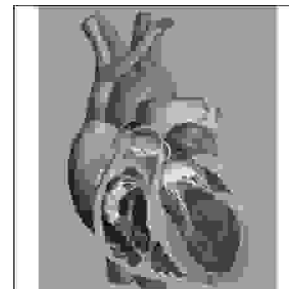


ORIGINAL

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RISK FACTORS OF DIASTOLIC HEART FAILURE;

AN EPIDEMIOLOGICAL ANALYTIC STUDY



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ABSTRACT... hudadr1@yahoo.com, drarehman@gmail.com. **Background and objective:** Isolated diastolic dysfunction /heart failure is the cause of congestive heart failure in 50% of patients with normal systolic function. Several factors have been shown to be predisposing conditions associated with the development of diastolic dysfunction and diastolic heart failure. This study was designed to study the common and important factors leading to diastolic dysfunction of the heart. **Study design:** This was a descriptive analytic study. **Place & Duration:** This study was conducted at Cardiology Department of Mayo Hospital Lahore from January 1998 to September 1998. **Material and methods:** One hundred patients of diastolic heart failure who fulfilled our inclusion criteria were studied when they presented to echo room for echocardiography. Detailed Echocardiography examination of all patients included in this study was done to measure Doppler parameters of diastolic dysfunction like deceleration time, isovolumic relaxation time, S & D wave measurements on pulmonary vein. Detailed history was taken and physical examination was performed to evaluate the risk factor associated with diastolic dysfunction in each patient. **Results** Mean age of the study population was 51 \pm 18 years. Majority of patients 50(50%) had age range from 36 to 55 years. There were 62(62%) male and 38(38%) female patients. Majority of patients 34(34%) had NYHA class I symptoms and 30(30%) patients were in NYHA class II. Ejection fraction was normal in 54(54%) of patients while it was less than 40% in 24% of patients. Majority of patients, 28(28%) had Ischemic heart disease while 24(24%) patients had hypertension and 14(14%) had diabetes mellitus. Hypertension and Ischemic heart disease were present in 14(14%) patients. **Conclusion** Approximately 40% - 50% of patients with or without overt clinical features of heart failure have isolated diastolic dysfunction / DHF with normal systolic function. Coronary artery disease, arterial hypertension and diabetes mellitus are the major factors associated with diastolic dysfunction and DHF. Obesity and aging also contribute independently to the development of diastolic dysfunction in a reasonable number of patients.

Key words: Diastolic dysfunction, ischemic heart disease, hypertension, age

INTRODUCTION

Heart failure affects approximately 4.8 million persons in the United States, with about 500,000 new cases diagnosed each year^{1,2}. It is the leading cause of hospitalization in patients older than 65 years of age³. In spite of significant advances in the treatment of heart failure, mortality rate still remains high. About 30-40% of patients with advanced disease and 5-10% of patients with mild symptoms die within 5-10 years⁴.

Early studies suggested that as many as one third of patients presenting with overt heart failure have isolated diastolic heart failure^{5,6}, but recent studies have shown a prevalence of diastolic heart failure of 50% in patients greater than 70 years of age^{7,8}. The annual mortality rate for patients with diastolic dysfunction approximate 5-8% as compared to 10-15% for patients with systolic dysfunction⁹. Similarly mortality is also quite high with one year readmission rate approaching 50% in patients with diastolic dysfunction, which is nearly identical to that of patients with systolic dysfunction⁹.

Several factors have been shown to be predisposing conditions associated with the development of diastolic dysfunction and diastolic congestive heart failure. Chronic hypertension is the most common cause of diastolic dysfunction and diastolic heart failure (which is the symptomatic diastolic dysfunction)¹⁰. Some studies have reported that 60% of patients with diastolic congestive heart failure were hypertensive¹¹.

Coronary artery disease (CAD) is the second most common cause of diastolic dysfunction even in the absence of myocardial infarction¹². Recent data suggested that CAD is a cause of left ventricular diastolic dysfunction in approximately 1/3rd of patients with this condition.

Diastolic dysfunction is more common in elderly persons¹³ especially in women and prevalence of diastolic dysfunction increases with age. The Val-HEFT investigators found that in patients with heart failure and age less than 60 years of age only 15% have isolated diastolic dysfunction but in contrast, the patients having onset of heart failure after 80 years of age, at least 50%

have diastolic dysfunction as a primary pathology¹¹.

Obesity alone is the cause of 11% cases of cardiac failure in men and 14% of cases in women in the United States¹⁴. The Framingham study showed that after correction for other risk factors, for every point increase in body mass index, the risk of developing heart failure increases by 5% in men and 7% in women. The Framingham study also showed that diabetic patients have an additional risk factor to develop diastolic heart failure even in the absence of coronary artery disease and hypertension¹⁵. Many reports have shown a prevalence of about 30-60% of diastolic dysfunction even in well controlled diabetics¹⁶. Less common conditions associated with diastolic heart failure are hypertrophic Cardiomyopathy, restrictive Cardiomyopathy and pericardial diseases. This study was conducted to study the common and important factors contributing to the diastolic dysfunction and diastolic heart failure (DHF).

MATERIAL AND METHODS

This study was conducted at the department of cardiology, Mayo Hospital Lahore from January 1998 to September 1998. Patients coming for echocardiography were screened. Every patient having abnormal E/A ratio on Doppler study was included in the study irrespective of the cause of this abnormal E/A ratio. Patients were excluded if they were less than 25 years or had abnormal rhythm or if they were technically difficult for analysis. During the study period 100 consecutive patients were studied. Diastolic dysfunction was defined using 2D echocardiography and Doppler techniques as abnormal E/A ratio, deceleration time (DT) and isovolumic relaxation time (IVRT) abnormalities.

The LV measurements were taken to determine the evidence of LVH and ejection fraction. Two dimensional (2-D) and M mode echocardiography were performed followed by CW and PW Doppler study for Doppler measurements. The images were obtained including the apical four chamber and two chamber views so that blood flow measurements could be made across the Mitral valve. For all patients Early (E) and late (A) wave velocity was recorded as well as the E/A ratio was determined. Deceleration time and isovolumic

relaxation time and other parameters of diastolic function like and wave at pulmonary venous flow was determined. All echocardiographic measurements were performed by an experienced physician.

History was taken and complete physical examination of each patient was performed with special emphasis on cardiovascular system. Routine investigations especially blood sugar, urea, creatinine, ECG and a chest X-ray was done. A predesigned proforma was filled in for each patient.

STATISTICAL ANALYSIS

All statistical analysis was performed using SPSS (Statistical Package for Social Services). All categorical variables were analyzed using Chi Square test while continuous variables were analyzed by student test. A p value less than .05 was taken as significant. All tests applied were two tailed.

RESULTS

After fulfilling the inclusion criteria a total of 100 patients having diastolic dysfunction were studied. Mean age of the study population was 51 ± 18 years. Majority of patients 50(50%) had age range from 36-55 years. There were 62(62%) male and 38(38%) female patients. Table-I shows the epidemiological characteristics of the study population. Body mass Index was ≤ 25 Kg/m² in 42(42%) patients followed by 38(38%) patients in 26-30 Kg/m² group patients. Majority of patients 34(34%) had NYHA class I symptoms followed by 30(30%) patients having NYHA class II symptoms. Ischemic heart disease was the predisposing risk factor in 28(28%) patients followed by hypertension in 24(24%) patients. Twenty two (22%) patients did not have any obvious risk factor for diastolic dysfunction. Table-II and III show distribution of patients according to the risk factors. Hypertension and Ischemic heart disease were both present in 14(14%) patients. Echocardiography was performed to assess the severity of diastolic dysfunction. Table IV shows the echocardiographic characteristics of study population. Pulse wave Doppler revealed that E/A ratio was equal in 16(16%) patients while reversal of E/A ratio was observed in 66(66%) patients and restrictive pattern was present in 18(18%) patients. Majority of patients 44(44%)

had ejection fraction of $>60\%$.

Table-I. Epidemiological characteristics of the study population. (N=100)

CharacTeristics	No. of pts	%age
Mean age (years)	51±18	
<35 years	22	22%
35-55 years	50	50%
>55 years	28	28%
Male	62	62%
Female	38	38%
BMI (Kg/m²)		
≤ 25	42	42%
26-30	38	38%
31-35	16	16%
>35	04	04%
NYHA class		
I	34	34%
II	30	30%
III	26	26%
IV	10	10%

Table-II. Distribution of patients according to the risk factor (n=100)

Risk Factors	No. of pts	%age
Hypertension	24	24%
Ischemic Heart Disease	28	28%
Diabetes Mellitus	14	14%
Dilated Cardiomyopathy	2	2%
Hypertrophic Cardiomyopathy	2	2%
Myocarditis	2	2%
Pericardial diseases	6	6%
Without obvious risk factors	22	22%

Table-III. Patients having more than one risk factor (n=100)

Risk Factors	No. of pts	%age
Hypertension and IHD	14	14%
Hypertension and Diabetes	2	2%
IHD and Diabetes	4	4%
IHD, Diabetes and Hypertension	2	2%

Table-IV. Distribution of patients according to Echocardiographic Characteristics.

Characteristics	No of pts	%age
Equal E/A Ratio	16	16%
Reverse E/A Ratio	66	66%
Restrictive Pattern	18	18%
Ejection Fraction		
>60%	44	44%
51-60%	10	10%
40-50%	22	22%
<40%	24	24%

DISCUSSION

Diastolic heart failure is defined as failure of left ventricle to produce an adequate cardiac output at normal left ventricular filling pressure despite the presence of a normal left ventricular ejection fraction¹⁷. In the past, all the patients presented with cardiac failure were labeled as having systolic dysfunction, reason being that the diagnosis of diastolic dysfunction / diastolic heart failure (DHF) was always been dubious before the advent of Doppler echocardiography. Results of early studies suggested that as many as 40% of patients with heart failure have isolated DHF with normal ejection fraction¹⁸. However more recent data shows that the prevalence of diastolic dysfunction and DHF is dependent on age, sex, study setting (e.g Hospital vs Community), methods used to make the diagnosis (Echocardiography vs Invasive techniques), LVEF cutoff 40% vs 50% and the underlying disease that contribute to diastolic

dysfunction¹⁹.

In the current study 54(54%) of the patients had normal systolic function (LVEF \geq 50 %) and this is consistent with the results of Vasan¹⁸ who reported in his study that 13 - 74 % of heart failure patients have normal systolic function. The prevalence of asymptomatic diastolic dysfunction was estimated to be 27 % in a recent epidemiological study. Several community based studies showed that in patients with heart failure, the prevalence of normal LV systolic function was 42 - 55 %²⁰ and our results are also consistent with these results. Several hospital based studies showed that approximately 40 % of patients with heart failure have preserved left ventricular systolic function^{18,19} and these results coincide with the current study.

Several reports indicate that a sizeable proportion of the cases of heart failure with various underlying causes have preserved left ventricular systolic function²¹. Ischemic heart disease was the largest group observed in the current study, the reason being that most of the patients in our study were referred from our CCU and indoor of other medical wards and male predominance was due to high incidence of Ischemic heart disease (IHD) in male.

Limited data is available on the prevalence of cardiac failure with preserved systolic function in patients with coronary artery disease. Some studies suggested that the prevalence of cardiac failure with preserved systolic function after myocardial infarction was as high as 45 %²². These studies however are mostly case series so their estimates of prevalence may be subject to selection bias. The exact prevalence of patients with cardiac failure and preserved systolic function with CAD in the community is not known. Jens et al²³ reported that 30 % of patients after myocardial infarction with heart failure have preserved left ventricular systolic function which is consistent with our study results. Other studies showed this prevalence rate between 27 - 45 % for patients with heart failure and preserved systolic function (EF \geq 50 %) and coronary artery disease as the underlying condition²² and these results are also consistent with the current study results. Michael et al¹¹ also reported that CAD is a

contributing factor of diastolic dysfunction in heart failure patients in approximately one third of patients which coincide with our results.

The next most prevalent factor associated with diastolic dysfunction / DHF in the current study was systemic hypertension. Majority of hypertensive patients 16/24 (67%) in the current study had concentric left ventricular hypertrophy (LVH) on echocardiography which is consistent with the results of Michael et al²⁴ while 8 /24 (33%) were without LVH but they have diastolic dysfunction and this finding coincides with the results of Cuocolo et al²⁵ study who reported in his study that there is no correlation between the magnitude of LVH and diastolic dysfunction. Jonath et al²⁶ reported that hypertension is the most common risk factor for the DHF.

The Framingham study showed that 75 % of patients with DHF have hypertension²⁷. All the above previous studies showed that hypertension is the most common cause of diastolic dysfunction / DHF and DHF is the most common cause of morbidity and mortality in hypertensive patients especially African American even more than IHD (62% vs44%). This observation of the current study differs from these studies, the reason being that most of patients were referred from CCU and indoor of other medical wards. Secondly hypertension has no signs and symptoms and so known as silent killer and in our population mostly diagnosis is made on routine physical examination. Third, the treating physicians do not send the patient until and unless the patient has some symptoms.

In the current study 14 (14 %), male 8 (8%) and female 6 (6%) were diabetics. The presence of isolated diastolic dysfunction in diabetic patients in the absence of hypertension and IHD was first described by Rubler et al²⁸.

Carlos et al²⁹ reported that diastolic dysfunction precedes the systolic changes in the diabetic heart even in the absence of CAD. Many reports have shown prevalence of diastolic dysfunction from 30 - 60 % in well controlled and normotensive diabetic persons and these results coincide with the current study. O,Connor et al³⁰

found that about 30 % patients with diastolic dysfunction / DHF also were suffering from diabetes mellitus in the absence of obstructive CAD and hypertension. A recent study has shown that 40 % of the diabetic patients had diastolic dysfunction³¹ which is consistent with our results. Kitzman et al³² in his study found that among patients with DHF 25 - 30 % have diabetes, and / or renal insufficiency. 22 (22 %) patients in our study had no definite risk factor. Out of these 22 % patients, 14 (14%) were male and 8 (8 %) were female. On analysis of these 22(22%) patients, 6/22 (27%) were 65 years of age and MacFadyen et al³³ found that 18 % of patients in a community sample of elderly patients had isolated diastolic filling abnormalities on echocardiography, suggestive of DHF. Studies have shown that DHF is present in only 15 % of patients with heart failure and age less than 50 years of age, but as many as 50 % of patients with heart failure have isolated DHF who were more than 70 years of age¹⁸. A recent epidemiological study found that 45 % of patients aged between 65 75 years of age had diastolic dysfunction with or without signs and symptoms of heart failure and in patients greater than 75 years of age this prevalence increase to 70 %³⁴. So in our those six patients who were more than 65 years of age and had no definite associated risk factor aging is the cause of diastolic dysfunction and this coincides with the above studies.

As discussed above, 8(8%) patients have BMI \geq 35 and were labeled to have class II or more obesity according to WHO definition of obesity³⁵. Grossman et al¹⁵ reported that obesity alone is the cause of 11 % cases of DHF in men and 14 % of cases in women and these results are consistent with our results. The rest of 8 (8%) patients, 6 (6%) male and 2 (2%) female in this group (22%) of patients with out any obvious risk factor were less than 55 years of age, having normal weight according to their age and height but they have family history of hypertension. Graettinger et al³⁶ demonstrated in his study that normotensive relatives of hypertensive patients can have diastolic dysfunction and this diastolic dysfunction precedes even before the clinically apparent high blood pressure. Thus these 8 (8%) patients with family history of hypertension but clinically normotensive had diastolic dysfunction and this is consistent with the

results of Greattinger et al³⁶ and if we include this group of patients in our hypertensive group of patients it will make a total of 32 (32 %), the largest group in our study and this coincides with the previous studies results in which hypertension was found the commonest cause of diastolic dysfunction.

In the current study 22 (22%) patients had more than one risk factor contributing to diastolic dysfunction. Fourteen (14%) had hypertension and IHD, 4 (4%) had IHD and diabetes mellitus, 2 (2%) had diabetes mellitus and hypertension and in the last 2 (%) had IHD, hypertension and diabetes altogether. In our study less common risk factors associated with diastolic dysfunction were cardiomyopathy, pericardial diseases and myocarditis which is consistent with the results of previous studies.

CONCLUSION

Isolated diastolic dysfunction and DHF (which is symptomatic diastolic dysfunction) in our population is not an uncommon entity. Approximately 40 % - 50% patients with or without the clinical signs symptoms of heart failure have isolated diastolic dysfunction / DHF in the presence of normal systolic function. Coronary artery disease, arterial hypertension and diabetes mellitus are the major risk factors associated with diastolic dysfunction and DHF. Obesity and aging also contribute independently to the development of diastolic dysfunction in a reasonable number of patients.

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