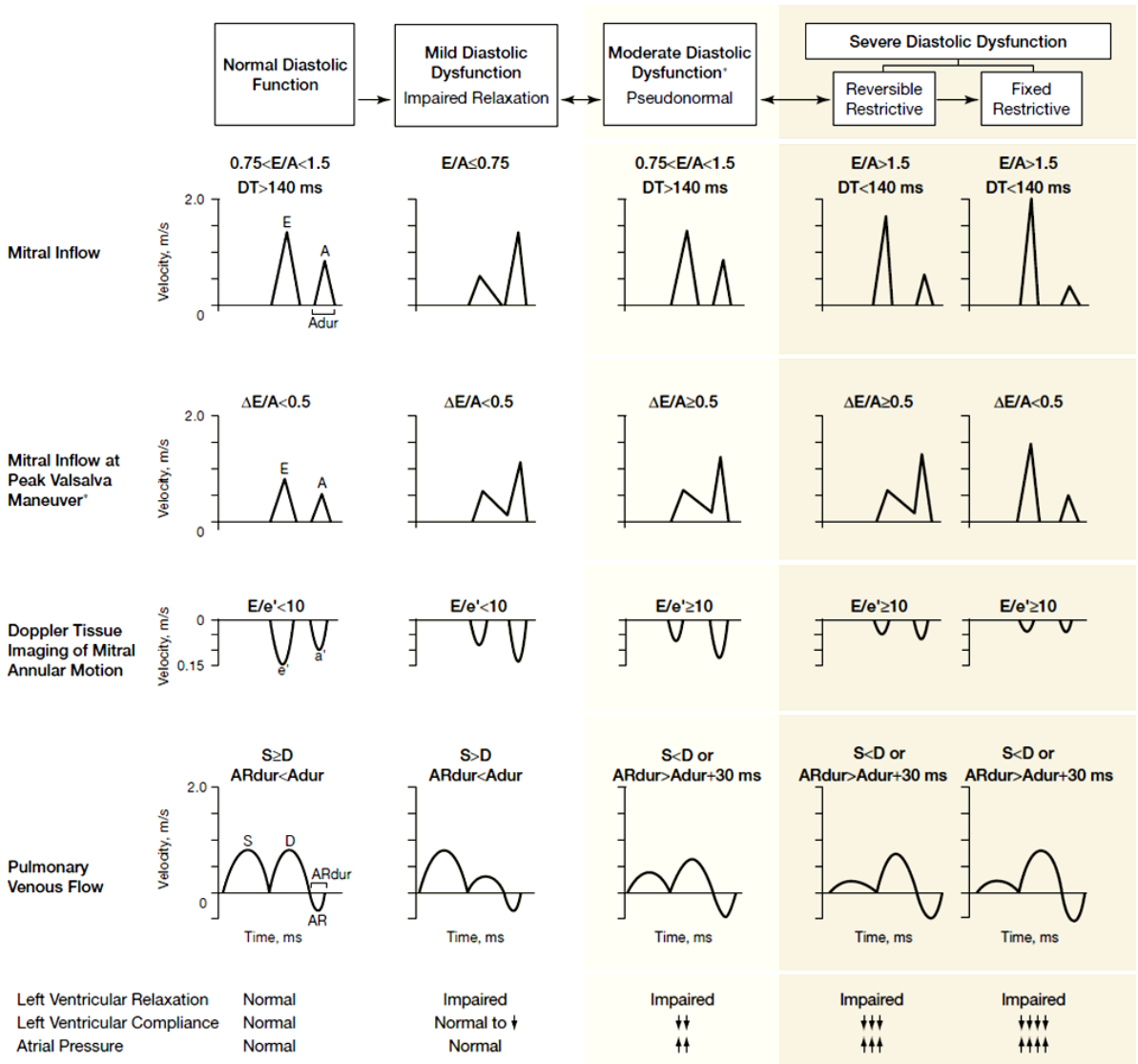


Figure 6

MATERIALS AND METHODS OF THE STUDY

MATERIALS AND METHODS OF THE STUDY

PATIENT SELECTION:

The present study included heart failure patients admitted to Government Stanley Hospital Medical Departments; a consecutive series of 52 heart failure patients admitted in the Department of Medicine, Stanley Medical College and Government Stanley hospital, during the period of 6 months from July 1st 2010 to Dec 30th 2010. Patients selected fulfilled the Framingham's criteria for heart failure & Normal/preserved ejection fraction.

INCLUSION CRITERIA:

1) Symptoms and signs of HF (Framingham criteria),

2) LV EJECTION FRACTION > 45-50%, and

3) Ability to rule out: Mitral stenosis, Mitral regurgitation, pericardial disease, and non cardiac causes of dyspnoea, oedema and fatigue.

EXCLUSION CRITERIA:

1) Heart failure patients with EF<45% any time during their clinical course

2) Patients who underwent cardiac surgeries (CABG, valve repair, etc)

3) Chest wall injuries (blunt/penetrating)

4) Age<14yrs

PATIENT EVALUATION

PATIENT EVALUATION

All of the 52 patients included in the study are thoroughly evaluated clinically with particular focus on identifying the clinical signs & symptoms of the heart failure. Patients are further investigated to identify several known risk factors for heart failure & increased mortality related to cardiac illness. Patients underwent Doppler echocardiographic evaluation within 24 hrs of presentation, chest x-ray; USG abdomen & pelvis were also done.

Patients age, sex, socioeconomic status, occupation were noted. Patient symptoms are further questioned for duration, onset (sudden/insidious), aggravating/precipitating factors (exertion/emotional upset/others), relieving factors (rest/posture/drugs), NYHA Class for dyspnea & presence of PND/orthopnoea/platypnea.

Patient clinical examination particularly focused on identifying several indicators of heart failure (Neck vein distention, Rales, S3 gallop, S4), including the vital signs & cardiovascular system. Respiratory, abdominal, CNS examinations were done & relevant findings noted.

Patients are subjected to several biochemical investigations like fasting & post-prandial blood glucose, fasting lipid profile, renal function tests, and complete hemogram.

Several key elements evaluated in the study are defined as followed:

1) Heart failure : Framingham Criteria for Congestive Heart Failure
2) Obesity : Based on BMI
3) Dyslipidemia: Hypertriglyceridemia: Triglycerides ≥150 mg/dL; Low HDL cholesterol: <40 mg/dL and <50 mg/dL, for men & women respectively; total cholesterol >250mg/dl; high LDL cholesterol >160mg/dl; or specific medication
4) Metabolic syndrome: NCEP:ATPIII 2001& IDF Criteria for Central Adiposity
5) Grade of Diastolic dysfunction: based on European Society of Cardiology 2007 criteria.
6) Cigarette smoking: Smoking Index
7) Diabetes mellitus: FPG>126mg/dl; PPPG>200mg/dl; HBA1c >6.5%.

Following anthropometric measurements are also taken as part of routine examination, weight, Height, waist circumference, Hip circumference. Following entities are calculated, BMI, BSA, W/H ratio. All measurements are taken by same equipment & noted in metric systems.

Echocardiography is done for all the patients within 24 hrs of onset of presentation. Both 2D and color Doppler echocardiography was done by a

single experienced cardiologist. Following ECHO characters are essentially noted:

a) Ejection fraction.

b) E wave velocity (m/sec) at mitral valve.

c) A wave velocity (m/sec) at mitral valve.

d) E/A ratio.

e) Deceleration time (msec).

All patients satisfied the inclusion & exclusion criteria necessary for selection under study.

STUDY DESIGN

This study is a cross sectional observational study.

OBSERVATIONS AND STATISTICAL ANALYSIS

OBSERVATIONS AND STATISTICAL ANALYSIS

The population of 52 patients included in the study belong to a unified group satisfying all the inclusion criteria & exclusion criteria. They are the patients with Heart failure with normal ejection fraction 'HFNEF'. Each patient underwent clinical examination to identify features of heart failure; biochemical investigations to identify the cardiac risk factors; 2D ECHO & Doppler ECHO study is quantify few specific Diastolic functional characteristics.

STATISTICAL METHODS

All continuous variables were assumed to be normally distributed and are reported as arithmetic mean with their standard deviation. The 95% confidence intervals are also reported where clinically applicable. The strength of the linear relationship between two variables is analyzed as Correlation coefficient (spearman). The Fisher's Exact test (2x3 Fisher's exact test calculator) [53] was used to compare and analyze the data. The null hypothesis was rejected at the 95% confidence interval, considering a probability value of $P < 0.05$ as statistically significant & probability value of $P < 0.0001$ as extremely significant.

Fisher's Exact test done using 2x3 Fisher's exact test calculator, Joosse SA. 2011 Fisher's exact test, available from http://in-silico.net/statistics/fisher_exact_test.

RESULTS

RESULTS

A total of 52 patients who consulted to the medical department Govt Stanley Hospital & who satisfied the inclusion as well exclusion criteria were enrolled for this study. Among the 52 patients 22 were males & 30 were females, with an average age of 62.54 (SD 13.27), the youngest among the lot being 40yr & the oldest being 88yr

Table 1: Details of age

Parameters	Average	SD	Min	Max
Age (Yrs)	62.54	13.27	40	88

The average age of the patients enrolled in the study was 62.54 years.

Table 2: Details of age according to the gender

Anthropometry	Gender								Grand total
	Male				Female				
	N	Mean ± SD	Min	Max	N	Mean ± SD	Min	Max	
Age	22	57.09 ± 12.74	43	80	30	66.53 ± 12.36	40	88	52

SEXWISE DISTRIBUTION OF PATIENTS IN THE STUDY

TABLE -3

Age group	Number	Percentage
Male	22	25
Female	30	26.92

Out of 52 patients, 42.31% were male whereas, 57.69% were female. Thus majority of the patients were female.

AGE WISE DISTRIBUTION OF PATIENTS IN STUDY GROUP

Table 4: Age wise distribution of the patients.

Age	**Gender**				**Grand total**
	Male		**Female**		
	N	**%**	**N**	**%**	
40-50	10	**76.92**	3	**23.08**	**13**
51-60	6	**42.86**	8	**57.14**	**14**
61-70	1	**9.09**	10	**90.90**	**11**
71-80	5	**55.56**	4	**44.44**	**9**
80-90	0	**0**	5	**100**	**5**
Grand Total	22	**42.31**	30	**57.69**	**52**

In studied group, majority of the cases were from the age group of 40-60 years. 21.15% cases were from the age group 61-70 years. 9 cases were seen in 71-80 years age group whereas, 5 cases were from the age group of 81-90 years

Figure 1

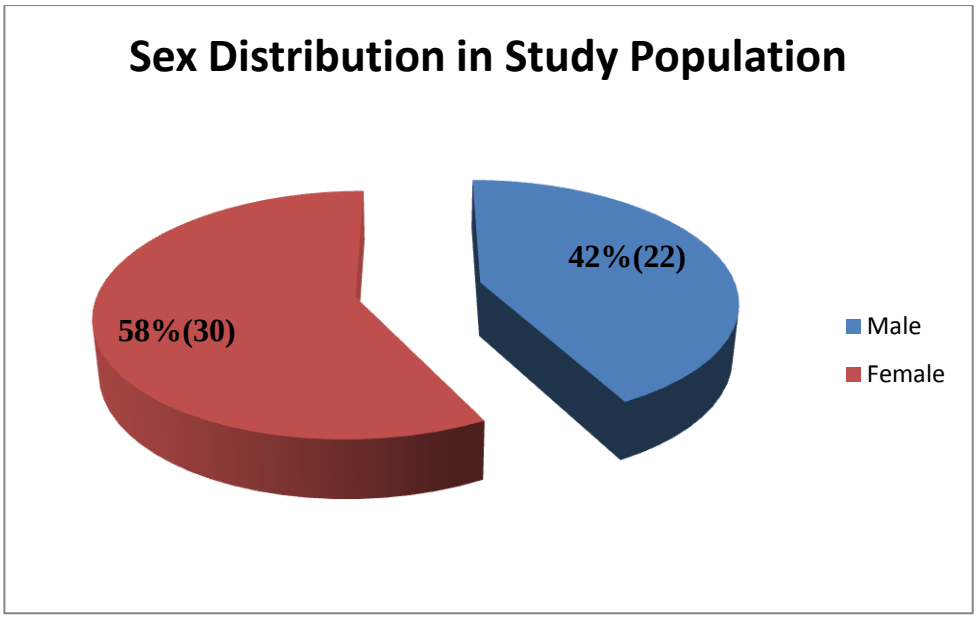


Figure 2

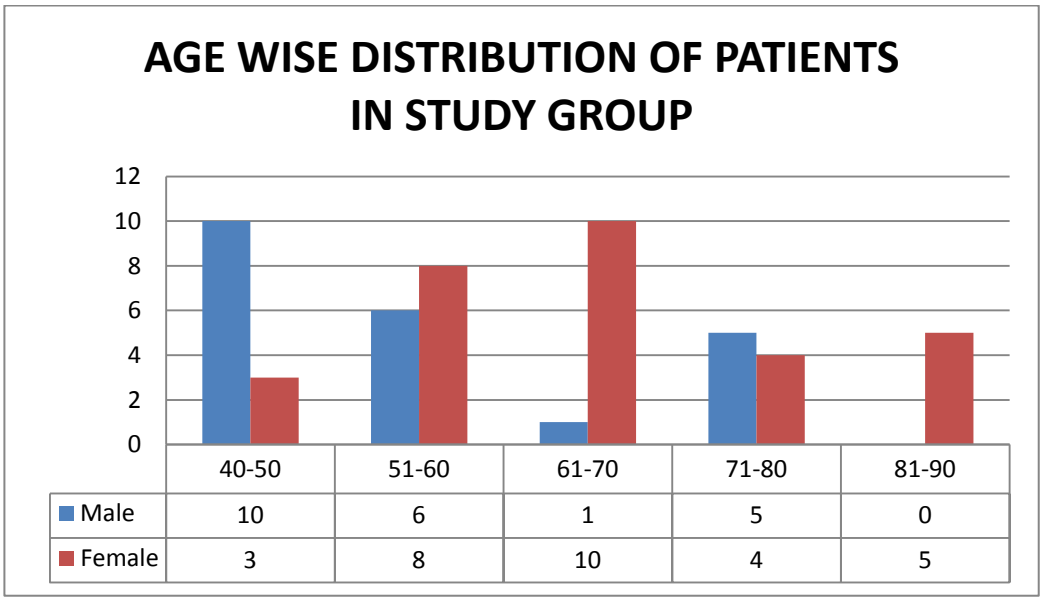


Table 5: Distribution based on the anthropometry according to the gender

Anthropometry	Gender								Grand total
	Male				Female				
	N	Mean ± SD	Min	Max	N	Mean ± SD	Min	Max	
Height	22	165.90 ± 8.45	150	178	30	149.83 ± 5.10	142	165	52
Weight	22	81.36 ± 20.22	46	110	30	62 ± 8.87	46	81	52
BMI	22	29.09 ± 4.95	20.44	36.75	30	27.52 ± 3.02	21	34.24	52
BAS	22	1.88 ± 0.27	1.38	2.22	30	1.56 ± 0.12	1.34	1.88	52
Waist in cm	22	98.68 ± 13.78	78	124	30	86.83 ± 7.31	68	102	52
Hip in cm	22	101.14 ± 15.34	81	134	30	92.03 ± 8.47	73	106	52
W/H ratio	22	0.97 ± 0.04	0.91	1.05	30	0.94 ± 0.05	0.82	1.09	52

Table 6: Correlation of BMI with grade of DD.

Grade of diastolic dysfunction	BMI	Waist to Hip ratio
	Mean ±Sd	Mean ±Sd
1	27.13±4.30	0.94±0.05
2	27.79±3.57	0.96±0.04
3	31.43±3.02	0.98±0.06
Grand Total	28.19±3.99	0.95±0.05

Table 7: Comparison of W/H ratio as per the grade of diastolic dysfunction

W/H ratio	Grade of diastolic dysfunction			Grand Total
	1	2	3	
<0.9	4	1	-	5
	(22.22%)	(4%)		(9.61%)
0.9 to 1	12	21	5	38
	(66.67%)	(84%)	(55.56%)	(73.07%)
>1	2	3	4	9
	(11.11%)	(12%)	(44.44%)	(17.31%)
Grand Total	18	25	9	52

Table 8: Comparison of BMI as per the grade of diastolic dysfunction

BMI group	Grade of diastolic dysfunction			Grand Total
	1	2	3	
<18. 5 kg/m2	-	-	-	0
≥ 18.5 to 24.9 kg/m2	7	7		14
	(38.89%)	(28%)		(26.92%)
≥ 25.0 to 29.9 kg/m2	5	9	2	16
	(27.78%)	(36%)	(22.22%)	(30.77%)
30.0 to 34.9 kg/m2	5	9	6	20
	(27.78%)	(36%)	(66.67%)	(38.46%)
35.0 to 39.9 kg/m2	1		1	2
	(5.56%)		(11.11%)	(3.85%)
≥ 40 kg/m2.	-	-	-	0
	0			
Grand Total	18	25	9	52

Table 9: Correlation of BMI and W/H ratio as per the grade of diastolic dysfunction

Parameter	Parameter	Correlation coefficient (spearman's)	P value
Diastolic dysfunction	BMI	0.291	0.036
	W/H ratio	0.348	0.012

P value is significant if <0.05

Table 10: Details of risk factors

Risk factors	Number of subjects with the risk factors (n=52)	
	N	%
Diabetes	32	61.54
Dyslipidemia	35	67.31
Hypertension	48	92.30
Metabolic syndrome	40	76.92
Obesity	22	42.31
Alcohol	16	30.77
Smoking	16	30.77

Hypertension was the most common risk factor reported in the study in 94.23% of patients followed by Dyslipidemia in 67.31% cases, Diabetes was seen in 61.54% cases, metabolic syndrome was seen in 76.92% cases. Obesity, smoking & alcohol were seen was seen in 42.31%, 30.77%, 30.77% cases respectively.

Table 11: Details of presenting complaints

Presenting complaints	Number of subjects with the risk factors (n=52)	
	N	%
Dyspnea	47	90.38
Edema	22	42.31
Fatigue	47	90.38
PND	29	55.77

Dyspnea and fatigue was present in 90.38% of cases, PND in 55.77% cases and edema in 42.31% cases.

Table 12: Details of physical examination

Physical examination	Average	SD	Min	Max
Pulse rate /min	83.21	8.31	64	102
Systolic BP (mm of hg)	173.27	24.17	130	230
Diastolic BP (mm of hg)	107.81	11.35	84	130
Respiratory rate (cycles/min)	21.10	2.08	18	26

The mean pulse rate of the patients was 83.21 ± 8.31/min. Mean systolic blood pressure of the patients recorded was 173.27 ± 24.17 mm of Hg. Average diastolic pressure of the patients was 107.81±11.35mm of Hg, whereas the respiratory rate of the patients studied was 21.10 ± 2.08 cycles /min.

Table 13: Details of physical examination according to the gender.

Physical examination	Gender								Grand Total
	Male				Female				
	N	Mean ± SD	Min	Max	N	Mean ± SD	Min	Max	
Pulse rate bpm	22	84.36 ± 7.13	74	102	30	82.37 ± 9.10	64	98	52
Systolic	22	178 ± 28.33	130	230	30	169.8 ± 20.42	130	220	52
Diastolic	22	108.18 ±12.16	84	130	30	107.53 ± 10.92	84	124	52
Respiratory rate cycle/min	22	21.14 ± 2.43	18	26	30	21.07 ± 1.82	18	25	52

Table 14: Echo characteristics according to the gender

Echo characteristics	Gender									
	Male					Female				
	Number	Mean	SD	Min	Max	Number	Mean	SD	Min	Max
E wave m/s	22.00	0.90	0.28	0.50	1.50	30.00	0.87	0.32	0.32	1.56
A wave m/s	22.00	0.87	0.15	0.54	1.10	30.00	0.85	0.16	0.49	1.10
E/A ratio	22.00	1.10	0.48	0.55	2.14	30.00	1.03	0.38	0.51	2.10
DT ms	22.00	147.91	33.17	80.00	198.00	30.00	158.27	30.50	83.00	210.00
EF %	22.00	51.59	2.67	46.00	56.00	30.00	51.77	2.53	46.00	56.00
LVEDV ml	22.00	104.09	23.22	80.00	196.00	30.00	96.57	14.50	68.00	121.00
LVEDVI ml/m2	22.00	56.71	17.54	37.20	124.84	30.00	62.38	11.29	41.21	84.61
Grade of diastolic dysfunction	22.00	1.86	0.77	1.00	3.00	30.00	1.80	0.66	1.00	3.00

Table 15: Details of echo characteristics.

Echo characteristics	Average	SD	Min	Max
A wave (m/s)	0.86	0.15	0.49	1.1
E/A ratio	1.06	0.42	0.51	2.14
DT(ms)	153.88	31.76	80	210

Average of E wave in the study was 0.93 m/sec, A wave in the study was 0.86 m/s. Mean E/A ratio reported was 1.06. Average DT (ms) was 153.88.

Average Ejection fraction of the study group is calculated as 51.30%. Diastolic dysfunction was found in all of 52 patients included in the study group, Grade 1 Diastolic dysfunction present in 18 patients, Grade 2 Diastolic dysfunction present in 25 patents, Grade 3 Diastolic dysfunction present in 9 patients.

Table 16: Details of E wave as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	**Average E wave m/s**	**StdDev E wave m/s**
1	0.57	0.11
2	0.98	0.21
3	1.23	0.20
Grand Total	0.88	0.30

Table 17: Details of A wave as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	**Average A wave m/s**	**Std Dev A wave m/s**
1	0.88	0.14
2	0.89	0.13
3	0.71	0.16
Grand Total	0.86	0.15

Table 18: Details of E/A ratio as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Average E/A ratio	Std Dev E/A ratio
1	0.65	0.07
2	1.10	0.20
3	1.76	0.25
Grand Total	1.06	0.42

Table 19: Details of DT as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Average of DT ms	StdDev of DT ms
1	166.83	25.75
2	163.36	16.64
3	101.67	21.56
Grand Total	153.88	31.76

Table 20: Details of hypertension as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with Hypertension		P value
	N	%	
Grade 1(n=18)	14	77.77	0.0195
Grade 2(n=25)	25	100.00	
Grade 3(n=9)	9	100.00	
Grand Total	48	94.23	

Fisher's exact test is applied. P value is significant if < 0.05

In grade I diastolic dysfunction, all 14 patients had hypertension. In grade II diastolic dysfunction, 100% patients had hypertension. And in patients with grade III diastolic dysfunction, all 9 patients had hypertension. In our study, all three groups were comparable.

Table 21: Details of Dyslipidemia as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with Dyslipidemia		P value
	N	%	
Grade 1(n=18)	12	66.67	0.0447
Grade 2(n=25)	14	53.85	
Grade 3(n=9)	9	100.00	
Grand Total	35	67.31	

Fisher's exact test is applied. P value is significant if < 0.05

In grade I diastolic dysfunction, 66.67% patients had dyslipidemia. In grade II diastolic dysfunction, 53.85% patients had dyslipidemia, whereas in grade III diastolic dysfunction, all 9 patients had dyslipidemia. Statistically all three groups were comparable.

Table 22: Details of obesity as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with obesity		P value
	N	%	
Grade 1(n=18)	6	33.33	0.0437
Grade 2(n=25)	9	34.62	
Grade 3(n=9)	7	77.78	
Grand Total	22	42.31	

Fisher's exact test is applied. P value is significant if < 0.05

In our study, 18 patients had grade I diastolic dysfunction, out of which 33.33 % patients were obese. 25 patients had grade II diastolic dysfunction, out of which

34.62% patients were found to be obese. Whereas, 9 patients had grade III diastolic dysfunction of which 77.78% patients were found obese. All three groups were comparable in the study.

Table 23: Details of diabetes as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with diabetes		P value
	N	%	
Grade 1(n=18)	13	72.22	0.3438
Grade 2(n=25)	15	57.69	
Grade 3(n=9)	4	44.44	
Grand Total	32	61.54	

Fisher's exact test is applied. P value is significant if < 0.05

Table 24: Details of metabolic syndrome as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with Metabolic syndrome		P value
	N	%	
Grade 1(n=18)	15	83.33	0.0728
Grade 2(n=25)	16	61.54	
Grade 3(n=9)	9	100.00	
Grand Total	40	76.92	

Fisher's exact test is applied. P value is significant if < 0.05

Table 25: Details of smoking & alcohol as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with smoking		P value
	N	%	
Grade 1(n=18)	5	27.78	0.941
Grade 2(n=25)	8	30.77	
Grade 3(n=9)	3	33.33	
Grand Total	16	30.77	

Fisher's exact test is applied. P value is significant if < 0.05

Figure 3

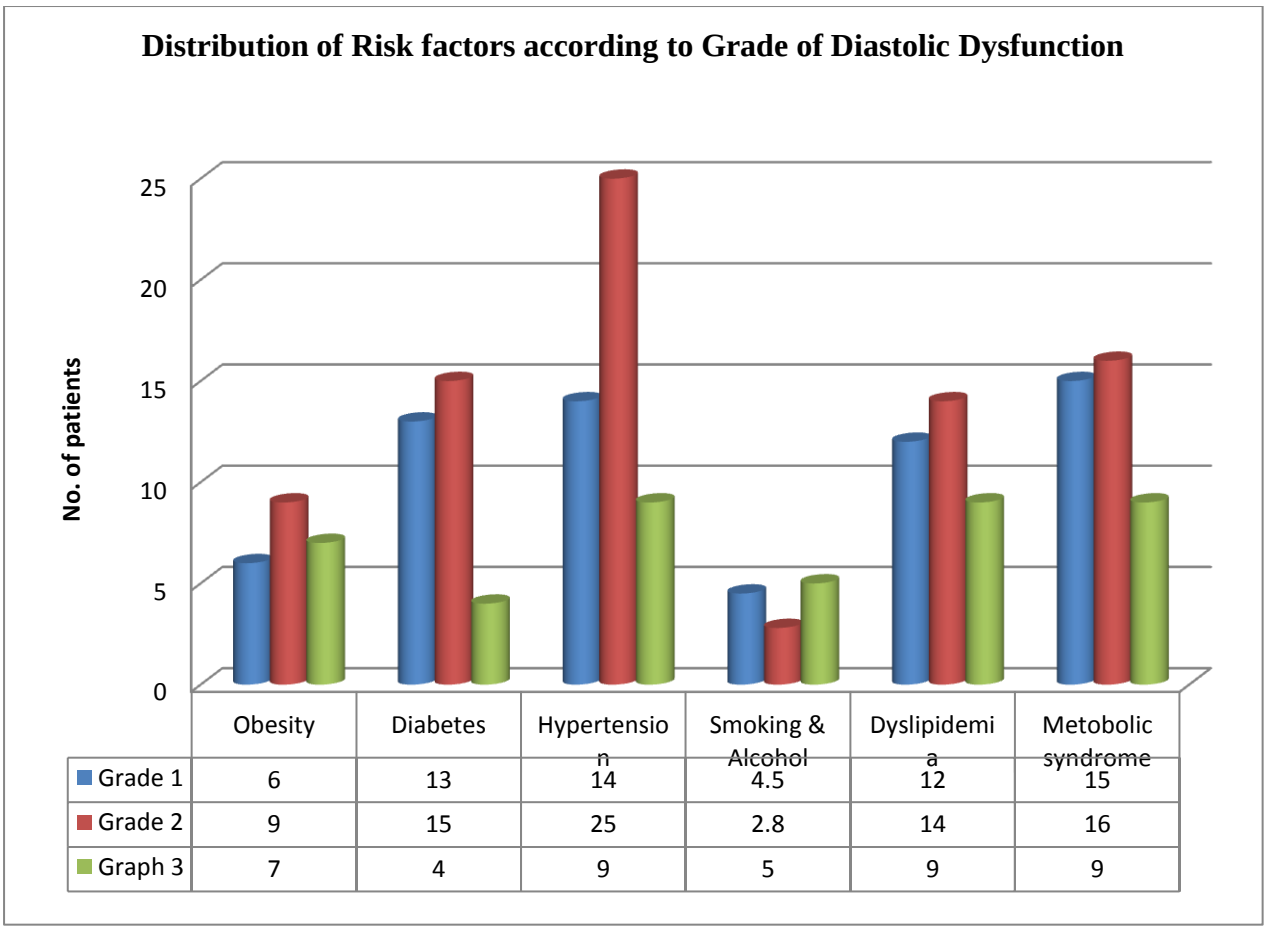


Table 26: Details of S4 as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with S4		P value
	N	%	
Grade 1(n=18)	4	22.22	<0.0001
Grade 2(n=25)	21	84	
Grade 3(n=9)	9	100	
Grand Total	34	65.38	

Fisher's exact test is applied. P value is significant if < 0.05

Table 27: Details of S3 as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients with S3		P value
	N	%	
Grade 1(n=18)	7	38.89	0.674
Grade 2(n=25)	10	38.46	
Grade 3(n=9)	5	55.56	
Grand Total	22	42.31	

Fisher's exact test is applied. P value is significant if < 0.05

Table 28: Details of crepts as per the grade of diastolic dysfunction

Grade of diastolic dysfunction	Number of patients Crepts		P value
	N	%	
Grade 1(n=18)	16	88.89	0.435
Grade 2(n=25)	21	80.77	
Grade 3(n=9)	9	100.00	
Grand Total	46	88.46	

Fisher's exact test is applied. P value is significant if < 0.05.

DISCUSSION

DISCUSSION

This study conducted at Govt. Stanley Hospital with an aim to identify the clinical profile, risk factors, and echocardiographic characteristics of the patients with heart failure with normal ejection fraction. This is a cross-sectional observation study aimed at population consulting at Medical Departments of Govt Stanley hospital.

Following passages will describe & discuss the study findings in comparison with standard data & reviews available for Heart failure with normal ejection fraction (HFNEF) under several sub-headings:

AGE & SEX

The average age of the patients enrolled in the study was 62.54 years. In studied group, majority of the cases were from the age group of >50yrs, 14 cases (26.92%) were from the age group 50-60 years. 21.15% cases were from the age group 61-70 years. 9 cases (17.31%) were seen in 71-80 years age group whereas, 5 cases (9.62) were from the age group of 81-90 years. Overall 75% of patients included in the study group above 50 years.

Out of 52 patients, 42.31% were male whereas, 57.69% were female. Thus majority of the patients were female.

This reaffirms the findings from several studies[3, 5, 8] that the patients with HFNEF are more likely to be older and women.

Our attempts to identify the relation between increasing age & grade of diastolic dysfunction has not resulted in statistical significant results with average age of patients with Grade 1 diastolic dysfunction is 59 years; Grade 2 diastolic dysfunction 61.48 years; Grade 3 diastolic dysfunction 61.05 years.

Haass M et al[53] in their study(The I-PRESERVE Trial) concluded that in the usual patients with HFpEF, there were significant differences in the baseline characteristics with females showing overall better prognosis than males, this may however may be influenced by significant reduced risk of non-HF-related outcomes in females. There were significant differences in independent predictors of all- cause hospitalizations and mortality, with obesity, diabetes and CKD being most prominent in females

Gottdiener JS, et al[55] in their study the relationship between left ventricular systolic function and outcome of congestive heart failure in elderly persons. They concluded that there is higher prevalence of HFpEF among the elderly and mortality is higher among such individuals.

Owan TE et al[3] studied the trends in the prevalence and outcome of HFpEF. They concluded that there was significant trend towards increased proportions among heart failure patients with normal ejection fraction over the past 15 years and there was however same mortality rate there by emphasizing the importance of this growing public health problem

RISK FACTORS

This study is a cross sectional observation study & all the patients include belonged to a unified group with Heart failure with Normal ejection fraction. We compared the risk factor profile of patients belonging to different grade of diastolic dysfunction (Grade 1, 2 & 3).

Overall Hypertension was the most common risk factor reported in the study in 94.23% of patients followed by Dyslipidemia in 67.31% cases, Diabetes was seen in 61.54% cases, metabolic syndrome was seen in 76.92% cases. Obesity, smoking & alcohol were seen was seen in 42.31%, 30.77% cases respectively.

In grade I diastolic dysfunction, 14 patients (77%) had hypertension. In grade II diastolic dysfunction, 100% patients had hypertension. And in patients with grade III diastolic dysfunction, all 9 patients had hypertension. This was statistically significant (p=0.0195)

In grade I diastolic dysfunction, 66.67% patients had dyslipidemia. In grade II diastolic dysfunction, 53.85% patients had dyslipidemia, whereas in grade III diastolic dysfunction, all 9 patients had dyslipidemia, this association was also significant (p=0.0447)

In our study, 18 patients had grade I diastolic dysfunction, out of which 33.33 % patients were obese. 25 patients had grade II diastolic dysfunction, out of which 34.62% patients were found to be obese. Whereas, 9 patients had grade III

diastolic dysfunction of which 77.78% patients were found obese, this association was also statistically significant (p=0.0437).

We found no statistically association with Diabetes, smoking & alcohol & increasing Grade of Diastolic dysfunction.

This reaffirms the findings from several studies[3, 5, 8] that the patients with HFNEF are more likely to be older, women & hypertensive, in addition we found statistically significant association with hypertension, dyslipidemia & obesity with increasing Grade of diastolic dysfunction.

Toshihiko G et al[54] studied hemodynamic indices especially the augmentation index Alx, which shows the detrimental influence of arterial reflection wave from the lower body on LV diastolic function. They assessed the gender difference in these indices. The study revealed that there were no significant differences with age, heart rate, mean blood pressure, or indices of Diabetes and Dyslipidemia among males and females. There were no significant differences noted with LVEF or LV end diastolic pressures. Women showed significantly greater Alx values in comparison to men and there was significant correlation between plasma BNP values and Alx. There were also significantly higher BNP values, among females. They concluded that a combination of higher AIx and shorter height that is observed in women with shorter height may be one of the causes of the increased prevalence of HFpEF in women

PRESNTING SYMPTOMS

Dyspnea and fatigue was present in 90.38% of cases, PND in 55.77% cases and edema in 42.31% cases.

ANTHROPOMETRY

Average height of the patients was 156.63 ± 10.42 cm. Average weights of the patients was 70.19 ± 17.51 kg. Average BMI recorded were 28.19 ± 3.99 kg/m^2. Average BSA was 1.70 ± 0.26. Average height, weight, BMI, BSA for male patients was 165.90 ± 8.45, 81.36 ± 20.22, 29.09 ± 4.95 & 1.88 ± 0.27 respectively. Average height, weight, BMI, BSA for female patients was 149.83 ± 5.10, 62 ± 8.87, 27.52 ± 3.02 &1.56 ± 0.12 respectively.

Mean waist of the patients recorded was 91.85 ± 11.98 cms, average hip circumference of the studied group was 95.88 ± 12.58 cm and the waist to hip ratio noted was 0.95 ± 0.05.

We found statistically significant association with increasing BMI (p=0.036) & W/H ratio (p=0.012) with increasing Grade of Diastolic dysfunction.

PHYSICAL FINDINGS

The mean pulse rate of the patients was 83.21 ± 8.31/min. Mean systolic blood pressure of the patients recorded was 173.27 ± 24.17 mm of Hg. Average diastolic pressure of the patients was 107.81±11.35mm of Hg, whereas the respiratory rate of the patients studied was 21.10 ± 2.08 cycles /min.

In grade I diastolic dysfunction, S4 wave was seen in 22.22% patients. In grade II diastolic dysfunction, S4 wave was seen in 84% patients, whereas in patients with grade III diastolic dysfunction, S4 wave was seen in 100% cases. This association was found statistically extremely significant ($p<0.0001$) for increasing Grade of Diastolic dysfunction.

We found no statistical significance for presence of S3 & crepitations with increasing Grade of Diastolic dysfunction.

ECHO CHARCTERISTICS

For Grade 1 DD the average E wave is 0.57±0.11 m/s, A wave is 0.88±0.14 m/s, mean E/A ratio 0.65±0.07, Deceleration time is 166.83±25.75 ms.

For Grade 2 DD the average E wave is 0.98±0.21 m/s, A wave is 0.89±0.13 m/s, mean E/A ratio 1.10±0.20, Deceleration time is 163.36±16.64 ms.

For Grade 3 DD the average E wave is 1.23±0.21 m/s, A wave is 0.71±0.16 m/s, mean E/A ratio 1.76±0.25, Deceleration time is 101.67±21.56 ms

Overall Average of A wave in the study was 0.86 m/s. Mean E/A ratio reported was 1.06. Average DT (ms) was 153.88 ms.

Our study was valuable in describing the demographic profile, clinical presentation, anthropometric variability with increasing Grade of Diastolic dysfunction, risk factors & ECHO characteristics associated with increasing Grade of Diastolic dysfunction.

Table 29

Prevalence of co-morbidities in heart failure with preserved ejection fraction

Parameter[a]	Controlled trials					Epidemiologic studies				Inpatient registries		
	CHARM-Preserved	SENIORS	PEP-CHF	I-PRESERVE	Average for all controlled trials	CHS	Framingham	Mayo	Average for all epidemiological studies	OPTIMIZE	ADHERE	Average for all inpatient registries
Age, *y*	67	76	76	72	72	75	80	74	76	75	74	75
Hypertension	64%	62%	79%	89%	74%	59%	59%	63%	60%	76%	77%	77%
Diabetes mellitus	28%	26%	21%	28%	26%	27%	22%	33%	27%	38%	45%	42%
CAD	44%	68%	27%	25%	41%	58%	37%	53%	49%	38%	50%	44%
Atrial fibrillation	29%	36%	20%	29%	29%	15%	29%	41%	28%	33%	21%	27%
TIA/CVA	28%	0.1%	–	10%	13%	5%	–	–	5%	15%	17%	16%
GFR, *mL/min*	72	56	62	72	66	56	42	40	46	51	37	44
Hemoglobin, *g/dL*	13	–	–	14	14	14	12	12	13	12	12	12
BMI, kg/m^2	29	–	28	30	29	27	27	30	28	–	30	30

STUDY LIMITATIONS

This study & its results are limited by several important factors

First and the most important factor is the sample size. Heart failure is a highly prevalent medical condition and it is essentially difficult to make & draw conclusions from the small sized (52 patients) study

Secondly the study centre being a tertiary care centre, its patient population may include only severely ill and may not include mildly symptomatic patients, there by altering the prevalence and demographic characteristics.

Third factor the definition of Heart Failure with Preserved Ejection Fraction 'HFNEF'. Several of the recent studies accepted the criteria used in our study. But there are differences in opinion about the need for utilization of cardiac catheterization for the diagnosis of HFNEF.

Fourth factor being, most the patients included in the study received treatment from different physicians and the treatment protocol was individualized. Presentation clinical profile would have had some impact due to these factors.

CONCLUSIONS

CONCLUSIONS

The conclusions of this study are following:

1) Patients with Heart failure with normal ejection fraction 'HFNEF' are more likely to be older (75%) and women (57.69%).

2) Dyspnea and fatigue (90.38%) are most common presenting symptoms

3) Hypertension (94.23%) is the most common risk factor.

4) Statistically significant association found with Hypertension ($p=0.0195$), Dyslipidemia ($p=0.0447$) & obesity ($p=0.0437$) with increasing Grade of diastolic dysfunction.

5) Among the physical findings Fourth Heart sound (S4) is most commonly associated with increasing grade of Diastolic dysfunction, this association is extremely significant statistically ($p<0.0001$); also increasing BMI ($p=0.036$) & W/H ratio ($p=0.012$) are associated with increasing Grade of Diastolic dysfunction & this association was also statistically significant.

ANNEXURES

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HEART FAILURE WITH PRESERVED EJECTION FRACTION CLINICAL PROFILE RISKFACTOR ANALYSIS & ECHO EVALUATION

PROFORMA

Name: **I.P.No.:**

Age:

Sex: **DOA:**

Occupation: skilled.prof/semi-skilled.prof/manual labourer **DOD:**

Address:

Socioeconomic status:

Mobile No: **Schooling (yrs) -**

Diagnosis **PHOTO**

Presenting Complaints

Fatigue.....Yes/No

Dyspnoea ….....….Yes/No

Pedal edema.....Yes/No

PND.....Yes/No

Cheyne-Stokes breathing.....Yes/No

Others--Anorexia /Nausea/Early satiety/Confusion/Sleep dist/Mood dist

History of presenting illness

Dyspnoea

Duration -

Onset - sudden/insidious

Time of onset in relation to pain -

Aggravating/precipitating factors - exertion/emotional upset/others

Relieving factors - rest/posture/drugs

NYHA Class - I/II/III/IV

PND / orthopnoea/ platypnea / orthodeoxia

Fatigue

Duration -

Onset - sudden/insidious

Aggravating/precipitating factors - exertion/emotional upset/others

Relieving factors - rest/drugs

Pedal edema

Duration -

Onset - sudden/insidious

Aggravating/precipitating factors - exertion/emotional upset/others

Relieving factors - rest/drugs

PERSONAL HISTORY

Smoking - beedies/cigarettes

a) smoker

b) ex-smoker -time since quit .....

c) Never smoker

- Duration

- number……/day

-pack yrs.....

Alcohol - duration

- quantity……../day

- unit...../week

Tobacco chewing - Yes/No

- Duration

Treatment History

- Any long term medication – Yes/No

- If yes mention Rx and duration of Rx

GENERAL PHYSICAL EXAMINATION

ANTHROPOMETRIC MEASUREMENTS

Wt (in Kg) -

Ht (in cm) -

BMI (kg/m2) –

Waist circumference –

Hip circumference –

Waist/Hip ratio –

Icterus - Yes/No

Pallor - Yes/No

Cyanosis - central/Peripheral/Nil

Clubbing - Yes/No

Lymphadenopathy - Yes/No

Pedal edema - Yes/No

Vitals:

Pulse -...../ minute

BP - ...../mmHg in right upper limb

Pulse pressure - ...../mmHg

CVS:

Apical Impulse:

Heart Sounds:

Added sounds : S3 Y/N S4 Y/N

Murmurs:

RS : Air entry:

Adventitious sounds:

Per Abdomen :

INVESTIGATIONS

Hb ..... gm%

TLC .....cells/cumm

ESR .....mm/hour

Urine routine

RBS .....mg%

FBS, PPBS - .....mg% .....mg%

Serum creatinine ..... mg%

Urea .....mg%

Fasting lipid profile

Total Cholesterol - ..... mg%

LDL - ..... mg%

HDL - ..... mg%

Triglycerides - ..... mg%

Chest x-ray **USG abdomen & pelvis**

ECHOCARDIOGRAPHIC EVALUATION

A) Ejection fraction

B) E wave

C) A wave

D) E/A ratio

E) DST (deceleration time)

F) EDV

G) GRADE OF DIASTOLIC DYSFUNCTION:

MASTER CHART

SNO	AGE	SEX	FTG	DYS	EDE	PND	HGT	WGT	BMI	BSA	WST	HIP	W/H	OBS	ALH	SM	DBT	DYL	SHT	MSY	PR	SBP	DBP	RR	S3	S4	CRT	E	A	E/A	DT	EF%	LVEDV	VEDV	GRD
1	43	M	Y	Y	Y	N	169	88	30.81	1.98	105	100	1.1	Y	Y	Y	N	Y	Y	Y	88	230	130	20	N	Y	Y	1.2	0.8	1.5	120	53	93	46.96	3
2	47	M	N	Y	Y	N	172	98	33.12	2.1	112	123	0.9	Y	N	N	Y	N	Y	N	74	180	110	18	N	Y	N	1.2	1	1.2	155	51	98	46.66	2
3	60	M	Y	Y	N	N	168	86	30.47	1.95	89	91	1	Y	Y	Y	Y	N	Y	N	80	168	100	18	N	N	N	1.1	1	1.2	166	50	100	51.28	2
4	66	F	Y	Y	Y	Y	152	60	25.96	1.56	96	106	0.9	N	N	N	Y	Y	Y	Y	92	170	106	22	Y	Y	Y	1.1	1	1.1	154	55	94	60.25	2
5	85	F	Y	Y	N	N	148	53	24.19	1.45	82	94	0.9	N	N	N	N	N	Y	N	88	166	110	20	N	N	Y	0.7	1	0.7	210	56	88	60.68	1
6	56	F	N	Y	N	N	150	68	30.22	1.63	102	98	1	Y	N	N	Y	Y	Y	Y	75	160	100	20	Y	Y	Y	1	0.5	2.1	83	52	110	67.48	3
7	46	M	N	Y	Y	Y	173	102	34.08	2.15	123	134	0.9	Y	Y	Y	N	Y	Y	Y	102	148	94	22	Y	Y	Y	1	0.5	1.9	85	51	102	47.44	3
8	55	F	Y	Y	N	Y	148	58	26.47	1.51	82	94	0.9	N	N	N	Y	N	Y	Y	96	150	98	24	Y	N	Y	0.5	0.9	0.5	154	54	86	56.95	1
9	56	F	Y	Y	Y	Y	146	64	30.02	1.56	88	102	0.9	Y	N	N	Y	Y	Y	Y	98	148	108	23	Y	N	Y	1.2	1.1	1.1	160	48	118	75.64	2
10	60	F	N	Y	N	Y	147	74	34.24	1.66	98	106	0.9	Y	N	N	Y	Y	Y	Y	78	220	110	18	N	Y	Y	1.2	0.8	1.6	83	55	120	72.28	3
11	80	M	Y	Y	N	N	156	60	24.65	1.59	80	86	0.9	N	Y	Y	N	N	Y	N	82	150	98	18	Y	N	N	0.8	0.9	0.9	186	46	89	55.97	2
12	50	M	N	Y	Y	Y	174	108	35.67	2.21	112	110	1	Y	Y	Y	Y	Y	Y	Y	84	172	112	19	N	N	Y	0.5	0.9	0.6	156	52	121	54.75	1
13	62	F	Y	Y	Y	Y	150	60	26.66	1.54	92	104	0.9	N	N	N	Y	Y	Y	Y	88	152	92	22	Y	N	Y	0.6	0.9	0.8	140	48	98	63.63	1
14	50	F	Y	Y	N	N	165	81	29.75	1.88	97	102	1	N	N	N	Y	Y	Y	Y	86	156	92	23	N	Y	Y	1	1.1	0.9	160	50	89	47.34	2
15	63	F	Y	Y	N	Y	156	66	27.12	1.65	80	97	0.8	N	N	N	Y	Y	N	Y	78	134	84	18	N	N	N	0.7	1	0.7	158	46	106	64.24	1
16	60	F	Y	Y	Y	Y	152	70	30.29	1.66	96	101	1	Y	N	N	Y	Y	N	Y	92	132	80	20	Y	N	Y	0.5	0.7	0.8	166	52	102	61.44	1
17	88	F	Y	Y	N	N	146	53	24.86	1.43	83	76	1.1	N	N	N	N	N	Y	Y	78	158	110	18	Y	Y	Y	0.6	0.7	0.8	202	54	112	78.32	2
18	65	M	Y	Y	Y	Y	176	94	30.34	2.1	118	121	1	Y	Y	Y	Y	Y	Y	Y	80	178	118	23	Y	Y	Y	0.7	0.8	0.9	148	46	89	42.38	2
19	40	F	Y	Y	Y	N	144	66	31.82	1.56	88	94	0.9	Y	N	N	Y	Y	Y	Y	78	190	120	22	Y	Y	Y	1.1	0.9	1.3	154	50	110	70.51	2
20	70	F	Y	Y	N	Y	151	66	28.94	1.61	84	90	0.9	N	N	N	Y	N	Y	N	82	210	116	20	N	Y	N	0.9	1	0.9	178	48	86	53.41	2
21	56	F	Y	Y	N	N	158	70	28.04	1.71	92	96	1	N	N	N	N	N	Y	Y	86	200	124	20	N	Y	Y	1.2	0.9	1.4	142	52	79	46.19	2
22	46	M	Y	Y	Y	N	174	96	31.7	2.1	100	104	1	Y	N	N	Y	Y	N	Y	88	130	84	24	N	N	Y	0.7	1.1	0.6	123	56	96	45.71	1
23	76	M	Y	Y	Y	Y	178	98	30.93	2.15	110	106	1	Y	N	N	N	Y	Y	Y	92	198	120	24	Y	Y	Y	1.2	0.8	1.6	113	52	80	37.2	3
24	44	M	Y	N	Y	N	172	100	33.8	2.12	104	105	1	Y	Y	Y	Y	Y	Y	Y	88	150	86	20	Y	N	Y	0.7	1	0.7	146	48	111	52.35	1
25	50	M	Y	Y	N	Y	166	78	28.3	1.86	100	96	1	N	N	N	Y	Y	Y	Y	92	210	118	22	N	Y	Y	1	0.6	1.9	80	55	98	52.68	3
26	54	M	Y	Y	Y	Y	156	58	23.83	1.56	90	91	1	N	N	N	Y	N	N	Y	90	130	84	20	Y	N	Y	0.6	0.9	0.6	166	52	116	74.35	1
27	55	M	Y	Y	N	Y	156	54	22.18	1.52	84	86	1	N	Y	Y	Y	N	Y	N	84	150	100	18	N	N	Y	1.2	1	1.2	170	51	98	64.47	2
28	46	M	Y	Y	N	Y	160	86	33.59	1.89	96	103	0.9	Y	Y	Y	N	Y	Y	Y	78	160	116	20	N	Y	Y	1.1	1	1.2	156	50	90	47.61	2
29	78	M	Y	Y	N	Y	150	46	20.44	1.38	84	81	1	N	Y	Y	N	N	Y	N	78	180	106	23	N	N	Y	0.6	0.9	0.6	188	54	88	63.76	1
30	48	M	Y	Y	Y	Y	176	98	31.63	2.14	103	105	1	Y	Y	Y	Y	Y	Y	Y	88	220	120	23	N	Y	Y	1.2	0.9	1.4	142	55	100	46.72	2
31	78	F	Y	Y	N	Y	148	46	21	1.36	78	82	1	N	N	N	N	N	Y	N	68	192	102	20	N	Y	Y	0.9	0.8	1.1	122	52	108	79.41	2
32	60	F	Y	Y	Y	N	152	66	28.56	1.62	92	96	1	N	N	N	Y	Y	Y	Y	76	168	118	22	N	Y	Y	1	0.8	1.3	156	50	100	61.72	2
33	81	F	Y	Y	N	N	156	60	24.65	1.59	84	88	1	N	N	N	N	Y	Y	Y	86	170	110	19	N	Y	N	0.5	0.8	0.7	168	51	76	47.79	1
34	80	M	Y	Y	N	N	154	52	21.92	1.48	84	88	1	N	N	N	Y	Y	Y	Y	74	186	112	18	N	Y	Y	0.7	0.9	0.7	198	52	89	60.13	1
35	76	F	Y	Y	N	N	148	60	27.39	1.53	86	93	0.9	N	N	N	N	Y	Y	Y	89	190	122	21	N	Y	Y	1.3	0.9	1.5	133	54	106	69.28	3
36	68	F	Y	Y	N	N	144	54	26.04	1.43	82	87	0.9	N	N	N	N	Y	Y	N	92	164	98	22	N	Y	Y	1.1	0.9	1.2	167	53	121	84.61	2
37	70	F	Y	Y	Y	N	152	70	30.29	1.66	88	94	0.9	Y	N	N	Y	Y	Y	Y	88	172	112	22	N	N	Y	0.5	0.7	0.7	198	51	80	48.19	1
38	54	F	Y	Y	Y	Y	155	76	31.63	1.75	92	93	1	Y	N	N	Y	Y	Y	Y	87	196	122	25	Y	Y	Y	1.1	0.8	1.4	156	55	98	56	2
39	66	F	Y	Y	N	N	146	58	27.2	1.49	86	88	1	N	N	N	Y	Y	Y	Y	88	154	94	22	Y	Y	Y	0.9	1	0.9	162	50	86	57.71	2
40	88	F	Y	Y	N	N	142	48	23.8	1.35	82	80	1	N	N	N	N	Y	Y	N	74	188	112	20	N	Y	Y	0.5	0.5	0.9	186	52	88	65.18	2
41	57	M	Y	Y	Y	N	166	78	28.3	1.86	92	90	1	N	Y	Y	N	Y	Y	Y	88	158	100	22	Y	Y	Y	0.9	1	0.9	168	50	98	52.68	2
42	65	F	Y	Y	N	N	148	66	30.13	1.59	88	92	1	Y	N	N	Y	Y	Y	Y	96	176	122	24	Y	Y	Y	1.6	1	1.6	128	54	112	70.44	3
43	76	F	Y	N	Y	Y	150	60	26.66	1.54	86	88	1	N	N	N	Y	Y	Y	Y	78	150	110	20	N	N	Y	0.7	1	0.7	198	50	98	63.63	1
44	68	F	Y	Y	N	Y	146	56	26.27	1.47	86	90	1	N	N	N	Y	Y	Y	Y	68	166	116	22	N	Y	Y	0.9	1	0.9	178	50	84	57.14	2
45	88	F	Y	N	N	Y	156	66	27.12	1.65	76	80	1	N	N	N	N	N	Y	N	64	188	124	19	Y	Y	Y	0.3	0.5	0.6	180	54	68	41.21	1
46	49	F	Y	Y	Y	Y	152	70	30.29	1.66	92	93	1	Y	N	N	Y	Y	Y	Y	76	168	108	20	Y	Y	Y	1.2	1	1.3	176	52	86	51.8	2
47	66	F	Y	Y	N	Y	144	46	22.18	1.34	68	73	0.9	N	N	N	N	Y	N	N	68	200	112	22	N	Y	Y	1.1	1	1.1	176	55	112	83.58	2
48	73	M	Y	N	N	Y	160	56	21.87	1.57	78	83	0.9	N	Y	Y	Y	Y	Y	Y	76	140	96	20	Y	N	Y	0.7	1	0.7	178	53	196	124.8	1
49	76	F	Y	Y	N	N	143	49	23.96	1.37	79	84	0.9	N	N	N	Y	N	Y	Y	78	156	100	22	N	N	Y	0.4	0.8	0.6	120	50	76	55.47	1
50	56	M	Y	N	N	Y	158	60	24.03	1.6	86	88	1	N	Y	Y	N	Y	Y	Y	88	188	112	23	N	Y	Y	1	0.7	1.4	164	52	108	67.5	2
51	43	M	Y	Y	N	Y	163	84	31.61	1.89	97	102	1	Y	Y	Y	Y	Y	Y	Y	74	190	108	24	N	Y	Y	0.6	1	0.6	156	51	110	58.2	1
52	59	M	Y	Y	Y	Y	173	110	36.75	2.22	124	132	0.9	Y	Y	Y	Y	Y	Y	Y	88	220	124	26	Y	Y	Y	1.5	0.7	2.1	90	55	120	54.05	3

KEYS TO MASTER CHART

FTG	Fatigue
DYS	Dyspnea
EDE	Edema
PND	Paroxysmal Nocturnal Dyspnea
HGT	Height
WGT	Weight
BMI	Body Mass Index
BSA	Body Surface Area
WST	Waist Circumference
HIP	Hip Circumference
W/H	Waist-Hip Ratio
OBS	Obesity
ALH	Alcohol
SMK	Smoking
DM	Diabetes mellitus
DYL	Dyslipidemia

SHT	Hypertension
MSY	Metabolic Syndrome
PR	Pulse rate
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
RR	Respiratory Rate
S3	Third Heart Sound
S4	Fourth Heart Sound
CRS	Crepts
E	E Wave Velocity
A	A Wave Velocity
E/A	E/A Ratio
DT	Deceleration Time
EF	Ejection Fraction
LVEDV	Left Ventricular End-Diastolic Volume
LVEDVI	Left Ventricular End-Diastolic Volume Index
GRD	Grade Of Diastolic Dysfunction

ABBREVIATIONS

HF	Heart Failure
LV	Left Ventricle
LA	Left Atrium
LVEF	Left Ventricular Ejection Fraction
SHF	Systolic Heart Failure
DHF	Diastolic Heart Failure
HFNEF	Heart Failure with Normal Ejection Fraction
HFpEF	Heart Failure with Preserved Ejection Fraction
ECHO	Echocardiogram
EF	Ejection Fraction
DD	Diastolic Dysfunction
HCM	Hypertrophic Cardiomyopathy
LVH	Left Ventricular Hypertrophy
ECG	Electrocardiogram
ICU	Intensive Care Unit
MVO	Mitral Valve Orifice

AR	Atrial Retrograde Velocity
S/D	ratio of systolic to diastolic velocity of venous pulmonary veins
TDI	Tissue Doppler Imaging
IVR	Isovolumic Relaxation
IVRT	Isovolumic Relaxation Time
PND	Paroxysmal Nocturnal Dyspnea
NYHA	New York Heart Association
CABG	Coronary Artery Bypass Grafting
CKD	Chronic Kidney Disease
CHF	Congestive Heart Failure