



2D ECHOCARDIOGRAPHIC ASSESSMENT OF LEFT ATRIAL DIMENSIONS AND LEFT VENTRICULAR FILLING PRESSURES IN PATIENTS DIAGNOSED WITH ATRIAL FIBRILLATION – AN OBSERVATIONAL STUDY

Cardiology

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ABSTRACT

Background: Atrial fibrillation (AF) is the most common sustained arrhythmia seen in clinical practice. AF prevalence increases with age and is often linked to underlying conditions such as hypertension, heart failure and valvular disease. 2D echocardiography (2D Echo) offers insights into atrial size, ventricular function, and structural abnormalities such as valvular disease and left heart dimensions. **Aim:** To analyze the echocardiographic assessment of left atrial dimensions and left ventricular filling pressure in patients diagnosed with atrial fibrillation. **Materials And Methods:** This is a descriptive observational study to analyze echocardiographic assessment of left atrial dimensions and left ventricular filling pressure in patients diagnosed with atrial fibrillation. The study was conducted in a tertiary care centre from June 2024 to December 2024. Over 7 months, 102 patients diagnosed with AF were analyzed. **Results:** The majority of patients diagnosed with AF were in the 61-80 age group, comprising 59 individuals (57.84%). Common observations include concentric left ventricular hypertrophy (LVH) and hypertension, which were observed in 43 and 76 patients respectively. Left atrial (LA) dimensions revealed an average size of 4.71 ± 0.15 cm in males and 4.36 ± 0.11 cm in females. Out of 102 patients, 70 (68%) patients were categorized as having moderate LAVI (left atrial volume index) and LA enlargement which included 28 males and 42 females. LAVI measured 45.035 ± 1.45 cm in males and 43.42 ± 0.91 cm in females. Filling pressure during atrial fibrillation measured by E/e' was found to be 13.84 ± 2.35 cm in males and 13.78 ± 2.28 cm in females. Additionally, PAH pressure was 45.8 ± 11.27 mmHg in males and 53.28 ± 15.20 mmHg in females. Among heart diseases, CAD was the most prevalent affecting 42 patients (41%). **Conclusion:** The 2D echocardiographic evaluation of atrial fibrillation (AF) patients is critical for therapeutic decision-making and prognosis. This study aimed to collect information on left atrial (LA) enlargement, left atrial volume index (LAVI), concentric left ventricular hypertrophy (LVH), pulmonary artery pressures and LV filling pressure in AF patients. Our study revealed AF patients had higher LA volume, LVH, higher PAH, and increased filling pressure consistent with existing literature.

KEYWORDS

Atrial fibrillation, Cardiac arrhythmia, Echocardiography, Transesophageal echocardiography (TEE)

INTRODUCTION

Atrial fibrillation (AF) is the most frequent heart rhythm abnormality encountered in clinical practice. Restoring sinus rhythm (SR) can alleviate symptoms and improve left ventricular (LV) function.¹ As a prevalent cardiac arrhythmia, AF represents any abnormality or disruption in the normal activation sequence of the heart muscle and can be classified based on several factors including rate, mechanism, duration and site of origin. The arrhythmia increases the risk of cardiovascular complications such as stroke, heart failure etc. potentially leading to deterioration or can even result in sudden cardiac arrest.²

AF is often associated with significant morbidity and mortality that poses a significant risk to patient health primarily due to its impact on the anatomy and physiology of the heart. It is essential to accurately assess the dimensions of the left atrium (LA) and the filling pressures of the left ventricle as these measurements provide vital insights into hemodynamics related to arrhythmias and aid clinical management. The prevalence of AF increases with age, affecting approximately 3.8% of individuals aged 60 and older and affecting nearly 9% of those over 80.³

2D echocardiography (Echo) is a non-invasive tool for examining heart anatomy, especially the left atrium (LA), which often undergoes structural changes like dilation in individuals with atrial fibrillation (AF). These changes linked to AF chronicity, increased stroke risk and prognosis can be assessed through LA dimension measurements. This information aids decisions on rhythm or rate control and anticoagulant therapy.

In cases of diastolic dysfunction, commonly seen in AF, 2D echo helps measure ventricular filling pressures, providing insight into LV relaxation and stiffness. Elevated filling pressures may worsen without atrial contraction in AF, and indicators like the E/A ratio, E/e' ratio, and pulmonary vein flow patterns assist in managing heart failure and treatment strategies.

Echocardiography is crucial for diagnosing and predicting outcomes in arrhythmia patients. Transthoracic echocardiography (TTE) is cost-effective and provides accurate assessments of myocardial, valvular, and congenital heart conditions. Transesophageal echocardiography (TEE) offers detailed imaging for intracardiac structures and stroke risk in AF patients. New techniques like myocardial deformation imaging further enhance diagnostic and prognostic capabilities.

The current study aims to investigate whether multiple echo cardiographic measures may be utilized to more accurately assess left ventricular (LV) filling pressure in patients with atrial fibrillation (AF). Individuals with AF often experience a lower quality of life and reduced physical activity which significantly impacts their overall well-being due to various anatomical, hemodynamic, and coagulation-related consequences⁴. According to the Framingham Heart Study, AF is associated with a nearly doubled risk of both overall and cardiovascular mortality.³

Methodology Study Design

This is a descriptive observational study to analyse 2D echo cardiographic characteristics of left atrial dimensions and left ventricular filling pressures in patients diagnosed with atrial fibrillation. The study was conducted in a tertiary care hospital situated in Bengaluru from June 2024 to December 2024.

Study Population

The study population included all in-patients and outpatients who were diagnosed with atrial fibrillation to evaluate the echocardiographic characteristics of left atrial dimensions and left ventricular filling pressures in these patients.

Inclusion Criteria:

- Patients aged >18 years or older.
- Newly diagnosed with atrial fibrillation (diagnosis made within the last 30 days).

- History of prior atrial fibrillation or atrial flutter.
- Undergoing echocardiography as part of routine clinical care.

Exclusion Criteria:

- Pregnant women
- Lactating women
- Extensively critically ill patients
- Inadequate echocardiographic images due to technical issues or poor acoustic windows.

Data Collection

Patient Enrollment

Eligible patients will be identified through the outpatient clinics and inpatient wards. Informed consent will be obtained from all participants prior to their inclusion in the study.

Clinical Data

Patient demographic information and medical history including age, gender, co-morbidities, and medication will be documented. Baseline laboratory tests and clinical assessments will also be recorded. The clinical data collected will encompass age, gender, BMI, hypertension, diabetes, dyslipidemia and smoking status as well as a medical history of coronary artery disease.

Echocardiographic Evaluation

A complete transthoracic echocardiographic evaluation was performed with a Philips EPIQ 7C Ultrasound Echocardiographic system (Royal Philips Electronics, Amsterdam, The Netherlands). Echocardiographic evaluations included M mode, 2D and Doppler evaluation performed according to current guidelines.

M-Mode Evaluation And 2D Evaluation

LA anterior-posterior and superior-inferior diameters were measured on the parasternal long-axis and apical 4-chamber views at end-systole, according to the American Society of Echocardiography (ASE) guidelines. The LA end-systolic volume (LAESV), and LA end-diastolic volume (LAEDV) were assessed by the Simpson's method from the apical 4- and 2-chamber views. The measurements of the LA dimensions and volumes were calculated by averaging data obtained in 10 consecutive beats.

Doppler Evaluation

Transmitral pulsed Doppler was recorded from the apical 4-chamber view with the sample volume between the mitral leaflets. Early diastolic flow velocity (E-wave) and E-wave deceleration time (DT) were measured. Pulsed tissue Doppler imaging (TDI) was performed at the mitral annulus, recording septal and lateral early diastolic velocities (e' wave) and calculating the E/e' ratio as an index of LV filling pressure. Cutoffs for increased LV filling pressures were ADT <150 ms, septal e' <8 cm/s, and septal E/e' ratio ≥11. Peak ejection velocity (lateral s' wave), pulmonary venous flow pattern, and pulmonary artery systolic pressure (sPAP) were also recorded. In TEE patients, LA appendage antegrade flow velocity was assessed.

RESULTS

Complete echocardiographic data was obtained for 102 patients of which 50 (49.01%) were males and 52 (50.98%) were females. The age distribution of patients diagnosed with atrial fibrillation (AF) was as follows: 5 patients (4.90%) were in the 18-40 age group, 15 patients (14.7%) were in the 41-60 age group range, 59 patients (57.84%) were in the 61-80 year range and 23 patients (22.54%) were in the age group above 80 as shown in Table (1).

LA dimension assessment by 2D echo indicated an average size of 4.71 ± 0.15 cm in male patients and 4.36 ± 0.11 cm in female patients reflecting a moderate degree of enlargement. The mean LA size is greater in females compared to males. Out of 102 patients, 70 (68%) patients were found to be in moderate LAVI and LA enlargement category of which 28 were males & 42 were females. Males had an LAVI index 45.035 ± 1.45 cm and in females 43.42 ± 0.91 cm as shown in Table(3). These figures not only highlight the differences between genders but also emphasize the significant role of LAVI in assessing cardiac health.

Out of a total of 102 patients, concentric left ventricular hypertrophy (LVH) was identified in 43 individuals. Among these patients, 28 (65.11%) were male and 15 (34.88%) were female. Additionally, 76 patients had a history of hypertension, consisting of 42 (55.26%) males and 34 (44.73%) females, as shown in Table (2). The average filling pressure during atrial fibrillation (AF) measured as E/e' was found to

be 13.84 ± 2.35 cm in males and 13.78 ± 2.28 cm in females. The pulmonary artery pressure was recorded at 45.8 ± 11.27 mmHg in males and 53.28 ± 15.20 mmHg in females as shown in Table (4). Among the patients studied, 42 (41%) had coronary artery disease (CAD), 9 (8%) had rheumatic heart disease (RHD), 8 (7%) had degenerative valvular heart disease (DVHD), 7 (6%) had cardiomyopathy, and 2 (1%) had congenital heart disease. Notably, 33 patients (32%) did not have any structural heart disease.

CONCLUSION

The 2D Echocardiographic assessment of AF patients is crucial for making therapeutic decisions and serves as a prognostic indicator. This study aimed to identify & compile data on the mean and standard deviation (SD) for left atrial (LA) enlargement & left atrial volume index (LAVI), as well as the presence of concentric left ventricular hypertrophy (LVH), pulmonary artery pressure and filling pressure in AF patients. We found that at the time of AF diagnosis, most patients exhibited high LA volume, LVH, elevated PAH and increased filling pressure. However, we need a larger dataset in the Indian population to enhance the power of this study and generate information that can be used for standardization & guideline development and implementation.

Tables

Table 1: Frequency And Percentage Distribution Of Various Age Groups And Genders Among Patients Diagnosed With Atrial Fibrillation As Per Demographic Details, N=102.

Demographic details	Criteria	Number of patients (f)	Percentage (%)
Gender	Male	50	49.01
	Female	52	50.98
Age (years)	18-40	5	4.90
	41-60	15	14.7
	61-80	59	57.84
	80 and above	23	22.54

Table 2: Frequency and Percentage Distribution of patients with Atrial Fibrillation and concentric LVH and hypertension:

Criteria	Total patients	Gender	No of patients (f)	Percentage (%)
Concentric LVH	43	Male	28	65.11
		Female	15	34.88
Hypertension	76	Male	42	55.26
		Female	34	44.73

Table 3: Left Atrial Volume Index (LAVI) and LA Enlargement distribution according to Mean & SD :

Criteria	No of patients (N)=102	Mild (MEAN±SD)	Moderate (MEAN±SD)	Severe (MEAN±SD)
LAVI				
	Male 50	21(37.95±1.28)	28(45.035±1.45)	1
	Female 52	7(38.71±1.38)	42(43.42±0.91)	3(47±1)
LA Enlarge ment				
	Male 50	21(4.23±0.26)	28(4.71±0.15)	1
	Female 52	7(3.91±0.24)	42(4.36±0.11)	3(5.16±0.45)

Table 4: Left Filing pressure & Pulmonary artery hypertension pressures distribution according to Mean & SD :

LV FILLING PRESSURE		MEAN±SD
E/A ratio		1.637±0.735
E/e'		
Male		13.84±2.35
Female		13.78±2.28
PASP (mmHg)		
Male		45.8±11.27
Female		53.28±15.2

REFERENCES

- Fornengo C, Antolini M, Frea S, et al. Prediction of atrial fibrillation recurrence after cardioversion in patients with left-atrial dilation. *Eur Heart J Cardiovasc Imaging*. 2015;16(3):335-341. doi:10.1093/ehjci/jeu193
- Papadopoulos CH, Oikonomidis D, Lazaris E, Nihoyannopoulos P. Echocardiography and cardiac arrhythmias. *Hell J Cardiol*. 2018;59(3):140-149. doi:10.1016/j.hjc.2017.11.017
- To ACY, Klein AL. Role of echocardiography in atrial fibrillation ablation. *J Atr Fibrillation*. 2011;2(8):51-61. doi:10.4250/jcu.2011.19.2.51
- Conen D. Epidemiology of atrial fibrillation. *Eur Heart J*. 2018;39(16):1323-1324. doi:10.1093/eurheartj/ehy171