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Assessment and comparison of Left Ventricular diastolic function by Doppler modality (transmitral Doppler) with 2D echo (LA volume)

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Abstract

Aim: Assessment of left ventricular diastolic function by transmitral doppler and Left atrial volume estimation.

Materials and Method: This perspective cross sectional study was conducted at AVBRH, JNMC, Sawangi, Wardha, which is an 850 Bedded hospital with facilities for tertiary care. The study was carried out in 200 patients (100 cases and 100 controls) Study Group comprised of patients with risk factors like diabetes mellitus, hypertension and ischemic heart disease. Control group were devoid of any risk factors.

Results: In our study we found that mean e/a ratio in the study group was 0.93 ± 0.13 while that in the control group is 1.14 ± 0.11. The difference was statistically significant. (p = 0.0001), Mean e wave deceleration time (DT) in the study group was 150.26 ± 13.88 while that in the control group is 138.71± 13.79 and the difference between these two groups was statistically significant. (p = 0.000) , and Mean isovolumetric relaxation time (IVRT) in the study group was 95.44 ± 9.74 while that in the control group is 86.50 ± 8.90 and the difference between these two groups was statistically significant. (p = 0.000), Mean left atrial (LA) volume in the study group was 29.38 ± 2.34 while that in the control group was 26.01 ± 1.41 and the difference between these two groups was statistically significant.

Conclusion: The study of transmitral Doppler and 2 D echo variables revealed that, e/a ratio, e wave DT, IVRT, LA volume demonstrated significant change towards abnormal in subjects with presence of risk factors i.e. HT, DM, IHD either single or multiple. As regards the two modalities (Transmitral doppler and 2 D Echo) it was observed that both are equally effective in detecting LV diastolic function abnormalities.

Keywords: Isovolumetric relaxation time, Deceleration time, Left Ventricle, Diastolic function

Introduction

Left ventricular diastolic dysfunction (DD) is defined as the inability of the ventricle to fill to a normal end-diastolic volume, both during exercise as well as at rest, while left atrial pressure does not exceed 12 mm Hg.[1-3] Diastolic dysfunction refers to abnormal mechanical properties of the myocardium and includes abnormal LV diastolic distensibility, impaired filling, and slow or delayed relaxation.

The common causes of LV diastolic dysfunction are hypertrophy and ischemia, but several other conditions may cause heart failure in the presence of a normal LV ejection fraction (HFNEF). Patients with DD suffers from paroxysmal dyspnoea and "unexplained" pulmonary oedema with a normal ejection fraction.[4,5]

Thirty to fifty percent of patients hospitalized for heart failure present with diastolic dysfunction.[1,6-9] Assessment of left ventricular diastolic function is an essential component of the echocardiography examination in patients with dyspnoea or with the clinical syndrome of heart failure. Diastolic dysfunction with a preserved LV ejection fraction is seen in almost half of patients presenting with symptoms consistent with heart failure. These patients with primarily "diastolic heart failure" are often older and have co morbid conditions, such as hypertension, diabetes, or obesity. Others will have pericardial constriction or an underlying hypertrophic, restrictive or infiltrative cardiomyopathy.

There are four basic echocardiographic patterns of diastolic dysfunction. The mildest form (Grade I) is called an abnormal relaxation pattern. Grade II diastolic dysfunction (moderate) is called pseudonormal filling dynamics. There is considered moderate diastolic dysfunction and is associated with elevated left atrial filling pressures. Grade III and IV diastolic dysfunction are called restrictive filling dynamics. These are both severe forms of diastolic dysfunction and patients tend to have advanced heart failure symptoms.

The transmitral inflow Doppler velocities reflect the relationship between LA and LV pressures during diastole and provide the initial primary assessment of diastolic filling. The measurements are typically obtained using pulsed and continuous wave Doppler at the mitral valve leaflet tips in the apical four-chamber view. The peak velocities of the early rapid filling (E) wave, the late filling atrial contraction (A) wave, the E/A wave ratio, and the E-wave deceleration time (DT) determine the diastolic mitral filling pattern. Additional measurements include the A-wave duration and the isovolumic relaxation time (IVRT), which is obtained by simultaneous display of the end of aortic ejection and the onset of mitral inflow using continuous wave or pulsed wave Doppler interrogation through the LV outflow tract.[15]

Till date very few studies have compared Doppler modality (transmitral Doppler) and 2-d ECHO. Hence this study had been undertaken in order to assess and

compare the LV diastolic function by Doppler modality (transmitral Doppler) with 2-D ECHO (LA volume). An attempt was also made to assess their sensitivity in early prediction of LV diastolic function abnormalities in various age groups as well as in presence or absence of disease.

Material and Method

The study was conducted at Rural Medical College Hospital, Wardha which is a 1400 Bedded hospital with facilities for tertiary care after taking approval of institutional ethical committee.

This was a prospective cross sectional study with control group. The study was carried out in 200 subjects. (100 cases and 100 controls). Duration of the study was 2 years.

Detailed history was obtained and clinical examination was done. Past history of illness and risk factors like DM, HTN, IHD were noted. Treatment history was taken. Then the 2D echocardiography was done.

2D echo assessments

Normal pattern: In healthy, young, disease-free individuals the E-wave exceeds the A-wave, and therefore the E/A ratio is more than 1.

Impaired left ventricle relaxation pattern: Prolonged isovolumetric relaxation time (> 200 ms) and deceleration time (> 220 ms), decreased E-wave velocity and increased A wave, this produces an E/A ratio <1.

Pseudonormal left ventricular filling pattern: E /A ratio of 1-1.5 and a normal deceleration time (160-200 ms).

Restrictive left ventricle filling pattern: E/A ratio >2, shortened deceleration time (<160 ms) and isovolumetric relaxation time (<70 ms).

LA Volume: As per, observational studies LA volume index ≥ 34 mL/m^2 is an independent predictor of death, heart failure, atrial fibrillation, and ischemic stroke.[12]

Observation and Results

Table 1: Comparison of e/a ratio of study and control group

Group	N	Mean	Std. Deviation	Std. Error Mean
Control	100	1.14	0.11	0.01
Study	100	0.93	0.13	0.01
	P = 0.000, S			

Table 2: Comparison of e wave dt of study and control group

Descriptive Statistics

Group	N	Mean	Std. Deviation	Std. Error Mean
Control	100	138.71	13.79	1.37
Study	100	150.26	13.88	1.38
	P = 0.000, S			

The present study shows mean e wave dt of 100 patients of control group is 138.71 ± 13.79 and of study group mean e wave dt of 100 patients is 150.26 ± 13.88.This difference was found to be statistically significant.

Table 3: Comparison of IVRT of study and control group

Group	N	Mean	Std. Deviation	Std. Error Mean
Control	100	86.50	8.90	0.89
Study	100	95.44	9.74	0.97
	P =0.0000			

Table 4: Comparison of LA volume of study and control group

Group	N	Mean	Std. Deviation	Std. Error Mean
Control	100	26.01	1.41	0.14
Study	100	29.38	2.34	0.23
	P = 0.0000			

Table 5: Associated risk factors in study group

Risk Factors	No of patients	Percentage(%)
Diabetes Mellitus	20	20
Diabetes, Hypertension	6	6
Diabetes, Ischaemic heart disease	8	8
Diabetes, hypertension, ischaemic heart disease	3	3
Hypertension	39	39
Hypertension, ischaemic heart disease	11	11
Ischaemic heart disease	13	13
Total	100	100.00

Discussion

In our study we found that mean e/a ratio in the study group was 0.93 ± 0.13 while that in the control group is 1.14 ± 0.11. The difference was statistically significant. (p = 0.0001), signifying that Mean e/a ratio is significantly lesser in patients having risk factors as compared to patients having no risk factor, irrespective of age. In subgroup analysis difference of mean e/a between patients having risk factors as compared to patients having no risk factor in both < 40 yrs age group (0.93 ± 0.13 Vs 1.14 ± 0.11) and ≥ 40 years age group (0.94 ± 0.13 Vs 1.14 ± 0.11). (p = 0.001) was statistically significant.

In our study, Mean e wave DT in the study group was 150.26 ± 13.88 while that in the control group is 138.71± 13.79 and the difference between these two groups was statistically significant. (p = 0.000) signifying that Mean e wave DT is significantly higher in patients having risk factors as compared to patients having no risk factor, irrespective of age. In subgroup analysis difference of mean e wave dt between patients having risk factors as compared to patients having no risk factor in both < 40 yrs age group (150.76 ± 11.06 Vs 137.36 ± 13.09) and ≥ 40 years age group (149.76 ± 16.32 Vs 140.06 ± 14.45). (p = 0.002) was statistically significant.

The Mean IVRT in the study group was 95.44 ± 9.74 while that in the control group is 86.50 ± 8.90 and the difference between these two groups was statistically significant. (p = 0.000), signifying that Mean IVRT is significantly higher in patients having risk factors as compared to patients having no risk factor, irrespective of age. In subgroup analysis difference of mean IVRT between patients having risk factors as compared to patients having no risk factor in both < 40 yrs age group (94.92 ± 10.42 Vs 86.80 ± 8.31) and ≥ 40 years age group (95.96 ± 9.10 Vs 86.20 ± 9.53). (p = 0.001) was statistically significant.

The Mean LA volume in the study group was 29.38 ± 2.34 while that in the control group was 26.01 ± 1.41 and the difference between these two groups was statistically significant. (p = 0.000), signifying that LA volume is significantly higher in patients having risk factors as compared to patients having no risk factor, irrespective of age. In subgroup analysis Mean LA volume difference between patients having risk factors as compared to patients having no risk factor in both < 40 yrs age group (29.70 ± 2.69 Vs 26.06 ± 1.60) and ≥ 40 years age group (29.06 ± 1.89 Vs 25.96 ± 1.19). (p = 0.001) was statistically significant.

Without taking into consideration the effect of ageing on LV diastolic function, which is physiological, our study amply indicates that irrespective of age, the LV diastolic function parameters get affected by the presence of risk factors 39% of patients in the study group had hypertension, 20% has DM, 13% has IHD, 11% has HT + IHD, 8% has DM + IHD, 6% has DM + HT and 3% has DM + HT + IHD.

Conclusion

The study of transmitral Doppler and 2 D echo variables revealed that, all of them, namely e/a ratio, e wave dt, ivrt, la volume demonstrated significant change towards abnormal in subjects with presence of risk factors i.e. HT, DM, IHD either single or multiple. Therefore, aggressive stratification and treatment of risk factors would go a long way in prevention or amelioration of LV function in particular and cardiovascular morbidity in general. This appears to be the need of the hour. This would greatly reduce the health care burden. Further studies would be necessary to validate and throw more light on our study findings.

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