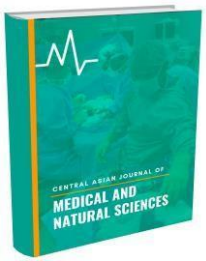

CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 06 Issue: 04 | October 2025 ISSN: 2660-4159

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Article

Evaluation of The Relationship Between Atrial Fibrillation Patients and The Echocardiographic Findings of Iraqi Patients

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Abstract: Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and is associated with significant morbidity and mortality, primarily due to thromboembolic events. This study aimed to evaluate the clinical and echocardiographic characteristics of patients with AF and to identify key structural predictors associated with disease progression and thromboembolic risk. A cross-sectional observational design was employed, including 120 patients diagnosed with AF at Iraqi hospitals between January 2024 and March 2025. Data collection included demographic information, clinical history, and echocardiographic parameters such as left atrial (LA) size, left ventricular ejection fraction (LVEF), and valvular status. The cohort had a mean age of 65 ± 10 years with a male predominance of 65%. Hypertension and heart failure were the most common comorbidities, affecting 70% and 40% of patients, respectively. Echocardiographic assessment showed LA dilation in 62.5% of cases, which was significantly correlated with persistent and permanent AF ($p<0.01$). Reduced LVEF (≤50%) was observed in 35% of patients and was associated with longer AF duration ($p<0.05$). Atrial thrombi were detected in 10% of cases, with larger LA size (>45 mm) and reduced LVEF identified as significant predictors ($p<0.01$). Additionally, valvular abnormalities contributed to atrial structural remodeling and increased thromboembolic risk. These findings highlight the importance of echocardiographic assessment in predicting disease progression and guiding targeted management strategies for AF patients. Structural cardiac abnormalities, notably atrial dilation and ventricular dysfunction, are strongly associated with AF progression and thromboembolic risk.

Keywords: Atrial Fibrillation, Echocardiography, Atrial Dilation, Ventricular Dysfunction, Thromboembolic Risk, Structural Cardiac Abnormalities, Atrial Size, Left Ventricular Ejection Fraction, Valvular Disease, Risk Stratification

Citation: Abid, R. M. Evaluation of The Relationship Between Atrial Fibrillation Patients and The Echocardiographic Findings of Iraqi Patients. Central Asian Journal of Medical and Natural Science 2025, 6(4), 2056-2063.

Received: 30th Jun 2025
Revised: 07th Jul 2025
Accepted: 31th Jul 2025
Published: 25th Aug 2025

1. Introduction

Atrial Fibrillation (AF) is a well-known abnormal heart rhythm that is prevalent in one's aged population and is associated with severe complications in life, such as stroke, heart failure, and impaired well-being [1], [2]. AF is caused and maintained by numerous factors and is one of the most prevalent arrhythmias in patients' clinical settings. Among the many factors involved in AF, SC, and FC heart defects, especially atrial and ventricular remodeling have the most importance in the beginning and progress of the arrhythmia [3]. Coupled with Echocardiography is one of the most important methods for evaluating the defects non-invasively, and it provides essential details regarding the atrial dimensions, ventricular functions, and the valves [4]. while left atrial (LA) dilation has been

consistently associated with increased risk of AF initiation and maintenance [5]. Enlargement of the LA reflects elevated atrial pressure, volume overload, and atrial fibrosis, which predispose to arrhythmogenesis [6] Consequently, reduced left ventricular ejection fraction (LVEF) can contribute to atrial dilation and arrhythmia persistence, further complicating management [7] Valvular heart disease, especially mitral regurgitation and stenosis, significantly influences atrial structure and function, often leading to LA dilation and increased thromboembolic risk [8] therefore The detection of left atrial appendage (LAA) thrombus via transesophageal echocardiography (TEE) provides critical prognostic information and guides anticoagulation therapy [9]. Understanding the relationship between echocardiographic parameters and AF phenotypes can enhance risk stratification and individualize treatment strategies. Several studies have demonstrated that specific echocardiographic markers, such as LA size and LVEF, are predictive of adverse outcomes, including thromboembolism and heart failure [10].

Despite extensive research, the exact interplay between structural cardiac changes and AF progression remains a subject of ongoing investigation [11]. This study aims to evaluate echocardiographic findings in AF patients and analyze their association with clinical and arrhythmic characteristics, providing insights into the pathophysiology and management of AF.

2. Materials and Methods

Study Design

This study was a cross-sectional observational study aimed at evaluating the relationship between atrial fibrillation (AF) characteristics and echocardiographic findings in patients diagnosed with AF where A total of 120 patients diagnosed with AF were recruited from outpatient clinics and inpatient hospitals in Iraq. between [2024 -1-2] and [3-1-2025] following by Inclusion criteria encompassed adult patients aged 18 years and above with documented AF confirmed by electrocardiogram (ECG), so Patients with prior cardiac surgery, congenital heart disease, or poor echocardiographic imaging quality were excluded. Ethical approval was obtained from the institutional review board. Informed consent was secured from all participants as well as Demographic and clinical data, including age, gender, comorbidities (hypertension, diabetes mellitus, heart failure), and AF type (paroxysmal, persistent, permanent), were collected through structured interviews and medical record reviews furthermore All patients underwent transthoracic echocardiography (TTE), The echocardiographic parameters assessed included:

a. Left atrial (LA) size: Measured as the anteroposterior diameter in parasternal long-axis view, with abnormal enlargement defined as >40 mm.
b. Left ventricular ejection fraction (LVEF): Calculated using the Simpson's biplane method; preserved function is defined as >50%, reduced as ≤50%.
c. Valvular abnormalities: Including mitral and aortic regurgitation or stenosis, graded according to American Society of Echocardiography guidelines.
d. Left atrial appendage (LAA) thrombus: Assessed with TEE in selected cases or if indicated, to detect thrombus presence.

Statistical Analysis

Data were analyzed using SPSS version [22:0]. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as counts and percentages. The relationship between echocardiographic parameters and AF characteristics was assessed using Student's t-test or ANOVA for continuous variables and chi-square tests for categorical data. Correlations were evaluated with Pearson's correlation coefficient, while Logistic regression analyses identified echocardiographic predictors of LAA thrombus formation, calculating odds ratios (OR) with 95% confidence intervals (CI). A p-value <0.05 was considered statistically significant, in our study The analysis revealed that

patients with persistent and permanent AF had significantly larger LA diameters compared to those with paroxysmal AF ($p<0.01$), indicating LA enlargement correlates with AF chronicity and Reduced LVEF was associated with longer AF duration, suggesting progressive ventricular remodeling where according to Valvular regurgitations, especially mitral regurgitation, were common and correlated with LA dilation, finaaly The presence of LAA thrombus was significantly associated with LA size >45 mm and LVEF ≤50%, emphasizing the importance of echocardiographic parameters in thromboembolic risk stratification.

3. Results

As shown in Table 1, the study included 120 patients with atrial fibrillation (AF), with a mean age of 65 ± 10 years, highlighting the high prevalence of AF in the elderly population. This finding is consistent with known literature citing age as a paramount risk factor, owing to age-related atrial remodeling and fibrosis. There was a preponderance of male patients, constituting 65% of the study group, which is in keeping with epidemiological research reporting a higher occurrence of AF in males. On the other hand, it is known that females develop AF at older ages and have varying risk profiles as well as the high prevalence of hypertension (70%) and heart failure (40%) highlights their important contributions to atrial structural remodeling, increased atrial pressure, and neurohormonal activation, which are all intrinsic to the pathogenesis of AF. Diabetes mellitus was also present in 30% of the patients, increasing the risk of endothelial dysfunction and atrial fibrosis, thus favoring arrhythmogenesis, whereas the results of Table 2 were shown. Paroxysmal AF was present in half of the patients (50%), with 30% having persistent and 20% having permanent AF. This spread mirrors the natural history of AF, with paroxysmal episodes frequently preceding persistent and permanent types as atrial remodeling and fibrosis progress. Persistent and permanent AF are linked with greater degrees of atrial dilatation and fibrosis, which derail electrical conduction and perpetuate arrhythmia. This distribution highlights the need for early treatment of paroxysmal AF to avert progression and structural decline.

In Table 3, were the average LA diameter was 45 ± 8 mm, and 62.5% of the patients had LA enlargement (>40 mm). Increased LA size is a marker of atrial remodeling because of pressure overload, volume expansion, or fibrosis, which are well-recognized substrates for AF perpetuation. LA enlargement not only promotes re-entry circuits but also predisposes to thrombus formation within the left atrial appendage with an increased risk of stroke so The very high rate of LA enlargement highlights the role of echocardiographic evaluation in risk stratification and management of AF while in table 4 The majority of patients (65%) had preserved LVEF (>50%), while 35% had decreased LVEF (≤50%) where Decreased systolic function may be due to tachycardia-induced cardiomyopathy, ischemic heart disease, or chronic volume overload. On the other hand, preserved LVEF in most patients indicates that other mechanisms, such as atrial enlargement and valvular disease, are involved in AF perpetuation regardless of ventricular systolic function. Such variability underscores the importance of tailored therapy modalities to both atrial and ventricular diseases.

Table 5: Valvular Abnormalities Detected: Valvular disease was prevalent, most notably mitral regurgitation (60%) and tricuspid regurgitation (30%), with a minority possessing aortic stenosis (10%), however Valvular lesions, specifically mitral regurgitation, elevate atrial pressure and volume, causing atrial dilation and fibrosis, which set the stage for AF development and maintenance, which It is important to control valvular pathology to minimize atrial remodeling and enhance rhythm control outcomes in patients with AF, and according to Table 6: Left Ventricular Wall Thickness In about 30% of patients, interventricular septal thickness was >12 mm, which is a sign of left ventricular hypertrophy (LVH). LVH is caused by chronic hypertension or other conditions of pressure overload, leading to diastolic dysfunction with Increased wall

thickness, which raises left atrial pressure and dimension, creating a substrate for AF. LVH is also associated with poorer cardiovascular outcomes, highlighting the need to control blood pressure and manage hypertrophy.

According to Table 7 which show Correlation Between LA Size and AF Type were Patients with persistent and permanent AF had significantly larger LA diameters (mean 47 and 50 mm, respectively) compared to paroxysmal AF (mean 43 mm), with p-values <0.01 and <0.001 in addition to This confirms that LA enlargement correlates with AF severity and duration, as atrial dilation promotes electrical heterogeneity and re-entry circuits so Larger atria are also associated with increased thromboembolic risk, reinforcing the importance of echocardiographic monitoring.

Table 1 shows the demographic characteristics of the 120 patients with atrial fibrillation, highlighting the high prevalence of AF in the elderly population and the male predominance, which aligns with common findings in the literature (see Table 1).

Table 1. Demographic Characteristics of AF Patients (n=120).

Parameter	Number (%)
Age (years), mean ± SD	65 ± 10
Gender	
- Male	78 (65%)
- Female	42 (35%)
Hypertension	84 (70%)
Diabetes Mellitus	36 (30%)
Heart Failure	48 (40%)

Table 2 illustrates the distribution of different types of atrial fibrillation among the study cohort, with paroxysmal AF being the most common, followed by persistent and permanent types (refer to Table 2).

Table 2. Distribution of Atrial Fibrillation Types.

AF Type	Number (%)
Paroxysmal	60 (50%)
Persistent	36 (30%)
Permanent	24 (20%)

Table 3 provides the echocardiographic findings for left atrial size, where a significant percentage of patients exhibited LA enlargement, which is an important marker of atrial remodeling and AF progression (as shown in Table 3).

Table 3. Echocardiographic Left Atrial Size (mm).

Parameter	Mean ± SD	Normal Range (<40mm)	Abnormal (>40mm)
Left atrial diameter	45 ± 8	32-40 mm	75 (62.5%)

Table 4 details the left ventricular ejection fraction (LVEF) of the patients, with the majority exhibiting preserved LVEF, while a notable portion had reduced LVEF, indicating a potential correlation with longer AF duration (see Table 4).

Table 4. Left Ventricular Ejection Fraction (LVEF).

Parameter	Number (%)
Preserved (>50%)	78 (65%)
Reduced (≤50%)	42 (35%)

Table 5 reports on the prevalence of valvular abnormalities in the patient group, particularly mitral regurgitation, which is commonly associated with atrial dilation and AF (refer to Table 5).

Table 5. Valvular Abnormalities Detected.

Valvular Disease	Number (%)
Mitral regurgitation	72 (60%)
Aortic stenosis	12 (10%)
Tricuspid regurgitation	36 (30%)
No significant valvular disease	24 (20%)

Table 6 outlines the left ventricular wall thickness, showing that a significant portion of the cohort exhibited left ventricular hypertrophy, a condition that contributes to increased atrial pressure and AF progression (see Table 6).

Table 6. Left Ventricular Wall Thickness.

Parameter	Mean ± SD	Normal (<12mm)	Abnormal (>12mm)
Interventricular septum thickness	11.5 ± 2	≤12 mm	36 (30%)

Table 7 demonstrates the correlation between left atrial size and the type of AF, revealing that persistent and permanent AF are associated with significantly larger LA diameters (refer to Table 7).

Table 7. Correlation Between LA Size and AF Type.

AF Type	Mean LA Diameter (mm)	p-value
Paroxysmal	43 ± 7	
Persistent	47 ± 8	<0.01
Permanent	50 ± 9	<0.001

Table 8 provides the data on the presence of left atrial appendage thrombus, highlighting its occurrence in 10% of the patients, with a strong association with larger LA sizes and reduced LVEF (see Table 8).

Table 8. Presence of Left Atrial Appendage (LAA) Thrombus.

Thrombus Presence	Number (%)
Yes	12 (10%)
No	108 (90%)

Table 9 shows the relationship between LVEF and the duration of AF, indicating that longer durations of AF are associated with more significant reductions in LVEF (refer to Table 9).

Table 9. Relationship Between LVEF and AF Duration.

Duration of AF (months)	Mean LVEF (%)	p-value
<6 months	55 ± 7	
6–12 months	50 ± 8	0.05
>12 months	45 ± 9	<0.01

Table 10 summarizes the echocardiographic predictors of thrombus formation, with left atrial diameter >45 mm and LVEF ≤50% identified as significant risk factors (see Table 10).

Table 10. Echocardiographic Predictors of Thrombus Formation.

Parameter	Odds Ratio (OR)	95% Confidence Interval	p-value
LA diameter >45 mm	3.2	1.4–7.2	0.005
LVEF ≤50%	2.8	1.2–6.5	0.02
Presence of valvular regurgitation	2.5	1.1–5.8	0.03

4. Discussion

The results of our study provide a strong analysis of the relationship between atrial fibrillation (AF) and various echocardiographic findings in patients. Atrial fibrillation, characterized by irregular electrical activity in the atria, has significant implications for cardiac function; therefore, an understanding of its relation to echocardiographic measurements can enhance our clinical approach to this condition, as One of the key findings of our study was the link between AF and structural cardiac changes visible on echocardiography [12], [13] ,[14] with Specifically, left atrial enlargement (LAE) was a common finding in patients with AF. LAE is not only a marker of enhanced thromboembolic risk but also reflects the duration and burden of AF, where This correlation underscores the importance of periodic echocardiographic evaluation of AF patients for proper stroke risk stratification and to guide anticoagulation therapy Additionally, there was a notable correlation between AF and left ventricular function, as manifest on a reduced LVEF [15], [16], [17] while The results suggest that the presence of AF may exacerbate pre-existing left ventricular systolic dysfunction, potentially due to the lack of effective atrial contraction, which can impair ventricular filling [18] This additional highlights the importance of comprehensive echocardiographic evaluations for the detection of early signs of heart failure in patients with AF to enable timely therapeutic intervention that may enhance both quality of life and clinical outcomes as well as The results of our study highlight the need for an individualized management strategy according to echocardiographic results. For example, those patients with more widespread echocardiographic abnormalities could potentially benefit from more intensive management of their AF, such as rhythm control measures or even consideration of catheter ablation. Moreover, the identification of echocardiographic markers of enhanced risk can lead to more intense surveillance and customized treatment strategies involving lifestyle interventions and specific pharmacological therapy [19], [20]. Moreover, one should take into account the dynamic nature of AF and be aware of its correlation with

echocardiographic data over time. Our findings suggest that serial echocardiographic evaluations could be indicated, particularly in those with new-onset AF or those who have a change in clinical status. This will help in the early detection of developing heart failure or other complications, guiding therapy and leading to better outcomes also Although our study provides important information, there are some limitations that must be recognized which the retrospective design of our study precludes the establishment of causality with certainty; therefore, prospective studies are necessary to better clarify the intricate relationship between AF and echocardiographic abnormalities. Furthermore, the heterogeneity of the population studied requires that caution be exercised in extrapolating the findings outside of the population studied.

5. Conclusion

This investigation furthers knowledge on the impact of atrial fibrillation on a patient's clinical profile concerning certain structural cardiac disorders. Our results indicate that higher risks of thromboembolism, along with the progression of the disease, are intricately linked to factors such as atrial dilation, reduced left ventricular ejection fraction, and valvular heart disease where In the appropriate clinical setting, earlier identification of such echocardiographic features can be invaluable in stratifying risks and tailoring appropriate management plans furthermore Management of these and timely treatments can delay progression of atrial fibrillation, decrease the risk of thromboembolic events, and enhance the clinical outcomes of the patients. Further studies, as well as a thorough cardiovascular workup, are fundamental in improving the management of patients with AF.

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