

ATRIAL FIBRILLATION FOLLOWING MITRAL VALVE REPLACEMENT FOR MITRAL STENOSIS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Atrial fibrillation (AF) is a frequent and serious postoperative complication in patients undergoing mitral valve replacement (MVR), especially in those with underlying mitral stenosis (MS). Postoperative AF increases the risk of morbidity, prolongs hospital stays, and is associated with elevated mortality. Early identification of risk factors is crucial for optimizing patient outcomes. **Objective:** To assess the incidence of postoperative atrial fibrillation in patients undergoing MVR for mitral stenosis and evaluate its association with clinical characteristics and outcomes. **Study Design:** Observational study. **Setting:** Cardiac Surgery Department of National Institute of Cardiovascular Diseases, Karachi, Pakistan. **Duration of Study:** January 2024 to January 2025. **Methods:** A total of 60 patients aged 18–70 years undergoing mitral valve replacement (MVR) for moderate to severe mitral stenosis were enrolled. Postoperative atrial fibrillation (AF) was identified through continuous electrocardiogram (ECG) monitoring during hospitalization. Data were collected on age, sex, comorbidities (diabetes mellitus and hypertension), prior mitral valve replacement (MVR), left atrial diameter, and left ventricular ejection fraction (LVEF). Postoperative outcomes included length of hospital stay, renal failure, and mortality. Statistical analysis was performed using chi-square and independent t-tests. A p-value < 0.05 was considered statistically significant. **Results:** Postoperative AF developed in 10 out of 60 patients (16.7%). Patients who developed AF were more likely to be over 50 years of age (90% vs. 48%, $p = 0.01$), have diabetes (80% vs. 18%, $p < 0.0001$), hypertension (80% vs. 22%, $p < 0.0001$), and a history of prior MVR (50% vs. 12%, $p = 0.005$). Left atrial enlargement (≥ 40 mm) and reduced LVEF ($< 50\%$) were significantly more common in the AF group (80% vs. 30%, $p = 0.003$; and 90% vs. 28%, $p < 0.0001$, respectively). Postoperative AF was significantly associated with extended hospital stay (> 7 days: 80% vs. 22%, $p < 0.0001$), and increased mortality (70% vs. 2%, $p < 0.0001$). **Conclusion:** Postoperative atrial fibrillation is a common complication following MVR for mitral stenosis, with an incidence of 16.7%. It is significantly associated with advanced age, diabetes, hypertension, prior valve surgery, left atrial enlargement, and reduced LVEF. Its occurrence leads to worse clinical outcomes hospital stays and higher mortality. These findings underscore the need for careful preoperative risk assessment and targeted perioperative management strategies to mitigate the incidence and impact of postoperative AF.

Keywords: Atrial Fibrillation, Mitral Valve Replacement, Mitral Stenosis, Postoperative Complications, Risk Factors, Cardiac Surgery

INTRODUCTION

Mitral stenosis (MS) is a valvular heart condition described by mitral valve orifice narrowing (1). Despite advancements in contemporary medicine, rheumatic heart disease continues to be the most common cause of mitral stenosis, particularly in low- to middle-income nations (2). Rheumatic mitral stenosis typically develops in individuals aged 20 to 40 years, usually occurring approximately 10-15 years after the initial onset of rheumatic fever. MS resulting from rheumatic heart disease mainly occurs in the immigrant population and individuals with restricted access to healthcare services (3). Calcific degenerative mitral valve stenosis disease represents a less prevalent etiology of mitral stenosis, predominantly observed in the elderly population. Those diagnosed with symptomatic mitral stenosis usually show signs of heart failure, atrial fibrillation (AF), as well as thromboembolic events. Factors that contribute to the development of mitral stenosis encompass a prior occurrence of rheumatic fever as well as an untreated streptococcus infection (4-6).

AF represents the most widespread form of cardiac arrhythmia. The condition is caused by irregular electrical activity in the heart's atria, leading to fibrillation. This condition is defined as a tachyarrhythmia, suggesting that the heart rate is frequently elevated (7). This arrhythmia can be categorized as paroxysmal, lasting less than seven days, or persistent, extending beyond seven days. The irregular rhythm of the heart results in turbulent blood flow, significantly

increasing the risk of thrombus formation, which may dislodge and result in a stroke. AF represents the most common cardiac etiology for stroke occurrence. Factors that contribute to the development of atrial fibrillation encompass advanced age, hypertension, pre-existing cardiac as well as pulmonary conditions, congenital heart anomalies, and elevated alcohol intake. Symptoms can range from being completely asymptomatic to presenting with various manifestations, including chest pain, palpitations, increased heart rate, nausea, shortness of breath, excessive sweating, as well as overall fatigue. AF, while potentially a chronic condition, has prompted the development of various treatment options and risk modification strategies aimed at reducing stroke risk in patients who continue to experience this arrhythmia (7-9).

Inflammation is a critical factor in the complicated pathogenesis influenced by surgical trauma, extended cardiopulmonary bypass, as well as ischaemia/reperfusion injury. Pericardial disruption leads to an elevated generation of pericardial fluid accompanied by localized inflammation. Inflammation of the pericardium results to the apoptosis of cardiac myocytes, which subsequently modifies electrical activity and contributes to the occurrence of arrhythmias. Electrolyte abnormalities, such as hypomagnesaemia as well as hypokalaemia, are associated with a higher likelihood of postoperative atrial fibrillation (10-13). AF is a common and significant complication following mitral valve replacement for mitral stenosis, leading to increased morbidity and mortality. The study has the potential to provide

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important insights into the optimization of post-operative care, improve patient outcomes, and inform clinical decision-making in the management of atrial fibrillation following mitral valve replacement.

METHODOLOGY

This observational study was conducted at Cardiac Surgery Department of National Institute of Cardiovascular Diseases, Karachi, Pakistan, from January 2024 to January 2025, following ethical clearance from our hospital. Study involved 60 patients who underwent mitral valve replacement (MVR) for mitral stenosis (MS). We enrolled adults aged 35 years or older with moderate to severe MS requiring surgical intervention which was confirmed by preoperative echocardiography. Patients having a history of preoperative AF, prior cardiac arrhythmias requiring antiarrhythmic therapy, active endocarditis, or emergency surgery due to hemodynamic instability were not included in the study.

Patients' demographics, along with their clinical attributes, were recorded. Preoperative echocardiographic parameters including left atrial (LA) diameter, left ventricular ejection fraction (LVEF) were documented. All the surgeries were performed by a specialist cardiac surgeon with experience exceeding 5 years.

Postoperative monitoring for AF was carried out using continuous telemetry for the first week, which was followed by daily 12-lead electrocardiograms (ECGs) until discharge. Atrial fibrillation was evaluated based on any episode lasting longer than 30 seconds which was confirmed by ECG requiring medical or electrical intervention. Additional postoperative outcomes assessed included, hospital length of stay, renal dysfunction (defined as a 50% increase in serum creatinine or the initiation of dialysis), and mortality during the hospital stay.

Data analysis was done using SPSS 26. Variables like age were defined using the mean and standard deviation (SD). For demographic, clinical and outcome variables we used frequencies and percentages. The Chi-Square test was performed to assess the association between AF and various variables, with a significance level of ≤ 0.05 .

RESULTS

The mean age in our study was 52.05 ± 8.61 years. There were 34 males (56.7%) and 26 females (43.3%). Among the patients, 17 (28.3%) had diabetes while 19 (31.7%) were hypertensive and 16 (26.7%) were smokers. Rheumatic heart disease was present in 38 patients (63.3%) while 11 (18.3%) having history of previous mitral valve replacement. Left ventricular ejection fraction was found to be below 50% in 23 (38.3%) patients, and left atrial size exceeded 40 mm in 23 (38.3%) patients (Table 1).

Postoperative atrial fibrillation occurred in about 10 (16.7%) patients (Table 2). Comparative analysis exhibited potential associations between atrial fibrillation and several baseline features. Patients aged > 50 years had a higher incidence of atrial fibrillation (90.0%) ($p=0.01$). Diabetes 80.0% ($p<0.0001$), hypertension 80.0%

($p<0.0001$), and smoking 60.0% ($p=0.009$) were more frequent in the atrial fibrillation group. History of previous MVR was also notably associated with atrial fibrillation 50.0% ($p=0.005$). Reduced left ventricular ejection fraction $<50\%$ was seen in 90.0% of AF cases ($p<0.0001$). Additionally, left atrial enlargement which was ≥ 40 mm was more common in patients with AF 80.0% ($p=0.003$) (Table 3). Postoperative outcomes also exhibited notable associations with AF. Extended hospital stays, which were >7 days, were more frequent in the atrial fibrillation group, 80.0% ($p<0.0001$). Renal failure was observed in 80.0% of AF patients ($p<0.0001$). Mortality was again notably higher in the AF group, 70.0% ($p<0.0001$) (Table 4).

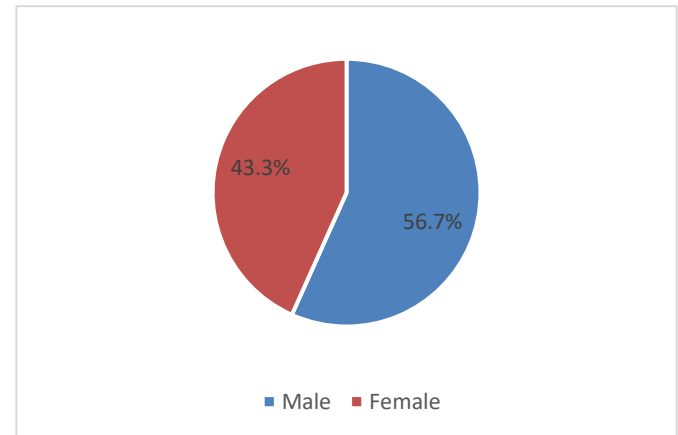


Figure 1: Gender distribution

Table 1: Clinical profile of the patients

Clinical profile		N	%
Diabetes	Yes	17	28.3%
	No	43	71.7%
Hypertension	Yes	19	31.7%
	No	41	68.3%
Smoking	Yes	16	26.7%
	No	44	73.3%
Rheumatic heart disease	Yes	38	63.3%
	No	22	36.7%
Previous MVR	Yes	11	18.3%
	No	49	81.7%
LVEF	$< 50\%$	23	38.3%
	$\geq 50\%$	37	61.7%
LA size (mm)	< 40	37	61.7%
	≥ 40	23	38.3%

Table 2: Frequency of atrial fibrillation

Atrial fibrillation	N	%
Yes	10	16.7%
No	50	83.3%

Table 3: Association of atrial fibrillation with baseline characteristics

Baseline characteristics		Atrial fibrillation				P value
		Yes		No		
		N	%	N	%	
Age distribution (Years)	35 to 50	1	10.0%	26	52.0%	0.01
	> 50	9	90.0%	24	48.0%	
Gender	Male	7	70.0%	27	54.0%	0.35
	Female	3	30.0%	23	46.0%	
Diabetes	Yes	8	80.0%	9	18.0%	0.0001

Hypertension	No	2	20.0%	41	82.0%	0.0001
	Yes	8	80.0%	11	22.0%	
Smoking	No	2	20.0%	39	78.0%	0.009
	Yes	6	60.0%	10	20.0%	
Rheumatic heart disease	No	4	40.0%	40	80.0%	0.23
	Yes	8	80.0%	30	60.0%	
Previous MVR	No	2	20.0%	20	40.0%	0.005
	Yes	5	50.0%	6	12.0%	
LVEF	No	5	50.0%	44	88.0%	0.0001
	< 50 %	9	90.0%	14	28.0%	
LA size (mm)	> = 50%	1	10.0%	36	72.0%	0.003
	< 40	2	20.0%	35	70.0%	
	= > 40	8	80.0%	15	30.0%	

Table 4: Association of postoperative outcomes with atrial fibrillation

Postoperative outcomes		Atrial fibrillation				P value
		Yes		No		
		N	%	N	%	
Hospital stay (Days)	4 to 7	2	20.0%	39	78.0%	0.0001
	> 7	8	80.0%	11	22.0%	
Renal failure	Yes	8	80.0%	1	2.0%	0.0001
	No	2	20.0%	49	98.0%	
Mortality	Yes	7	70.0%	1	2.0%	0.0001
	No	3	30.0%	49	98.0%	

DISCUSSION

The findings from our study showed a 16.7% incidence of postoperative atrial fibrillation (AF) following mitral valve replacement (MVR) for mitral stenosis, aligning with Khan et al., who reported a 19.4% incidence of AF (14). Mirhosseini et al. showed that AF was observed in 14% patients (15). Alghosoon et al. showed that 16.8% of patients had developed AF (16). Our findings align with the reported trends of postoperative AF after MVR.

We observed notably strong link of AF with increased age (>50 years) which echoes with the findings by Khan et al. where they showed that patients over 50 had a 35.4% AF risk compared to their younger counterparts. This age-related susceptibility likely reflects cumulative atrial remodeling and an increased comorbidity burden in older populations, as suggested by Kernis et al. in their analysis, which showed that older age was associated with early AF (17).

In our study, we found that hypertension, along with diabetes, showed a potential association with AF occurrence. These findings align with Khan et al.'s observation of an increased AF frequency among diabetic patients (32.5% vs. 37.5%, $p = 0.02$), suggesting that metabolic factors may contribute to arrhythmia risk. The potential role of hyperglycemia-induced endothelial dysfunction in AF pathogenesis, although biologically plausible, was not directly examined in either our study or the study by the authors. Khan et al. also mentioned that hypertension was notably higher in AF group (14).

The 60% smoking rate among AF patients sits well with the observations by Alghosoon et al. (2023), who identified smoking as a marginal risk factor ($p = 0.05$). This discrepancy may stem from differences in smoking quantification or population-specific susceptibility warranting deeper investigation into nicotine's electrophysiological effects in stenotic mitral valves, another reason for this discrepancy may stem from the fact that our study was conducted over a period of one year with 60 patients while their study had more than one thousand patients and was conducted from 2009 to 2020. Notably, 50% of AF patients had a prior MVR history, a finding well corroborated by Khan et al. and Kernis et al. (14, 17). This suggests that reoperative surgery compounds atrial trauma and fibrosis, creating substrates for reentrant circuits. We found that patients presenting with LVEF < 50% had notably higher frequency of postop

AP, an observed affirmed by Khan et al., who showed that 41% patients with postop AF had LVEF 40 to 49%, while Kernis et al. showed that patients with early postop AF had a mean LVEF of around 53 ± 15 (14, 17). This association underscores the interplay between ventricular dysfunction, elevated filling pressures, and atrial stretch-mediated arrhythmias.

Left atrial enlargement (≥ 40 mm) also exhibited a notable association with postoperative AF ($p = 0.003$), which is consistent with Kawamoto et al.'s identification of LA size as a critical predictor of AF (18). Khan et al. also confirmed our findings, exhibiting a notable association between increased LA size and postoperative AF (17). The 63.3% prevalence of rheumatic heart disease in the overall cohort provides context for Mirhosseini et al.'s observation of doubled AF rates in rheumatic versus non-rheumatic patients (15), though our study did not reach the point of significance, which can be attributed to our smaller sample of patients.

AF patients in our study experienced hospitalizations. Renal failure and mortality also showed notable association with postop AF, these findings are affirmed by Khan et al. in their cohort as well (14).

These findings collectively emphasize that AF following MVR is not merely a transient arrhythmia but a marker of multisystem physiological stress. We suggest that future research should prospectively validate these risk factors in larger cohorts and investigate whether preoperative optimization (e.g., glycemic control, smoking cessation) can potentially mitigate the risk of AF.

CONCLUSION

We conclude that, postop AF is a severe complication occurring after MVR in 16.7% patients. Several comorbidities were linked with this condition such as hypertension, increased LA size, decrease LVEF and smoking. Apart from these comorbidities, the postop outcomes like mortality, increased hospital stay and renal failure also showed a notable link with postop AF.

DECLARATIONS

Data Availability Statement

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All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned. (IRBEC-NICVD-24)

Consent for publication

Approved

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

MUHAMMAD OWAIS KHAN (Clinical fellow)

Conception of Study, Development of Research Methodology Design,

Study Design, final approval of manuscript.

Final approval of manuscript.

MUHAMMAD ISHAQ KHAN (Registrar)

Manuscript revisions, critical input.

AMINULLAH (Registrar)

Study Design, Review of Literature.

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Literature Review.

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Manuscript Revisions

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