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PREVALENCE OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN PREOPERATIVE VISIT CLINIC

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Contribution

SR and GB, conceived the idea and designed the study. SS, HS and SAF did data collection and manuscript writing. AA did the final review. All authors contributed equally to the submitted manuscript.

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ABSTRACT

Objective: To evaluate the prevalence of left ventricular dysfunction and some related factors in patients referred to the preoperative visit clinic.

Methodology: In this cross-sectional study, patients aged above 20 years who underwent echocardiography after physical examination at Poorsina Hospital affiliated to Guilan University of Medical Sciences Iran from January to July 2016. Patients were evaluated in two groups with left ventricular diastolic dysfunction and without left ventricular diastolic dysfunction. The research inclusion criteria included a lack of history of systolic heart failure and proven heart valve dysfunction, lack of deformity, infection and ulcers in the echo site. Lack of patient's willingness to continue the study and poor echocardiography window were our exclusion criteria. Then, the data was analyis in SPSS version 16.

Results: Among 399 patients, 175 had no diastolic dysfunction and 224 (56.1%) had diastolic dysfunction, 200 patients (89.3%)had grade 1 diastolic dysfunction and 24 patients (10.7%) had grade 2 dysfunction. There was a significant difference in the frequency distribution of sex between the two groups (p= 0.001), so that the odd ratio of this dysfunction was two times more in female compared to male. There was a significant difference between the two groups in the mean age and age ranges (p= 0.0001), with increased prevalence of diastolic dysfunctions in elderly. The mean BMI in the affected group was higher than that in non-affected group. (p = 0.034). There was a statistically significant difference between two groups with and without left ventricular diastolic dysfunction in terms of the history of diabetes (p= 0.0001).

Conclusion: Given the high prevalence of diastolic dysfunction in the community of patients, who were candidate for surgery especially at higher ages as well as patients with high risk factors (female sex, diabetes, hypertension and medicine users), echocardiography was recommended to investigate the preoperative heart diastolic dysfunction.

Key Words: Prevalence,Left Ventricular, Diastolic Dysfunction, Echocardiography

INTRODUCTION

Heart failure is one of the main causes of mortality in the world, leading to high costs of treatment and many complications for individuals and the community.[1,2] Through increasing the life expectancy, heart failure also increases and older people are more affected.[3] Heart failure is an epidemic disease affecting about 5.1 million adults in the United States in 2013 that would grow 25% by 2030.[4] Based on the latest clinical guidelines of the European Heart Association, heart failure is classified into three major groups based on heart ejection fractionincluding heart failure with reduced ejection fraction (LVEF< 40%), heart failure with moderate ejection fraction (LVEF 40-49%) and heart failure with preserved ejection fraction (LVEF ≥ 50%).[5,6].

Great changes have been created in the incidence of left ventricular DD over the past two decades. Clinical studies in general populations have indicated that 40-71% of patients with DD have a normal ejection fraction. The patho physiology of this group of patients is different from that of the patients with reduced ejection fraction. It is caused by dysfunction in the myocardial relaxation stage, increased hardness of the left ventricular wall, and in most cases, increased thickness of the atrium. Thus, the prognosis of heart failure among patients with preserved ejection fraction is similar to that of patients with reduced ejection fraction.[7,8] Indeed studies have indicated that mortality caused by heart failure with preserved ejection fraction is equal to the mortality caused by heart failure with reduced ejection fraction.[9,10] Investigations have shown that most patients experiencing heart failure with reduced ejection fraction have also DD.[6] It is supposed that the prevalence of DD might be higher than systolic dysfunction. So recognizing the underlying factors and taking appropriate measures against risk factors effectively prevents many of diastolic heart failures.[11]Left ventricular diastolic function can be easily assessed non-invasively by measuring the velocity of the blood passing through the mitral valve by echocardiography[12-14] Left ventricular function is recognized as a predictor of outcome in patients with heart failure.[9] Recent clinical guidelines have special emphasis on the diagnosis of asymptomatic and subclinical systolic and DD as well as their risk factors.[3] Early diagnosis of diastolic heart failure with preserved ejection fraction would lead to timely treatment and control of its complications. This research was conducted to investigate the prevalence of left ventricular DD and some related factors in patients referred to our preoperative visit clinic in order to determine patients at higher risk statue, aiming to develop a protocol for performing echocardiography among them focusing on diastolic dysfunction.

METHODOLOGY

This cross sectional analytical study was first approved by university's research ethics committee and then took place at Poorsina hospital, a referral academic center affiliated to Guilan university of Medical Science Iran from January to July 2016.

The research population included all patients aged over 20 years who were candidates for elective non-heart surgery referred for preoperative visit. Patients without a history of systolic heart failure and proven valve dysfunction and without deformity, infection, and ulcers were included in the study. Lack of willingness to continue the study and having poor echo windows were considered as the exclusion criteria. After obtaining the informed consent of the patients, demographic characteristics including age and sex, history of ischemic heart disease, diabetes mellitus, chronic blood pressure (systolic blood pressure above 140 mmHg and diastolic blood pressure above 90 mmHg) were collected. In addition, the smoking history was recorded as the number of cigarette packets per year and the history of medicine use.

Blood pressure, heart rate, height and weight (to calculate BMI) of the patients were measured and recorded by the nurse. To evaluate the diastolic function, echocardiography was performed using SonoSite Micro Maxx device (USA) and with the probe of SonoSite 1-5 Hz by echocardiography specialist. E peak and A peak were calculated through pulse Doppler wave and a, peak and e, peak were calculated by E/A and E/e, Deceleration Time (DT), and IsoVolumic Relaxation Time (IVRT) and were recorded in the echo report sheet. According to the results of this research, left ventricular diastolic failure was divided into normal, grade 1, grad 2, and grade 3 groups[14,15] Additionally, in the echocardiography, the patient's heart valves were examined and if there was a disease or specific case, it was recorded in the report sheet. Information obtained from medical records of patients was also recorded in order to be used in the continuation of treatment processes of patients. After collecting data, they were analyzed using SPSS, version 16, software and Chi-square, two-independent t -test and logistic regression tests.

RESULTS

Out of 399 patients referred to pre-operative visit clinic of Pursina teaching hospital, 224 (56.1%) patients had left ventricular diastolic dysfunction, and 175 (43.9%) had no left ventricular diastolic dysfunction. In addition, out of 224 patients with diastolic dysfunction, 200 patients (89.3%) had grade 1 dysfunction and 24 patients (10.7%) had grade 2 dysfunction.

The frequency distribution of the variables studied in two groups of patients with diastolic dysfunction and patients without diastolic dysfunction who referred to the preoperative visit clinic (Table 1).

The results revealed a significant relationship between the sex frequencies of patients referred to the preoperative visit clinic in the two groups of with and without diastolic dysfunction. The odds ratio of left ventricular diastolic dysfunction in women was 1.97 times more than that of men (Odd Ratio = 1.97). The mean age was 64.21 ± 11.04 years in the left ventricular diastolic dysfunction group, while it was 44.26 ± 13.69 years in no left ventricular diastolic dysfunction group. The odd ratio of left ventricular diastolic dysfunction in patients aged over 44 years was approximately 31 times more than that in patients aged less than 44 years (Odd Ratio = 31.35).

The mean BMI was 26.22 ± 4.89 in the group with left ventricular diastolic dysfunction and it was 24.99 ± 6.68 in group without left ventricular diastolic dysfunction. Two-independent sample t-test showed a significant difference between the means of BMI of the patients in two groups with and without left ventricular diastolic dysfunction (p = 0.034). Given the cutoff point of 25, the Odd Ratio was considered 1.006. In other words, the odds

Table 1: Frequency Distribution of Variables Examined In Two Groups of Patients With and Without Left Ventricular Diastolic Dysfunction

Variable type	Left ventricular diastolic dysfunctionn(%)	No left ventricular diastolic dysfunction n (%)	Sum n(%)	Statistical estimate p
Gender				
Female	135 (64)	76 (36)	211(100)	0.001
male	89(47.3)	99(52.7)	188(100)	
Age				
44 years>	7 (7.4)	88(92.6)	95 (100)	0.0001
64-65 years	109(58.6)	77(41.4)	186(100)	
65<	108 (91.5)	10(8.5)	118(100)	
BMI group				
19>	8(42.1)	11(57.9)	19(100)	0.15
19-25	80(58)	58(42)	138(100)	
25-30	93(52.5)	84(47.5)	177(100)	
30<	43(66.2)	22(33.8)	65(100)	
Smoking				
Yes	44(60.3)	29(39.2)	73(100)	0.43
no	180(55.2)	146(44.8)	326(100)	
Drug use				
Yes	40(75.5)	13(24.5)	53(100)	0.002
no	184(53.2)	162(46.8)	346(100)	
Diabetes history				
Yes	60(81.1)	14(18.9)	47(100)	0.001
no	164(50.5)	161(49.5)	325(100)	
Hypertension				
Yes	86(77.5)	25(22.5)	111(100)	0.001
No	138(47.9)	150(52.1)	288(100)	

ratio of left ventricular diastolic dysfunction in patients with higher

BMI was 25 times more than that in patients with BMI less than 25. The mean age of smoking (pack / year) was 18.52 ± 11.28 in the group with left ventricular diastolic dysfunction and 11.72 ± 7.31years in the group without left ventricular diastolic dysfunction. There was no statistically significant difference between the means of smoking in two groups with and without left ventricular diastolic dysfunction. The results showed that the odds ratio of left ventricular diastolic dysfunction in smokers was 1. 23 times higher than that of non-smokers (Odd Ratio = 1.23).

With regard to drug use, there was a significant relationship between medicine use in two groups with and without left ventricular diastolic dysfunction (p = 0.002). It was also revealed that the odd ratio of left ventricular diastolic dysfunction in medicine users was 0.36 times more than that of non-medicine users (Odd Ratio = 0.36). In addition, 81.1% of diabetic patients had left ventricular diastolic dysfunction. Significant difference was found between two groups with and without left ventricular diastolic dysfunction (p = 0.0001). The odd ratio of left ventricular diastolic dysfunction in patients with diabetes mellitus was 0.23 times more than that of non-diabetic patients (Odd Ratio = 0.23). Moreover, there was a significant relationship between distributions of the prevalence of hypertension in patients referred to the preoperative visit clinic in two groups of with and without left ventricular diastolic dysfunction (p = 0.0001). The odd ratio of left ventricular diastolic dysfunction in patients with hypertension was 0.26 times more than that of patients without hypertension (Odd Ratio = 0.26).

The comparison of the mean of some hemodynamic factors in patients referred to the preoperative visit clinic in two groups of with and without left ventricular diastolic dysfunction as shown in table 2.

Table 2: Comparison of The Mean of Some Hemodynamic Factors In Patients Referred To The Preoperative Visit Clinic In Two Groups of With and Without Left Ventricular Diastolic Dysfunction

Variable	Group	Mean and SD	Z value	P-Value
SBP	with left ventricular diastolic dysfunction	139.1±72.45	4.22	0.0001
	without left ventricular diastolic dysfunction	126.23±15.07		
DBP	with left ventricular diastolic dysfunction	77.23±10.17	0.47	0.63
	without left ventricular diastolic dysfunction	76.8±8.35		
MAP	with left ventricular diastolic dysfunction	24.45±97.85	3.05	0.002
	without left ventricular diastolic dysfunction	93.27±9.51		
HR	with left ventricular diastolic dysfunction	67.41±23.64	4.4	0.0001
	without left ventricular diastolic dysfunction	75.08±17.53		

Using logistic regression, various variables including sex, age range with a cutoff point of 44 years, BMI with cutoff point of 25, smoking, medicine use, diabetes and hypertension were entered in the Forward LR model. It was revealed that the intervening variables in the incidence of left ventricular diastolic dysfunction in the studied patients were sex, age, and diabetes. Therefore,those ages above 44 years increased the odd ratio of this dysfunction by 29 times and the female sex doubled that odd ratio (Table 3).

Table 3: Predictor Factors for Left Ventricular Diastolic Dysfunction Using Logistic Regression Variable in the Equation

Sig.Exp (B)		Lower	Upper		95% C.I. for Exp(B)	
Step 1[a] sex		.031	1.709		1.050	2.782
Age>44y	.000	30.527	13.317	69.974		
Diabetes (DM)		.000	.244		.114	.524
Constant		.002	.202			
Step 2[b] sex	.007	2.015		1.214	3.346	
Age>44y	.000	29.208		12.619	67.607	
Opium	.012		.372	.172	.803	
Diabetes (DM)	.000		.239	.112	.508	
Constant	.198		.459			

DISCUSSION

In contrast to systolic dysfunction, which is easily diagnosed in echocardiography, Diastolic dysfunction (DD) has been less considered. Because the diagnosis of relaxation abnormality and reduced compliance of ventricles might be more difficult. DDis characterized by difficulty in the relaxation of ventricles, leading to an increase in the pressure of ventricles filling[16]

Generally, diastole is divided into four steps of isovolumic relaxation, fast filling, slow filling, and atrial contraction. In the elderly population, paying attention to diastolic dysfunction as a risk factor for cardiovascular outcomes is increasing. In clinical practice, echocardiography is a standard method for the diagnosis of diastolic dysfunctions. Based on echocardiographic findings, the diastolic dysfunction severity has been divided into mild, moderate and severe.[17] Left and right diastolic ventricular dysfunction may occur simultaneously or alone. It increases the critical left ventricular pressure in any case and may lead to problems for the patients following anesthesia and mechanical ventilation. DD is often asymptomatic in resting state. However, it progresses during activity or when the cardiovascular system is in stress condition, for example in uncontrolled hypertension, overload, or atrial fibrillation conditions. Anesthesiologists often face with symptomatic patients and challenging condition with DD. Systole function can be normal in these patients[17,18] Investigations have indicated that early diagnosis of this dysfunction is crucial and suggested that DD peri-operation is a risk factor of postoperative atrial fibrillation, especially at old ages. Investigations have also indicated that DD was a non-dependent factor for adverse heart postoperative outcomes.[19,20] It might be difficult to diagnose these patients, especially in preoperative visits. These patients can easily pass the anesthesiologists' preoperative visits but cause many problems during anesthesia. In fact, risk factors and predisposing and suspected factors of this dysfunction should be considered seriously. Heart risk factors may be the left atrium enlargement, systemic hypertension and coronary artery disease. Non-heart risk factors include female sex, diabetes, kidney failure, and high age. Heart failure becomes one of the major health issues in the community with increasing the life expectancy of people. Diastolic heart failure was seen in 40-50% of heart failure cases.[3,21] Left ventricular diastolic evaluation is vital for examining the heart function and its general health. Left ventricular diastolic function plays a key role in increasing heart pumping capacity and supports high levels of cardiac-respiratory function.[22] In the study of T. Tanya et al, the prevalence of left ventricular diastolic dysfunction was reported as 27.3% in the normal population based on echocardiography studies.3In the research carried out by Malgorzetta et al the prevalence of diastolic dysfunction was reported as 20% in the European population.[23] In another research, the prevalence of this dysfunction was reported 11.1%.[24] Diversity in the prevalence of this dysfunction might be due to differences in the studied population, used imaging techniques, and the criteria used to diagnose and grade left ventricular diastolic dysfunction.[23]

In the current research, the prevalence of diastolic dysfunction was 56.1% in patients referred to the preoperative visit clinic. The prevalence of first grade diastolic dysfunction was 89.3% and the prevalence of second grade diastolic dysfunction was 10.7%. Different studies have indicated that the prevalence of diastolic dysfunction varied according to age and it increased with the increasing of age.[3,25,26] In the study conducted by Alaur, the prevalence of diastolic dysfunction was reported 25-30% in normal population aged over 45 years. The age of patients with diastolic dysfunction was higher than that of the group without diastolic dysfunction.[24,27] In the research carried out by Fisher et al, the prevalence of diastolic dysfunction varied from 2.8% in subjects aged 25-25 years to 15.8% in subjects aged over 65 years.[24] In the current research, a significant relationship was found in the mean age of two groups with and without left ventricular diastolic dysfunction. It was also found that there was a significant difference in age distribution of patients referred to the preoperative visit clinic in two groups with and without left ventricular dysfunction ($p < 0.05$). Thus, it could be concluded that diastolic dysfunction occurred at an older age and aging was a risk factor for diastolic function.

In the current research, 64% of patients with diastolic dysfunction were female. Based on this research, the odd ratio of left ventricular diastolic dysfunction in women was 1.97 times more than that of men, which is in line with results of some studies (Shrestha, 2009). However, in the research conducted by Fisher, its prevalence was significantly higher in men (13.8%) compared to that in women (8.6%).[24] In this study, the odd ratio of left ventricular diastolic dysfunction in patients with BMI was 25 times higher than that in patients with BMI less than (Odd Ratio = 1.006). In the research conducted by T. Tanya et al, high BMI was significantly associated with a greater odd ratio of left ventricular diastolic dysfunction.[3,25] The research conducted by Fisher et al showed that obesity and especially the high BMI predicted diastolic dysfunction.[24] As the subjects studied in this research were older people in general, most of them had high BMI due to their low mobility. Moreover, the prevalence of left ventricular diastolic dysfunction was higher in older people. Thus, their odds ratio is expected to be high. Hypertension is a major risk factor for heart failure, coronary artery disease, kidney failure, and stroke all around the world. In the research carried out by Akintunde et al, the high prevalence of diastolic function dysfunction was seen among patients with primary hypertension.[28] Moreover, the research carried out by Rosa et al showed that diastolic dysfunction was common in people with hypertension.[29] In the current research, a significant relationship was found between two groups in frequency distribution of history of hypertension, which is in line with the results of the above-mentioned studies. Similar to other studies, we found that hypertension affected the development of left ventricular diastolic dysfunction, so it is possible to prevent left ventricular diastolic dysfunction in patients with hypertension in its early stages with proper control of the disease and its treatment.

Diabetes mellitus is one of the risk factors for congestive heart failure, in which diastolic function is weakened earlier than systolic function, and most patients may be asymptomatic and have no symptoms of heart failure.[11] Studies have also shown that 82% of diabetic patients suffer from left ventricular DD.[30]The current research indicated that diabetes might cause left ventricular diastolic dysfunction as statistically a significant relationship was found between frequency distribution of diabetes history in the two groups ($p = 0.0001$).Given higher age and BMI of the group with left ventricular diastolic dysfunction in the current research and considering the fact that the majority of

diabetics in the community have type 2 diabetes, which also depends on age, level of activity, weight and lifestyle, it is expected that the number of diabetics with diastolic dysfunction to be higher than the number of diabetics without this dysfunction and results of this research confirmed it. Hence, it is recommended that diabetic patients who are candidate for surgical procedures to undergo craniology and echocardiography examinations.While the relationship between smoking and increased risk of cardiovascular disease has been proven, our study did not show a statistically significant relationship between smoking and the DD in two groups. As the information collected on smoking was self-reported, some of them might not give the exact answers regarding the duration and rate of smoking or addiction for several reasons like forgetfulness and stigma. Therefore, the achieved findings might be underestimated, which could affect the results of the research.

The research conducted by Yilmaz also reported that DD was weakened in young smokers and severity of this weakness was closely associated to rate of smoking.[31] The results of research conducted by Dalen et al showed that smoking was more associated with right ventricular function than left ventricular function.[32] This research showed that drug users played a role in the development of DD as well.

CONCLUSION

Considering the high prevalence of diastolic dysfunction in old patients, especially those with risk factors including female gender, diabetes, hypertension, smoking and drug users) and potential risks during anesthesia, the routinely evaluation of diastolic dysfunction before surgery is strongly recommended. Furthermore attempt should be made to control left ventricular diastolic dysfunction by changing life style, weight loss, control of blood sugar, and hypertension, and stopping smoking.

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