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Original Article

The Prevalence of Left Ventricular Hypertrophy in Patients with Atrial Fibrillation and Hypertension

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ABSTRACT

Background and objective: Left ventricular hypertrophy (LVH) is a common cardiac condition characterized by the thickening and enlargement of the left ventricle as the main pumping chamber of the heart. Atrial fibrillation (AF) is a prevalent arrhythmia with major risk factors such as becoming older, heart failure, left ventricular hypertrophy, coronary heart disease, and hypertension. This study aimed to measure the prevalence of Left Ventricular Hypertrophy (LVH) in patients with Atrial Fibrillation (AF) and hypertension.

Materials and Method: From September 1, 2018, to February 28, 2019, this cross-sectional study was carried out on a group of 100 patients who had both AF and hypertension. The study took place at multiple healthcare facilities in Sulaimani City, including the Cardiac Tertiary-Specialization Hospital, Shar Hospital, Emergency Unit, and Shahed Dr. Hemen Hospital. All of the patients had a thorough evaluation that included an echocardiogram, an ECG, a comprehensive physical examination, height, and weight. Data were analysed using SPSS with descriptive statistics, t-tests, Chi-square tests, and contingency tables.

Results: In 56% of AF patients, there was the evidence of left ventricular hypertrophy; of whom, 35.7% had mild, 35.7% had moderate, and 28.6% had severe disease. A strong and significant relationship was found between older age, ex-smoking, chronic atrial fibrillation, medication use, hypertension, and a longer duration of hypertension in AF patients with a high prevalence of left ventricular hypertrophy.

Conclusion: Left ventricular hypertrophy is frequently observed among patients with atrial fibrillation.

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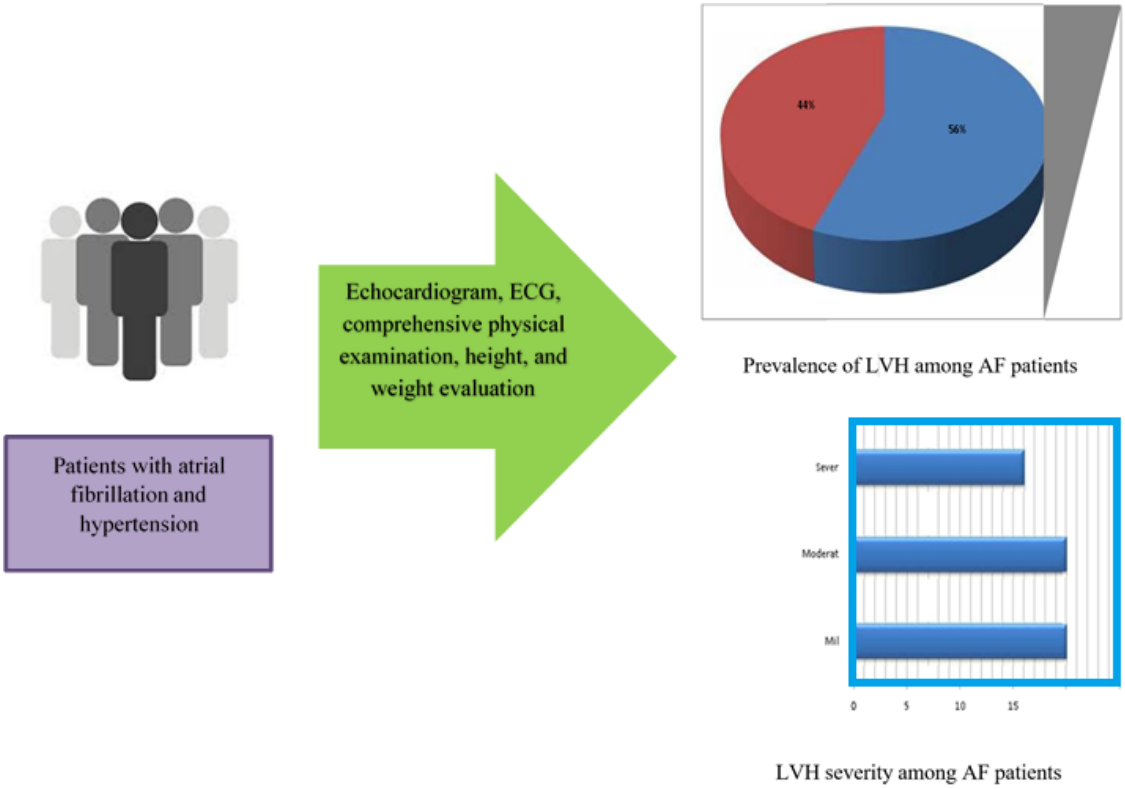
GRAPHICAL ABSTRACT



Introduction

A pathological condition known as left ventricular hypertrophy (LVH) is characterized by an increase in the left ventricular myocardium's thickness [1]. This problem is closely related to several heart diseases, including hypertension and atrial fibrillation (AF) [2]. AF is a cardiac rhythm disorder that is the most common form of supraventricular arrhythmia. It is characterized by an irregular and frequently fast heartbeat, and those who suffer from it may have a lower quality of life and a higher death rate [3, 4].

It is well-established that a significant risk factor for the onset of LVH and AF is hypertension, a major global health issue [5]. Millions of people worldwide suffer from the common cardiac arrhythmia known as atrial fibrillation, which has been related to a higher risk of mortality, heart failure, and stroke. The coexistence of these conditions can further exacerbate cardiovascular complications and worsen patient outcomes [6].

According to estimates, 33.5 million people worldwide suffer from AF [7]. while 1.28 billion persons between the ages of 30 and 79 suffer from hypertension, with two-thirds of those people living in low- and middle-income nations [8]. The prevalence of these diseases varies across different regions, with some areas having higher rates than others. In Iraq, the hypertension prevalence is estimated to be around 29.4%, while the AF prevalence is not well-documented [9].

Cellular, molecular, and structural changes in the myocardium are hallmarks of the complex disease known as LVH. Myocardial fibrosis, decreased diastolic function, and an increased risk of arrhythmias can all result from these alterations. The LVH existence in patients with AF and hypertension has important clinical ramifications since it is associated with an elevated risk of cardiovascular events such as heart failure, stroke, and sudden cardiac death [2].

The prevention of sudden cardiac death with implanted devices, medication, lifestyle modifications, and surgery are all part of the therapy for LVH [1]. Diagnostic options for LVH include electrocardiogram (ECG) and echocardiography [10].

Another diagnostic method that precisely determines the kind, amount, and severity of LVH is cardiac magnetic resonance (CMR) [11]. The treatment for LVH is determined by underlying etiology. Studies have indicated that drugs like ramipril can lead to the LVH regression or its prevention and lower the risk of cardiovascular events in situations when LVH is coupled with hypertension. Exercise and weight loss are advised as a part of the therapy strategy for obese people [1].

The findings of the study by Richard *et al.* (2011), showed that LVH increases the risk of atrial fibrillation, diastolic heart failure, systolic heart failure, and sudden death in patients with high blood pressure [12]. In addition, the findings of the study by Xiang *et al.* (2021) show that LVH is closely related to AF and negatively impacts the prognosis of AF patients [13].

Although the relationship between left ventricular enlargement, AF, and hypertension has been proven, there is little information about its prevalence in patients with hypertension and AF in Iraq. Estimating the prevalence of left ventricular enlargement in people with AF and hypertension will assist choose the best screening and treatment methods to enhance cardiovascular outcomes in this high-risk population. Therefore, this study aims to determine the LVH evaluation in patients with AF and hypertension in Sulaimani City, Iraq, and to identify associated demographic and clinical factors.

Materials and Methods

This study was a cross-sectional investigation carried out between September 1, 2018, and February 28, 2019, at Cardiac Tertiary-Specialization Hospital, Shar Hospital, Emergency Unit, and Shahed Dr. Hemen Hospital in Sulaimani City. All patients with AF who had been hospitalized at one of four hospitals in Sulaimani City and had high blood pressure made up the research population. This research required participants to meet specific criteria. They had to be a minimum of 18 years old, have had hypertension and atrial fibrillation, and provide verbal assent. Patients with various forms of atrial fibrillation, and people who could not give verbal consent were excluded from the study.

Furthermore, multiple measures were implemented in this study to ensure the accuracy and comprehensiveness of the collected data. First, the inclusion and exclusion criteria were carefully defined to ensure that only eligible individuals were included in the study. After that, a customized questionnaire was developed and utilized to standardize the data collection process. Trained research assistants administered the questionnaire, following a strict protocol to ensure consistency and reliability across all participants (α=0.8). To gather further information on the participants' health state, clinical examination, medical history, body mass index (BMI) calculation, ECG, and echocardiography were also performed on them. Through these objective metrics, self-report bias was reduced and the accuracy and dependability of the data were assured.

Participants underwent clinical examination, the type of medication used to control blood pressure, body mass index (BMI) calculation, ECG, and echocardiography. BMI was categorized as normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), or obese (≥30 kg/m^2) [14]. Smoking status was classified as a never, current, or former smoker.

Left ventricular mass index (LVMI-BSA) is an important parameter used in clinical practice to assess LVH. LVMI-BSA is calculated by dividing the left ventricular mass measured by echocardiography by the body surface area (BSA) of the patient. By indexing the left ventricular mass to body size, LVMI-BSA provides a more accurate assessment of LVH than simply measuring the absolute left ventricular mass [15, 16]. Interpretation of LVMI-BSA values depends on the patient's sex and age [17]. In this study, LVMI-BSA values greater than 95 g/m^2 for women and 115 g/m^2 for men were considered as the indicative of LVH [18]. Likewise, the LVH was determined as the voltage sum SV1+RV5 or RV6≥35 mm using Sokolow-Lyon voltage criteria [19]. Other data collected included the type of AF, medications, blood pressure, and duration of AF. The most prescribed drugs in the management of patients' blood pressure included:

hydrochlorothiazide, losartan, metoprolol, amlodipine, and captopril.

Ethical permission for the study was granted by the hospital authorities, and participants provided verbal informed consent before their enrolment. The study followed the guidelines set forth in the Helsinki Declaration. The participants were assured of the data confidentiality.

The Statistical Package for Social Sciences (SPSS) version 20 was used to enter the data, and descriptive statistics were shown as means, standard deviations, and frequencies as percentages. The proper statistical tests, such as the t-test for independent samples comparing two means and the Chi-square test for categorical variables, were run along with the usage of a number of contingency tables. Results were displayed as tables and/or graphs with a significance level (p-value) of ≤ 0.05. An expert in community medicine conducted the statistical analysis.

Results and Discussion

The study involved 100 patients diagnosed with AF, with a mean age of 63.8±15.5 years. The majority of patients (81%) were aged over 50. Among the AF patients, males accounted for 63% while females accounted for 37%. In terms of body mass index (BMI), 32% of AF patients had a normal BMI, 20% were overweight, and 48% were classified as obese. 30% of the patients with AF were current smokers, and 14% had previously smoked. 7% of patients with AF reported drinking alcohol (Table 1).

The mean duration of AF was11.1±10 months. Among the AF patients, 63% had paroxysmal AF, while 33% had chronic AF. Approximately 40% of AF patients were taking medications for AF management, including metoprolol, propranolol, aspirin, etc. Systolic hypertension (HT) was observed in 28% of AF patients, diastolic HT in 15% of AF patients, and both systolic and diastolic HT in 69% of AF patients. The mean duration of HT among AF patients was 48.3±33.6 months. Medications for HT such as Amilodipin, Captopril, Frusemide, etc. were taken by 69% of AF patients (Table 2).

LVH was seen in 56% of individuals with AF. Of them, 28.6% had severe LVH, 35.7% had mild LVH, and 35.7% had moderate LVH (Figures 1 and 2).

Table 1: Demographic characteristics of AF patients

Variable		No.	%
Age	Mean ± SD (63.8±15.5 years)		
	40 years old	6	6.0
	40-49 years old	13	13.0
	50-59 years old	13	13.0
	50-69 years old	24	24.0
	= 70 years old	44	44.0
sex			
	Male	63	63.0
	Female	37	37.0
BMI			
	Normal	32	32.0
	overweight	20	20.0
	Obese	48	48.0
smoking	No	56	56.0
	current	30	30.0
	Ex-smoker	14	14.0
	Total	100	100.0
	Alcohol consumption		
	yes	7	7.0
	No	93	93.0
Total		100	100.0

Table 2: Clinical features of AF patients

Variable	No.	%
Duration of AF mean ± SD (11.1±10 months)		
Paroxysmal		
Yes	63	63.0
No	37	37.0
Chronic		
Yes	33	33.0
No	67	67.0
Medication for AF		
No	60	60.0
Yes	40	40.0
Systolic HT		
Yes	28	28.0
No	72	72.0
Diastolic HT		
Yes	15	15.0
No	85	85.0
Both		
Yes	69	69.0
No	31	31.0
Duration of HT mean ± SD (48.3±33.6 months)		
Medication for HT		
No	31	31.0
Yes	69	69.0
Total	100	100.0

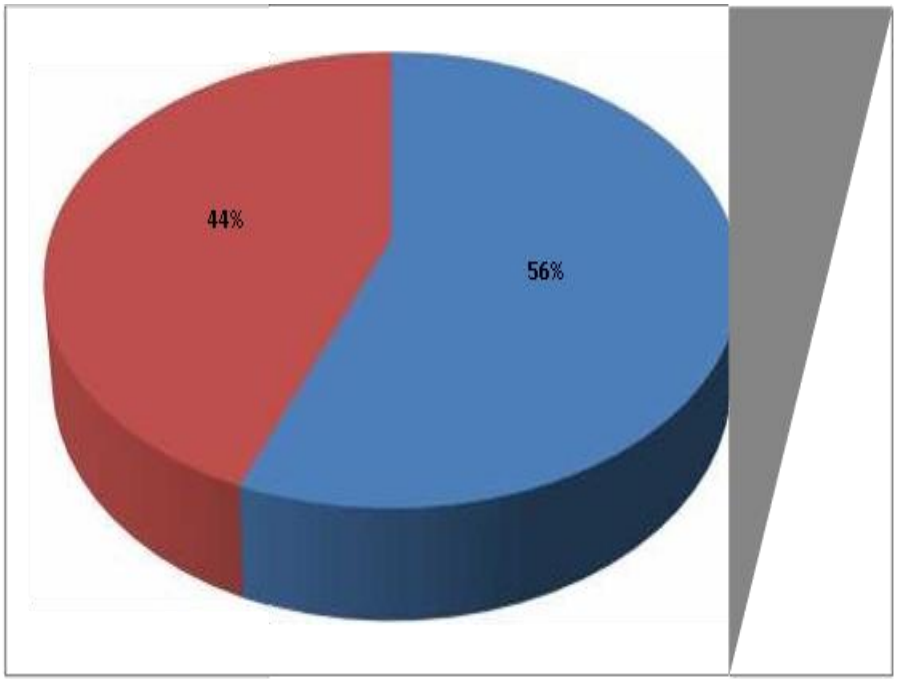


Figure 1: Frequency of LVH among AF patients

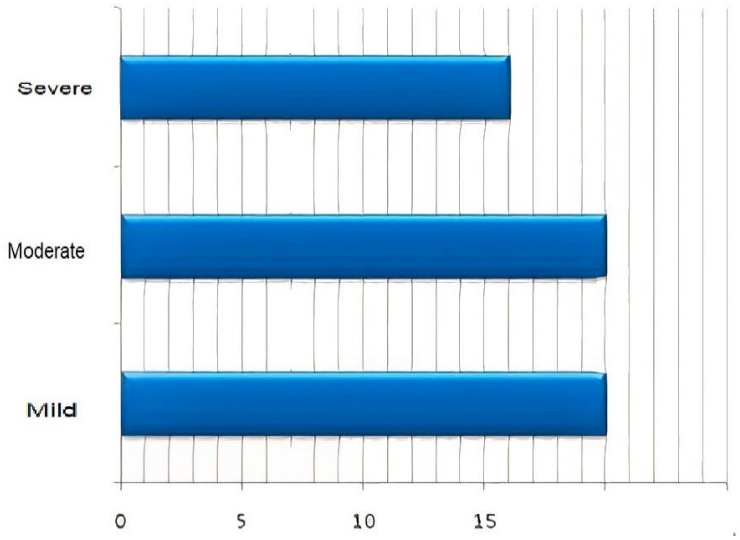


Figure 2: LVH severity among AF patients

Older AF patients and LVH were shown to have a substantial correlation (p=0.009). Regarding sex, there were no discernible differences between AF patients with LVH and those without LVH (p=0.07). There was a substantial link between LVH and AF patients who had quit smoking (p=0.02). Regarding alcohol use, there were no significant differences between AF patients with LVH and those without LVH (p=0.1). Similarly, there were no discernible differences in BMI between AF patients with LVH and those without LVH (p=0.2) (Table 3).

In terms of paroxysmal AF (p=0.07) and duration of AF (p=0.8), there were no discernible differences between AF patients with LVH and those without LVH. The mean duration of AF for patients with LVH was 12.5 months (±10.1), while it was 11.1 months (±10.3) for patients without LVH. The significant relationship was found between chronic AF and the presence of LVH (p=0.05). Furthermore, there was a significant relationship between the use of medications for AF and the LVH occurrence (p=0.002) (Table 4).

The mean duration of HT for patients with LVH was 65.7 months (±58.5), while it was 26 months (±36.2) for patients without LVH. Between AF patients with LVH and those without LVH, there were no appreciable variations in systolic HT (p=0.2) and diastolic HT (p=0.8). However, a substantial correlation between the existence of systolic and diastolic HT and LVH was found (p=0.001). The mean duration of HT was significantly longer for AF patients with LVH (p<0.001). In addition, a substantial link between using HT medication and developing LVH was seen. (p=0.006) (Table 5).

Cardiac arrhythmias are commonly related to LVH and this relationship is directly dependent on the effect of systemic hypertension on both AF and LVH. Hypertrophy of the heart muscle in hypertension individuals is defined not only by a rise in myocardial mass, but also by fibrous tissue growth and a reduction in intercellular coupling. These changes can result in the development of different arrhythmias [20, 21].

The present study revealed a significant prevalence of LVH among patients diagnosed with AF, with a rate of 56%. This finding closely aligns with the LVH prevalence of 52% reported in a previous study conducted by Proietti *et al.*, in Italy, which specifically examined LVH among patients with AF [22].

Despite the high prevalence observed in the present study, it is important to note that previous clinical studies have reported a wide range of LVH prevalence in AF, ranging from 23% to 68%. This variability could be attributed to the heterogeneity of the enrolled patients or variations in the methods used to evaluate LVH [13, 23].

Table 3: Distribution of demographic characteristics according to LVH

Variable	LVH	No LVH	P-value
	No.%	No.%	
Age			
<40 years old	1 (1.8%)	5 (11.4%)	0.009*S
40-49 years old	3 (5.4%)	10 (22.7%)	
50-59 years old	8 (14.3%)	5 (11.4%)	
60-69 years old	13 (23.2%)	11 (25.0%)	
≥70 years old	31 (55.4%	13 (29.5%)	
Sex			
Male	31 (55.4%)	32 (72.7%)	0.07** NS
Female	25 (44.6%)	12 27.3%)	
Smoking			
No	33 (58.9%)	23 (52.3%)	0.04*S
Current	12 (21.4%)	18 (40.9%)	
Ex-smoker	11(19.6%)	3 (6.8%)	
Alcohol consumption			
Yes	2 (3.6%)	5 (11.4%)	0.1** NS
No	54 (96.4%)	39 (88.6%)	
BMI			
Normal	19 (33.9%)	13 (29.5%)	0.2*NS
Overweight	8 (143%)	12 (27.3%)	
Obese	29 (51.8%)	19 (43.2%)	

* Fishers exact test, **Chi-square test, NS=Not significant, and S=Significant.

Table 4: Distribution of AF features based on LVH

Variable		LVH	NoLVH	P-value
		No. %	No. %	
Paroxysmal				
	Yes	31 (55.4%)	32 (72.7%)	
	No	25 (44.6%)	12 (27.3%)	
Chronic				
	yes	33 (41.1%)	10 (22.7%)	
	no	33 (58.9%)	34 (77.3%)	
Duration of AF				
Mean ± SD (month)		12.5±10.1	11.1±10.3	
medication				
	No	26 (46.6%)	34 (77.3%)	
	yes	30 (53.6%)	10 (22.7%)	

Table 5: Distribution of hypertension features according to LVH

Variable	LVH	No LVH	P-value
	No. %	No. %	
Systolic HT			0.2*NS
Ye	13 (23.2%)	15 (34.1%	
No	43 (76.8%)	29 (65.9%)	
Diastolic HT			0.8*NS
Yes	8 (14.3%)	7 (15.9%)	
No	48 (85.7%	37 (84.1%)	
Both			0.001*S
Yes	46 (82.1%)	23 (52.3%)	
No	10 (17.9%)	21 (47.7%)	
Duration of HT			0.001**S
Mean ± SD (months)	65.7±58.5	26±36.2	
Medication for HT			0.006*S
No	11 (19.6%)	20 (45.5%)	
Yes	45 (80.4%)	24 (54.5%)	

*Chi-square test, **Independent sample t-test, NS=Not significant, and S=Significant.

On the other hand, a study conducted by Chatterjee *et al.*, in the USA revealed that the LVH presence in hypertensive patients is linked to an increased risk of sustained supraventricular/atrial and ventricular arrhythmias [24].

This suggests the importance of identifying and improving risk stratification methods for this particular group of patients, highlighting an existing need in the field.

Patel *et al.* observed that the relationship between ECG-LVH (left ventricular hypertrophy measured by electrocardiography) and AF is not reliant on left ventricular mass estimation using echocardiography. Accordingly, AF can be predicted specifically by anomalies in cardiac electrophysiology [25].

It is still unclear what exact process is causing AF to be more prevalent.However, it is recognized that age, cardiac dysfunction, or increasing cardiac workload can lead to cardiac remodelling, which is defined by changes in heart size, shape, and function.

Increased end-diastolic pressure, an increase in end-diastolic volume, and diastolic and systolic dysfunction are all effects of cardiac remodelling [26, 27, 28].

The study which was conducted by Li *et al.* in China revealed that LVH severity is related to AF, and about 30% of patients with AF are diagnosed with severe LVH. This finding is consistent with the results of the present study [29].

According to a post-hoc analysis from the AF Following up Investigation of Rhythm Management (AFFIRM) study, LVH measured by left ventricular mass (LVM) was a reliable predictor of stroke and all-cause death in AF patients [30].

In hypertensive individuals, LVH is a maladaptive reaction to chronic pressure overload and a significant risk factor for atrial fibrillation, diastolic heart failure, systolic heart failure, and sudden death. The Framingham heart study found that even borderline isolated systolic hypertension in older individuals was linked to thicker left ventricular walls and worsened diastolic filling [31].

Georgakiset *et al.* reported that age significantly affects the clinical manifestations and complications of patients with atrial fibrillation, and there is a significant association between AF patients, older age, and LVH. These results are consistent with the findings of our study [32].

The estimated prevalence of AF in the general population is 0.4% to 1%, increasing with advancing age [33, 34].

It has been established that approximately one-third of AF patients are aged 80 or older, and it is predicted that by 2050, this age group will account for half of AF patients [35, 36].

It is now known that LVH in women is a substantial cardiovascular risk factor that is independent of blood pressure, despite the fact that no significant connection between sex and

LVH was found in the current study among patients with AF; several studies have suggested that women with LVH are more likely to experience AF and sudden death. In addition, a prominent cause of congestive heart failure in women is hypertensive heart disease [31].

The findings of the study by Hahad *et al.* are consistent with the present study, which indicated that LVH was independently linked with older age, male sex, smoking, diabetes, poor blood pressure control, and a history of cardiovascular or renal illness [37].

In contrast to the findings of the present study, the findings of Larstorp *et al.*'s research in Norway, which revealed that smoking had no influence on the risk of AF development among hypertensive patients with LVH [38].

The relationship between BMI and LVH has been examined in several studies. According to the research by Wu *et al.* on people with hypertension, BMI was an independent influencing factor for LVH. According to the study, the three main risk factors for LVH are BMI, systolic blood pressure (SBP), and haemoglobin concentration. When SBP or BMI surpassed 160 mmHg or 30 kg/m^2, the chances for LVH increased [39].

These findings are not in accordance with the findings of the present study. The reason for this contradiction in the findings can be due to the type of study, the length of follow-up period and the number of participants, which requires longitudinal research with a larger sample size. In another study, patients with left ventricular hypertrophy (LVH) presenting with dyspnea were the subject of a research by Aggul *et al.* In this study, the association between patient diagnosis (with or without pulmonary edema) and demographic and echocardiographic characteristics was examined. The results of the study, which are congruent with the current investigation, showed that BMI was not substantially correlated with LVH [40].

Aronow *et al.* did a study on 312 older adults who had chronic atrial fibrillation (AF). The results of the study were quite concerning as they revealed that the combination of left ventricular hypertrophy (LVH) and high blood pressure posed a significant risk for thromboembolic stroke, which is a type of stroke caused by a blood clot.

The study followed up on these individuals for 36 months and found that the risk ratio for thromboembolic stroke was 3.2, which highlights the importance of regular check-ups and early intervention to manage hypertension and LVH in older adults with AF.

These findings are consistent with the findings of the present study [2].

Furthermore, the current study revealed a substantial link between LVH and AF medication use. Chung *et al.* conducted a study on patients with both persistent AF and LVH. Their findings suggest that patients who take non-amiodarone antiarrhythmic drugs do not experience higher mortality rates compared to those who take amiodarone. This discovery is significant because it challenges the belief that amiodarone is always the better treatment option for LVH patients [41].

It is worth noting that hypertension and LVH are both risk factors for developing AF, which makes it even more crucial to manage these conditions effectively [42, 43].

Antiarrhythmic medication safety and AF therapeutic treatment in patients with LVH are not well understood [44].

Amiodarone is the sole medication specified in an algorithm of pharmacological therapy for people with LVH and AF, according to current guidelines for the management of the condition [45]. Although there is not much clinical evidence to back up these suggestions, research by Boriani *et al.* that looked at the safety and effectiveness of dronedarone in AF patients revealed that it might be used as an alternate medication [46].

The present study findings align with the results of a study conducted by Seko *et al.* (2018) in Japan, that highlighted that hypertensive patients have an elevated risk of developing both LVH and AF [47].

In addition, Sayin and Oto, have reported that antihypertensive treatment leading to the regression of LVH not only improves diastolic dysfunction, but also reduces the risk of mortality associated with AF [1].

The present study investigation shows that for AF patients with LVH, the mean HT duration was considerably longer. These findings are in line

with the study by Sharashova *et al.* which showed that long-term hypertension increased the risk of LVH and AF [48].

In contrast to these findings, the European Heart Survey conducted by Erküner *et al.* (2018) revealed that systemic hypertension was associated with an increased risk of developing AF in males [49].

Moreover, the present study showed a significant association between HT medication and LVH. This finding is similar to results of the Lønnebakken *et al.* study in Italy found that LVH prevention among HT patients requires strict control of HT and early initiation of antihypertensive treatment in addition to control other risks like metabolic factors [50].

It is crucial to note that this study had a number of limitations, including limited sample size, being carried out at a single centre, and the potential for selection bias.

Conclusion

The study found a high incidence of left ventricular hypertrophy (LVH) among patients with atrial fibrillation (AF), with the most severe cases observed in AF patients. Furthermore, the results identified various risk factors associated with LVH in patients with AF, such as older age, former smoking, chronic atrial fibrillation, antiarrhythmic drugs, hypertension, duration of hypertension, and antihypertensive medications. These results highlight the significance of tailored therapy for patients with AF, taking into consideration each patient's specific risk factors and creating personalized treatment programs.

According to the findings, there are some advices as follow:

(1) The LVH evaluation in patients with AF is beneficial for predicting mortality and assessing overall risk.

(2) Encouraging physicians to assess LVH or AF among hypertensive patients especially those with long duration of hypertension.

(3) Patients with risk factors of LVH require regular monitoring.

(4) Further large-sized multi-canter studies on the LVH prevalence in patients with AF should be supported.

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No potential conflict of interest was reported by the authors.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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