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Assessment of Diastolic Dysfunction in Patients with Atrial Fibrillation

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Abstract

Background: Atrial fibrillation (AF) is the most frequently encountered arrhythmia in clinical practice. Detection of concurrent diastolic dysfunction (DD) may be beneficial in patients with persistent AF. So the aim of the study was to evaluate the best echocardiographic parameter to assess diastolic function in patients with AF.

Patients and Methods: The study population consisted of 80 AF patients who were candidate for diagnostic coronary angiography or PCI. During the invasive procedure, the left ventricular end diastolic pressure (LVEDP) was measured then all patients underwent routine clinical and appropriate mitral flow and tissue Doppler velocities as well as standard echocardiographic measurements were obtained within 24 hours of the procedure.

Results: The patients were classified into 2 groups, group A included 40 patients with LVEDP <16mmHg and group B included 40 patients with LVEDP ≥16mmHg and found that E/e' average was the independent predictor of LVEDP>16 mmHg with OR 1.4 and p-value < 0.05.E/e' average sensitivity was 70%, specificity was 95%, AUORC was .88, Positive predictive value 93% and p value was <0.001.there was about 74% concordance between invasive and echocardiographic methods for E/e' average.

Conclusion: E/E' ratio is single best independent predictor of LVEDP with highest sensitivity and specificity when compared with other echocardiographic parameters.

Key words: ***Atrial Fibrillation , Diastolic Dysfunction***

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INTRODUCTION

Atrial fibrillation (AF) is an increasingly common heart rhythm disturbance that leads to frequent hospital admissions, heart failure, stroke, and higher mortality[1]. There is a close relationship between AF and heart failure, with numerous risk factors common to both conditions, and shared pathophysiology in patients with both reduce[2] and preserved[3] left ventricular ejection fraction (LVEF). Depending on the type of AF, the rate of prevalent heart failure is between 33% and 56%, hence clinicians treating patients with AF need reliable information on both systolic and diastolic left ventricular (LV) function [4].

Diastolic dysfunction shares many common risk factors with AF, including age, hypertension, obesity[5] and diabetes[6] Like AF, diastolic dysfunction increases with age[7].The loss of synchronized atrial contraction and altered left atrial pressure is likely to affect the reproducibility of echocardiographic measurements in AF. Factors that have been implicated include the ratio of proceeding to pre-preceding cycle length and heart rate during image acquisition.

PATIENTS AND METHODS

The study was designed as a prospective observational study. All the Participants were informed of its objectives before the study. The study

included 80 patients with permanent AF documented with 12 lead ECG with single lead rhythm strip who were candidate for diagnostic coronary angiography or PCI at National heart institute Hospital - Cairo – Egypt between May 2018 and April 2019. Patients with paroxysmal AF, significant valvular disease i.e. more than mild stenosis or reguge, prosthetic valve or mitral valve ring or poor echogenic window were excluded from the study.

During the diagnostic coronary angiography or PCI, LVEDP was measured. Within 24 hours, history taking with special emphasis on: Risk factors (Age, gender, diabetes, hypertension, smoking, dyslipidemia, family history).History of coronary artery syndromes (CAD), complete clinical examination and transthoracic echocardiography was performed .Recordings and calculations of different cardiac chambers and ejection fractions were made according to the recommendations of the American Society of Echocardiography[8]. Examination was performed with Philips IE33. Dedicated cardiac probe was positioned in standard parasternal and apical position and appropriate long and short axis parasternal as well as 4 and 2chambers apical views were obtained. Ejection fraction was calculated using modified Simpson method. Mitral flow velocity was measured with a pulse wave Doppler and sample volume positioned at the tip of mitral leaflets Peak early (E) transmittal flow velocities and deceleration time were obtained. Tissue Doppler measurements were recorded from apical 4 chamber view. Pulsed wave Doppler was measured with 5 mm sample volume positioned at junction of mitral annulus and adjacent septal and lateral myocardium. Myocardial early (E') diastolic velocities were measured and average (E/E') ratios were immediately calculated. Median of 5 consecutive complexes was calculated for all obtained measurements. Left atrial volume index (LAVI) was calculated using biplane area-length method from apical 4 and apical 2 chamber views[8]. Tricuspid regurge (TR) velocity was obtained from color guided CW Doppler from 4 chamber view.

Statistical analysis:

Data were analyzed using Statistical Program for Social Science (SPSS)

Version 25.0 for windows (SPSS Inc., Chicago, IL, USA), NCSS 12 for

Windows (NCSS LCC, Kaysville, UT, USA).

Quantitative data were expressed as mean ± standard deviation (SD).

Median and inter-quartile range (IQR) were also calculated for quantitative data. Qualitative data were expressed as frequency and percentage.

RESULTS

The patients were divided into two groups according to the LVEDP, Group A: 40 patients with LVEDP < 16 mmHg, This group included 40 patients, 22 patients were male (55%) while theremaining18 patients were female (45%) and Group B: 40 patients with LVEDP ≥ 16 mmHg, This group included 40 patients, 24 patients were male (60%) while the Remaining 16 patients were female (40%).

Baseline clinical characteristics: are presented in (Figure 1) showing no statistically significant differences between both groups regarding the baseline characteristics except the hypertension and ischemic heart disease(IHD) which had statistically significant differences between both groups. (P value= 0.025 and 0.036 respectively)

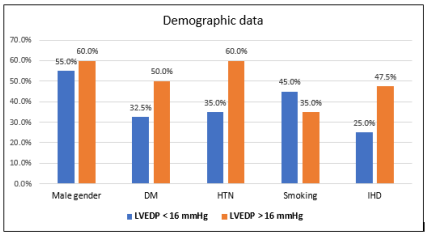

Fig. 1: Baseline clinical characteristics of both groups.

Echocardiographic data:

EF (%): The mean Ejection fraction values 61.0 ± 6.9% were higher in group A than group B 52.7 ± 7.7. There was statistically significant difference between the two groups with the P value < 0.05. MV deceleration time (m-sec): The MV deceleration time median range was111 (100 – 134) in group A, 111 (71 – 142) in group B. There was no statistically significant difference between the two groups with the P value >0.05. E/e' septal: it was 9.7 (7.6 – 10.8) in group A, versus 14.9 (11.7 – 22.5) in group B. There was statistically significant difference between the two groups with the P value < 0.05. E/e' lateral: its median range was 8.9 (6.9 – 10.5) in group A, versus 14.5(12.9 – 19.6) in group B. There was statistically significant difference between the two groups with the P value < 0.05. E/e' average: its median range was 9.4 (7.2 – 10.5) in group A, versus 14.9(12.0 – 21.8) in group B. There was statistically significant difference between the two groups with the P value < 0.05. LAVI (ml/m2): LAVI median range was 15.6 (13.3 – 18.9) in group A, versus23.4 (19.5 – 33.0) in group B. There was statistically significant difference between the two groups with the P value < 0.05. TR velocity (m/s): The TR velocity median range was 1.5 (1.2 – 2.1) in group A, versus 2.4 (1.9 – 3.0) in group B. There was statistically significant difference between the two groups with the P value < 0.05.

As presented in (Figure 2), E/e' average sensitivity was 70%, specificity was 95%, AUORC was .88,Positive predictive value 93% and p value was <0.001, EF sensitivity 65% and specificity 80%, LAVI sensitivity 20%and specificity 100%, TR velocity sensitivity 35% and specificity 80%.

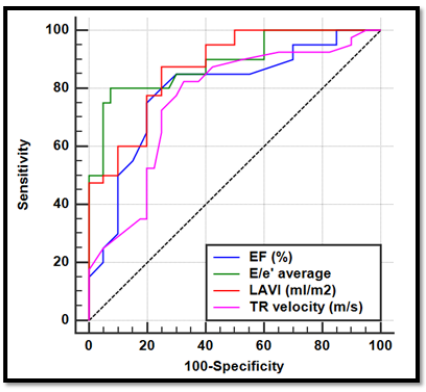

Fig. 2: The predictive performance of echo parameters for LVEDP>16 mmHg; ROC curve analysis

As presented in (Figure 3,4,5) There was about 74% concordance between invasive and echocardiographic methods for E/e' average, 47% concordance for LAVI and 47% concordance for TR velocity.

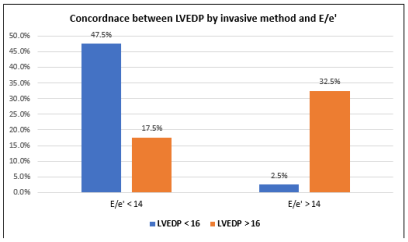

Fig. 3: Concordance between invasive LVEDP and E/e'.

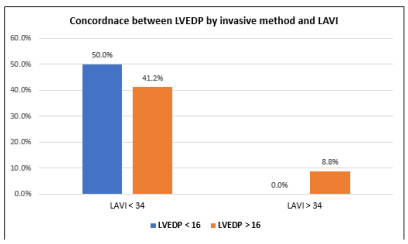

Fig. 4: Concordance between invasive LVEDP and LAVI.

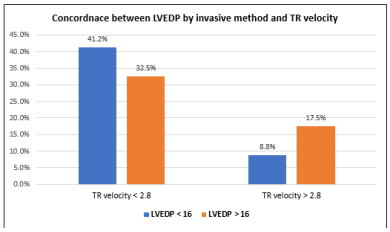

Fig. 5: Concordance between invasive LVEDP and TR velocity.

DISCUSSION

The results of this study showed that the mean Ejection fraction values were higher in group A more than group B. There was statistically significant difference between the two groups with the P value < 0.05. This was comparable with Kotecha, et al.,[9] study which reviewed 32 studies from 3066 search results (1968 patients with AF) with mean LVEF 53% (±10%) and found that reduced EF was associated with elevated filling pressure.

In our study, there was no statistically significant difference between the patients with LVEDP <16mmHg and patients with LVEDP ≥16mmHg regarding the MV deceleration time with the P value > 0.05. Similarly, study performed by Senechal, et al.,[10] who studied 42 consecutive patients with AF and found that DT average (124±27ms) did not correlate with PCWP with p-value 0.67.

In contrast, Traversi et al., [11].studied 51 patients with AF and heart failure to predict PCWP by Doppler echocardiography and found strong relation between MV deceleration time and elevated PCWP (r.75). This discrepancy in results may be due different type of patient in there study as they studied patients with heart failure.

In our study, the LAVI was statistically significant lower in patient with LVED < 16 mmHg than in patients with LVEDP≥16mmHg (P value < 0.05). This was in agreement with Naji, et al.,[12] who studied40 patients with persistent AF and found higher LAVI in AF group with p-value <0.001.

In our study there was statistically significant difference between the two groups with the P value < 0.05 according to average E/e'. This was in agreement with Wada, et al., [13] who studied 45 patients (30 men; mean age 69±9 years) with chronic AF for evaluation of LV filling pressure using E/e'in AF patients and found Significant relationships between PCWP and E/e' (r=0.57, P<0.001).

Also this was in agreement with Kusunose et al., [14] who studied 56 with chronic AF for evaluation the usefulness of the ratio of E/e' in AF patients and found that lateral E/e'correlated well with PCWP (r _ 0.74, p _ 0.001).

Also this was in agreement with Li et al.,[15] who studied 49 patients with non valvular AF and found that E/e' septal was 10±3.6 and E/e' lateral was 8.1±2.8 in group A vs. E/e' septal was 14.1±3.8 and E/e' lateral was 12±2.6 in group B with significant correlation between E/e' and LV filling pressure.

The cutoff value in our study for E/e' is > 14 and it has Positive Predictive Value= 93.3% and its Negative Predictive Value= 76% and the sensitivity to detect elevated LV filling pressure is 70% and specificity is 95%.

This was similar to Senechal, et al., [10] study who studied 42 patients with AF and determine the sensitivity of E/e' to detect elevated LV filling pressure to be 91% and specificity 85%.

Also this was in comparable with Kusunose et al.,[13] who studied 56 with chronic AF and determine the sensitivity of E/e' to detect elevated LV filling pressure to be 90% and specificity 90%.

Our results were different from Wada, et al., [12] who studied 45 patients with chronic AF for evaluation of LV filling pressure using E/e'in AF patients and determine the sensitivity of E/e' to detect elevated LV filling pressure to be 50% and specificity 90%. The low predictive values of this study may be due to smaller number of studied patients of Wada et al., [12] comparable of our study.

The cutoff value in our study for LAVI is > 34 ml/m2and it has Positive Predictive Value=100% and its Negative Predictive Value=55.6% and the sensitivity to detect elevated LV filling pressure is 20% and specificity is 100%.

This was in agreement with Anderson et al.,[16] who studied 450 patients and found that LAVI has Positive Predictive Value=91% and its Negative Predictive Value=83% and the sensitivity to detect elevated LV filling pressure is 84% and specificity is 88%.

The cutoff value in our study for TR velocity is>2.8 m/sand it has Positive Predictive Value=63.6% and its Negative Predictive Value=55.2% and the sensitivity to detect elevated LV filling pressure is 35% and specificity is 80%.

This was lower than Anderson et al., **[16]** who found that TR velocity is>2.8 m/s has Positive Predictive Value=91% and its Negative Predictive Value=83% and the sensitivity to detect elevated LV filling pressure is 84% and specificity is 88%. This difference in results may be due to their large number of patients comparing to relatively small number of patients in our study.

CONCLUSION

This study concludes that in patients with AF E/e' was the independent predictor of elevated LVEDP. There is high concordance between E/e' and LVEDP. Average E/e' had modest sensitivity and highest specificity in predicting elevated LVEDP and Diastolic dysfunction.Further larger studies are needed to confirm our finding in different racial groups and clinical subsets.

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