Journal of Rawalpindi Medical College (JRMC); 2016;20(4):258-261

Original Article

Effect of Age and Sex on Left Atrial and Left Ventricular Diastolic Diameters in Patients with Mild Diastolic Dysfunction (Grade I)

Muhammad Saeed [1], Inam ul Haq [2], Hamza Nadir [3]

1. Department of Cardiology, Holy Family Hospital and Rawalpindi Medical College, Rawalpindi;2. Department of Physiology, Rawalpindi Medical College, Rawalpindi;3 Second Year MBBS student, Rawalpindi Medical College, Rawalpindi.

Abstract

Background: To analyze the relationship between age, sex, left atrial and left ventricular diastolic diameters in patients with mild diastolic dysfunction.

Methods: In this cross-sectional observational study patients (n=434) diagnosed with mild or grade 1 diastolic dysfunction on Pulse Wave Doppler Echocardiography (E/A<0.8, E/e'<8, abnormal DT) were included. Patients with valvular abnormalities and pericarditis were excluded. Diastolic left atrial and ventricular sizes were determined on echocardiography as per guidelines.

Results:Sex did not show any significant correlation with left atrial and left ventricular diameters (p>0.05). Age was having moderate correlation with left atrial diameter (r=0.49). Age was having negative correlation with left ventricular diameter (r=-0.29) and this was statistically significant (p<0.01). On linear regression analysis, age was the only statistically significant variable that had an un-standardized beta coefficient (B) of 0.207 for left atrial diameter, and -0.7 for left ventricular diameter.

Conclusion:Age was significantly correlated with left atrial and left ventricular diastolic diameters in patients with grade 1 diastolic dysfunction while sex was not statistically significant. On linear regression, age was the only significant factor in predicting left atrial and left ventricular diastolic diameters.

Key Words: Diastolic diameters,Mild Diastolic Dysfunction (Grade I),Atrium, Ventricle

Introduction

Left atrial and left ventricular sizes are correlated with age and sex in normal individuals with left atrial sizes being greater as age advances and are also greater in men as compared to women. The ventricular sizes remain mostly equal in both sexes and vary a little with age. Diastolic Dysfunction is a clinical term that describes impairment in filling of ventricles during the diastolic phase of the cardiac cycle.[1] This restrictive filling of the ventricles is similar, in symptoms, to systolic dysfunction. Dyspnea, fatigue, exercise intolerance and pulmonary edema are associated with diastolic dysfunction. [1,2] However, symptoms of low cardiac output like poor effort tolerance is commonly observed in systolic dysfunction. Diastolic dysfunction is regarded as a critical stage in the course of a cardiac disease and can further worsen to cause atrial fibrillation, heart failure and death just like in systolic dysfunction.[2] The underlying pathophysiology of diastolic dysfunction lies in the concentric remodeling of the left ventricle due to chronic hypertension, aortic stenosis, atherosclerosis or age.[2,3] Heart is hardened due to fibrous remodeling and does not relax during the diastolic phase for proper filling . Due to its slow progression, the effects are initially mild and asymptomatic, but it gradually causes a rise in filling pressures during diastole. Blood begins to dam up in left atrium which will increase left atrial diameter and pressures.[4] The left ventricles, due to their remodeling have a greater mass with less internal volume and diameters.[5]

Concentric remodeling of the ventricles occur due to chronic hypertension, atherosclerosis, diabetes and obesity, all of which are age dependent.[4,6] Diastolic dysfunction has been correlated with age, showing that people above 40 years of age are more prone to develop diastolic dysfunction of various grades. [7] Diastolic dysfunction is divided into four grades upon its intensity. The four grades are differentiated using echocardiography. Echocardiographic parameters like flow rates, mitral annulus velocity, deceleration time are utilized to grade diastolic dysfunction. An important parameter is a ratio between flow rates during "early" diastole (E) and flow rates during atrial contraction phase of diastole (A).[8,9]

Mild diastolic dysfunction or Grade 1 has an E/A ratio less than 0.8 with abnormal deceleration time (DT). [9] Grade 1 diastolic dysfunction is related with chronic hypertension and is quite common as age advances.[9] In grade 1 diastolic dysfunction, left atrial diameters are increased more than normal due to damming of blood and left ventricular diameters decrease due to concentric remodeling of ventricles[5]. No research has been reported that correlated age or sex directly with left atrial and left ventricular diameters in patients with grade 1 or mild diastolic dysfunction. However, atrial and ventricular sizes are correlated with age and sex in normal individuals with atrial sizes being greater as age advances and are also greater in men as compared to women.[10] The ventricular sizes remain mostly equally in both sexes and vary little with age.[1] Enlarged atrial sizes are a cause of concern due to atrial fibrillation and heart failure.[11] Patients with mild diastolic dysfunction vary in sex, ages and left atrial and left ventricular sizes. Atrial sizes which are normal for a particular age is abnormal for another age and hence could be a cause of concern in clinical practice.[11] This study aims to analyze the relationship between age, sex, left atrial and left ventricular diastolic diameters in patients with mild diastolic dysfunction.

Patients and Methods

A cross-sectional observational study was carried out on 434 patients over a period of two years from January 2014 to January 2016 at Cardiology department of Holy Family Hospital, Rawalpindi. These patients were diagnosed with mild or grade 1 diastolic dysfunction on Pulse Wave Doppler Echocardiography (E/A<0.8, abnormal DT). Patients with valvular abnormalities and pericarditis were not included in this study. Diastolic left atrial and ventricular sizes were determined on echocardiography as per guidelines.[12] Statistical analysis was performed using IBM Statistical Package for Social Sciences (SPSS) version 16. Independent t-test, correlation and linear regression were performed on the data. A p-value of less than 0.05 was considered as significant.

Results

Left atrial diameters were slightly greater in male patients having mild diastolic dysfunction; however this difference was not statistically significant (Table 1). Left ventricular sizes were almost same in both the sexes (Table 1).Sex was not having significant correlation with left atrial and left ventricular diameters .Age had a negative correlation with left ventricular diameter (Table 2).

Table1: Characteristics of Population

Variable	Males (n=217)	Females (n=217)	p-value
Age	49.35±21.13	46.21±18.24	0.098
LAD	35.63±10.38	34.84±9.39	0.408
LVIDD	42.96±4.70	42.28±4.82	0.13

LAD= Left atrial diameter, LVIDD left ventricular internal diastolic diameter. Values are represented as means±SD. Sizes are measured in millimeters

Table 2: . Correlations (r)

Variable	LAD	LVIDD
Sex	0.07(p=0.88)	0.074 (p=0.1)
Age	0.498 (p<0.01)	-0.289 (p<0.01)

LAD= Left atrial diameter, LVIDD left ventricular internal diastolic diameter

Table 3: Linear Regression Analysis

LAD				LVIDD			
Variable	B	95% CI	p-value	Variable	B	95% CI	p-value
Age	0.207	.16to .25	p<0.01	Age	-0.7	-.92 to-.48	p<0.01
Sex	0.137	-1.5 to 1.8	p=0.8	Sex	0.9	.04-1.7	p=0.04
r^2=0.17				r^2=0.08			

LAD= Left atrial diameter, LVIDD left ventricular internal diastolic diameter. Regression coefficient (B) shows the change in size with unit change in age

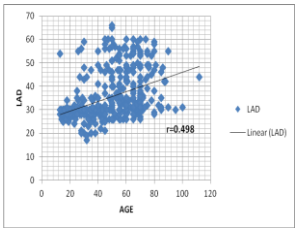

Figure 1: Graph showing increase in left atrial diastolic diameter (LAD) with age

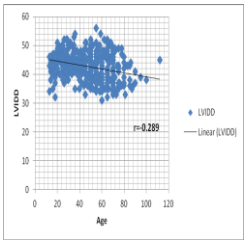

Figure 2 Graph showing decrease in Left ventricular internal Diastolic Diameter (LVIDD) with age

There was a direct relationship between left atrial diastolic diameter and age at r=0.498 (Figure 1). There was an shows an inverse relationship between left ventricular internal diastolic diameter and age at r=-0.289 (Figure 2).On linear regression analysis, age was the only statistically significant predictor with an un-standardized beta coefficient (B) of 0.207 for left atrial diameter, and -0.7 for left ventricular diameter (Table 3).

Discussion

Left atrial and left ventricular sizes are considered significant predictor of cardiac dysfunction and can

serve as a prognostic indicator in diastolic dysfunction.[13,14] However, atrial and ventricular sizes vary with age and sex.[10] It is therefore important to take into account age and sex related differences when left atrial size is evaluated in patients with diastolic dysfunction. No study has been reported that reflects these changes in left atrial and left ventricular sizes in patients with grade 1 diastolic dysfunction. In present study, no significant correlation was found upon correlating both sexes with left ventricular and left atrial diameters. This was also demonstrated by other researchers in normal healthy individuals.[15,16]

Age was significantly correlated with both left atrial and left ventricular diameters in our study. Moreover, it was also observed that advancement of age causes a rise in left atrial diameters while left ventricular diameters are decreased. Other researchers have also demonstrated the same results in normal individuals in their studies.[16,17] Effect of age on left atrial diameters can be explained by the restrictive filling patterns during diastole as the age advances. This restrictive filling is due to hardening of left ventricle which in turn is due to hypertension and atherosclerosis. Due to restrictive improper filling, blood dams up in left atrium and causes it to expand. Left ventricular hardening causes a decrease in its diameter whereas its mass increases.[18,19]

The results of present study were consistent with the other studies showing that rate of change in atrial and ventricular sizes with age advancement is more rapid in patients with grade 1 diastolic dysfunction than in normal individuals.[15,16,20] In left atrial diastolic diameters, the rate of change was found to be twenty times more in patients with mild diastolic dysfunction as compared to normal individuals.[20]

Left atrial enlargement is frequently associated with an increased risk of death, cardiovascular hospitalization and atrial fibrillation.[21] Left atrial diastolic size is a great prognostic tool in identifying the patients having higher risk of mortality secondary to congestive heart failure. It is a mirror that reflects the hemodynamic patterns in heart.[14] Diastolic dysfunction is a chronic condition coursing over many years. It is therefore essential in long term patient management to understand the left atrial changes in patients with diastolic dysfunction as it can provide early prognosis.

Conclusion

Age was significantly correlated with left atrial and left ventricular diastolic diameters in patients with grade 1 diastolic dysfunction while sex was not statistically significant. On linear regression, age was the only significant factor in predicting left atrial and left ventricular diastolic diameters.

References

1. Aziz F, Luqman-Arafath T, Enweluzo C. Diastolic Heart Failure : A Concise Review. J Clin Med Res. 2013;5(5):327–34.
2. Kitzman D, Little W, Brubaker P, Anderson R. Pathophysiological characterization of isolated diastolic heart failure in comparison to systolic heart failure. JAMA. 2002;288(17):2144–50.
3. Masugata H, Senda S, Inukai M, Murao K. Differences in left ventricular diastolic dysfunction between eccentric and concentric left ventricular hypertrophy in hypertensive patients.Function. J Int Med Res. 2011;39(3):772–79.
4. Gerdts E, Oikarinen L, Palmieri V, Otterstad JE. Correlates of left atrial size in hypertensive patients with left ventricular hypertrophy: the Losartan Intervention For Endpoint Reduction in Hypertension (LIFE) Study. Hypertension. 2002;39(3):739–43.
5. Adamu UG, Kolo PM, Katibi IA. Relationship between left ventricular diastolic function and geometric patterns in Nigerians with newly diagnosed systemic hypertension. Cardiovasc J Afr. 2009;20(3):173–77.
6. Gerdts E, Oikarinen L, Palmieri V. Correlates of left atrial size in hypertensive patients with left ventricular hypertrophy. Hypertension. 2002;39(3):739–43.
7. Vasan RS, Benjamin EJ, Levy D. Prevalence, clinical features and prognosis of diastolic heart failure: An epidemiologic perspective. J Am Coll Cardiol. 1995;26(7):1565–74.
8. Rakowski H, Appleton C, Chan KL, Dumesnil JG. Canadian consensus recommendations for the measurement and reporting of diastolic dysfunction by echocardiography: from the Investigators of Consensus on Diastolic Dysfunction by Echocardiography. J Am Soc Echocardiogr. 1996;9(5):736–60.
9. Nagueh SF, Appleton CP, Gillebert TC. Evaluation of left ventricular diastolic function.J Am Soc Echocardiogr. 2009;22(2):107–33.
10. Nikitin NP, Witte KKA, Thackray SDR. Effect of age and sex on left atrial morphology and function. Eur J Echocardiogr. 2003;4(1):36–42.
11. Patel DA, Lavie CJ, Milani R V, Shah S. Clinical Implications of Left Atrial Enlargement: A Review. Ochsner J. 2009;9(4):191–96.
12. Sahn DJ, DeMaria A, Kisslo J Quantitation in M-mode echocardiography: results of a survey of echocardiographic measurements. Circulation. 1978;58(6):1072–83.
13. Reed D, Abbott RD, Smucker ML, Kaul S. Prediction of outcome after mitral valve replacement in patients with symptomatic chronic mitral regurgitation. The importance of left atrial size. Circulation. 1991;84(1):23–34.
14. Modena MG, Muia N, Sgura FA, Molinari R. Left atrial size is the major predictor of cardiac death and overall clinical outcome in patients with dilated cardiomyopathy: a long-term follow-up study. Clin

Cardiol. 1997;20(6):553–60.
15. Stolzmann P, Scheffel H, Leschka S.Quantitative left ventricular and left atrial measurements in cardiac computed tomography. Eur Radiol. 2008;18:1625–34.
16. Funjan MM, Estephan MF, Al-hemiary KM. Effect of sex , age and anthropometric measurements on left ventricular mass index in a sample of Iraqi adults . J Fac Med Baghdad. 2011;53(3):327–32.
17. Zile MR and Lewinter MM. Left ventricular end-diastolic volume is normal in patients with heart failure and a normal ejection fraction.J Amercan Coll Cardiol. 2007;49(9):7–10.
18. Caruana L, Petrie MC, Davie AP, McMurray JJ V. Do patients with suspected heart failure and preserved left ventricular systolic function suffer from "diastolic heart failure" or from misdiagnosis? A prospective descriptive study. BMJ. 2000;321(7255):215–18.
19. Galderisi M. Diastolic dysfunction and diastolic heart failure: diagnostic, prognostic and therapeutic aspects. Cardiovasc Ultrasound. 2005;3:9.
20. Tedesco MA, Di Salvo G, Ratti G, Natale F, Iarussi D, Iacono A. Left atrial size in 164 hypertensive patients: an echocardiographic and ambulatory blood pressure study. Clin Cardiol. 2001;24(9):603–07.
21. Quinones MA, Greenberg BH, Kopelen HA. Echocardiographic predictors of clinical outcome in patients with left ventricular dysfunction enrolled in the SOLVD registry and trials. J Am Coll Cardiol. 2000;35(5):1237–44.