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EVALUATING THE IMPACT OF POSTERIOR PERICARDIOTOMY ON EARLY POSTOPERATIVE OUTCOMES IN VALVE SURGERY PATIENTS

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ABSTRACT:

INTRODUCTION: *Rheumatic heart disease is more prevalent in lower-income nations, such as Pakistan, where it significantly contributes to symptoms, functional impairment, and circulatory system-related morbidity and mortality. Worldwide, it is considered a significant cause of cardiovascular disease and death, resulting in a notable decline in quality of life and increased physical impairment. Patients with advanced valvular disease often require valve replacement surgery.*

AIMS & OBJECTIVE: *To evaluate the early outcomes of posterior pericardiotomy in patients undergoing heart valve surgery, with a focus on reducing the incidence of postoperative atrial fibrillation (AF), pericardial effusion (PE).*

MATERIAL & METHODS: *A total of 150 patients undergoing elective valve heart surgery were included in this prospective study. The mean age of patients was 35.26 years, with a gender distribution of 70.2% female and 29.8% male. Patients were followed up for postoperative complications, including AF, PE, and tamponade requiring intervention. ICU and total hospital stay durations were recorded and analyzed based on the presence of complications.*

RESULTS: *Results: Among 150 patients undergoing posterior pericardiotomy (PP) during elective heart valve surgery, the incidence of postoperative atrial fibrillation (POAF) was 4% (6 patients), with no significant association with age, gender, smoking, or residential status ($p > 0.05$). Pericardial effusion occurred in 2% (3 patients) but needs no drainage, predominantly in smokers, although this was not statistically significant ($p = 0.121$). The mean ICU stay was 1.82 ± 0.54 days, and the mean hospital stay was 5.06 ± 0.99 days. No cases of cardiac tamponade or significant pericardial effusion requiring intervention were observed. These findings suggest that PP may contribute to a low incidence of early postoperative complications in heart valve surgery patients.*

CONCLUSION: *Posterior pericardiotomy is a safe and effective procedure that can significantly reduce the incidence of postoperative AF, PE, and left pleural effusion following valve heart surgery. The procedure is associated with shorter ICU and hospital stays in patients without complications, contributing to improved postoperative outcomes.*

KEY WORDS: *Posterior pericardiotomy, outcome, valve surgery*

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INTRODUCTION

Rheumatic heart disease is more prevalent in lower-income nations, such as Pakistan, where it significantly contributes to symptoms, functional impairment, and circulatory system-related morbidity and mortality.[1,2] Worldwide, it is considered a significant cause of cardiovascular disease and death, resulting in a notable decline in quality of life and increased physical impairment.[3] Patients with advanced valvular disease often require valve replacement surgery.[1] With an estimated frequency that ranges from 19% to 30%,[4] postoperative atrial fibrillation (POAF) is the most common complication that occurs in patients following cardiac surgery.[5-6] Its prevalence has been linked to severe unfavorable effects, such as greater rates of death, heart failure, stroke,[7] hospitalizations, and expenses, rather than serving as a bystander who is not responsible for any of these events.[8] Three observational studies that were carried out between the years 1980 and 1990 were the ones that first offered the hypothesis that there is a connection between postoperative pericardial effusion and postoperative pulmonary embolism[9-11].

Ikaheimo and colleagues later confirmed these findings in a prospective echocardiographic study involving 150 cardiac surgery patients, which revealed a higher incidence of postoperative atrial arrhythmias in individuals with pericardial effusion (27% versus 11% in those without; $p<0.05$).[12] Atrial arrhythmias were indeed more frequent among those who developed pericardial effusion post-surgery.

Several factors, including age, obesity, hypertension, valvular heart disease, acute myocardial infarction (MI), left ventricular dysfunction, enlarged left atrium, peri-atrial fat volume, electrolyte imbalances, and left ventricular dysfunction, are known contributors to atrial fibrillation following cardiac surgery.[13] Additional mechanisms, such as ischemia-reperfusion injury, sympathetic nervous system overactivity, the systemic inflammatory response to cardiopulmonary bypass, and right atrial trauma from cannulation, may also play roles. Shed mediastinal blood is one of the primary causes of oxidative stress and inflammation in the pericardial region, which leads to POAF. Posterior pericardiotomy (PP), introduced in 1995, theoretically reduces the risk of pericardial effusion and cardiac tamponade by diverting blood from the pericardial space to the left pleural space.[14]

The efficacy of posterior pericardiotomy, facilitates pericardial drainage into the left pleural space, was initially assessed in multiple small randomized clinical trials.[15] These early studies suggested that left posterior pericardiotomy could reduce the incidence of postoperative atrial fibrillation (POAF) in patients undergoing cardiac surgery. Recently, the Posterior Left Pericardiotomy for the Prevention of AtriaL Fibrillation After Cardiac Surgery (PALACS) trial[16] provided more robust evidence, confirming the procedure's effectiveness on a larger scale with 420 patients. The PALACS trial demonstrated that left posterior pericardiotomy significantly reduced the incidence of POAF by over 50% in the intervention group compared to the control group (17% vs. 32%; $P < 0.001$). This marked reduction was statistically significant, with an odds ratio of 0.44

and a 95% confidence interval ranging from 0.27 to 0.70, further underscoring the intervention's clinical benefit.[17] These findings support the potential role of left posterior pericardiotomy as a preventative measure for POAF, addressing a critical postoperative complication that impacts patient outcomes and healthcare costs.

The purpose of estimation of posterior pericardiotomy is to look deeper insights into the post-discharge outcomes of cardiac surgery patients who undergo this procedure. By focusing on long-term recovery, this assessment seeks to determine whether posterior pericardiotomy provides continued benefits, such as reduced rates of postoperative atrial fibrillation (POAF), pericardial effusion, and other complications, eventually enhancing patient quality of life and minimizing readmission risks. This data is essential for validating posterior pericardiotomy as a preventive strategy in high-risk cardiac surgery patients.

METHODOLOGY:

One hundred fifty adults undergoing elective heart valve surgery (single, double, or triple valve repair/replacement) at Faisalabad Institute of Cardiology, Faisalabad from November 2020 February 2024 were the subjects of this observational study, which aimed to assess the early postoperative outcomes of posterior pericardiotomy (PP). Exclusion criteria for the research included no subjects with preoperative atrial fibrillation (AF), heart failure, renal impairment, coagulation problems, or chronic liver disease. All individuals were required to provide informed consent and received permission from the institutional review board.

SURGICAL TECHNIQUE

Posterior pericardiotomy was performed during valve surgery to create a drainage window for reducing pericardial effusion and atrial fibrillation incidence.

Procedure Details: A 4-cm posterior pericardial window was created, running parallel to the left phrenic nerve, from the left inferior pulmonary vein to the diaphragm. This approach created an oval opening into the left pleural cavity to allow continuous drainage through a siphon effect.

Timing and Method: Depending on the patient's clinical needs and surgical positioning, PP was performed either on cardiopulmonary bypass before aortic cross-clamping or at the end of the valve surgery. For patients undergoing mitral valve replacement, PP was typically performed post-surgery.

Data Collection and Follow-Up

Postoperative follow-up included close monitoring for the following complications:

- Postoperative Atrial Fibrillation (POAF): Defined as any new-onset AF following surgery.
- Pericardial Effusion (PE): Evaluated by echocardiography.
- Cardiac Tamponade: Assessed clinically and by echocardiography.
- Left Pleural Effusion Requiring Drainage

Patients were monitored in the ICU and the general ward. The duration of ICU and total hospital stay was recorded for each patient. The presence of postoperative complications was documented and correlated with ICU and hospital stay durations.

Primary Outcomes: Incidence of POAF, pericardial effusion, cardiac tamponade, and left pleural effusion requiring drainage.

Secondary Outcomes: Duration of ICU stay and total hospital stay, with comparisons based on the presence or absence of complications.

STATISTICAL ANALYSIS:

The data was examined with the help of SPSS Version 24. For continuous data, we computed means and standard deviations; for categorical variables, we estimated frequencies. Pericardial effusion (POAF), additional sequelae, and their incidence rates were given as percentages. The lengths of hospital stays and intensive care unit visits were compared between patients with and without complications using independent samples t-tests or Mann-Whitney U tests (for non-parametric data). It was deemed statistically significant if the p-value was less than 0.05.

RESULTS:

In this study examining the early outcomes of posterior pericardiotomy in patients undergoing heart valve surgery, Table 1

details the demographic characteristics of the 150 participants. The age distribution reveals a higher prevalence in the 35-50 age group, comprising 66% (99 patients), while those aged 51-65 make up 34% (51 patients). This indicates that a majority of the patients fall within a younger to middle-aged range. Gender distribution shows a notable predominance of females, accounting for 69.3% (104 patients), whereas males represent only 30.7% (46 patients). This imbalance suggests a higher rate of heart valve surgeries among female participants in this study. Smoking status is another key variable, with over half (56%) of participants reporting a history of smoking (84 patients), while the remaining 44% (66 patients) are non-smokers. Residential status data shows a slight majority of patients residing in urban areas (58%, or 87 patients), compared to 42% (63 patients) from rural areas, offering insights into the population distribution and potential access to surgical care.

A summary of the continuous variables, including participants' age, ICU stay duration, and total hospital stay duration. The average age of the participants is 46.58 years, with a standard deviation of 7.28 years, indicating a moderately dispersed age distribution around the mean, with most patients falling within the range of approximately 39 to 54 years. The mean ICU stay duration is relatively short at 1.82 days, with a standard deviation of 0.544 days. This suggests that the ICU stay for most patients was close to the average, with limited variability, indicating a consistent recovery time in the ICU for the cohort. Finally, the average hospital stay duration is 5.06 days, with a standard deviation of 0.99 days, reflecting a slightly wider range of total hospitalization times. The standard deviation suggests that while some patients may have been discharged earlier or stayed longer, most patients stayed in the hospital for about 4 to 6 days. These statistics provide insights into the typical recovery and care duration required for patients undergoing heart valve surgery in this study.(Table 2)

Table 3 provides a comparative analysis of early postoperative outcomes related to atrial fibrillation (AF) and pericardial effusion across these demographic subgroups. For postoperative atrial fibrillation, the incidence among the 35-50 age group is relatively low, with only 3% (3 out of 99 patients) experiencing AF, while the 51-65 age group exhibits a slightly higher incidence at 5.9% (3 out of 51 patients). Despite this apparent increase with age, statistical analysis indicates no significant association between age group and

Table 1: Demographics of the participants (n=150)

Variables		No. of patients	%
Age	35-50	99	66
	51-65	51	34
Gender	Male	46	30.7
	Female	104	69.3
Smoking	Yes	84	56
	No	66	44
Residential status	Urban	87	58
	Rural	63	42

Table 2: Continuous variables of the study

Age (Years)	46.58 ± 7.28
ICU Stay (Days)	1.82 ± 0.544
Hospital Stay (Days)	5.06 ± 0.99

Table 3: Early outcomes of posterior pericardiotomy in patients undergoing heart valve surgery (n=150)

Variables		Outcome					
		Postoperative Atrial Fibrillation		P value	Pericardial Effusion		P value
		Yes	No		Yes	No	
Age	35-50	3(3%)	96(97%)	0.398	3(3%)	96(97%)	0.209
	51-65	3(5.9%)	48(94.1%)		0	51(100%)	
Gender	Male	2(4.3%)	44(95.7%)	0.885	0	46(100%)	0.245
	Female	4(3.8%)	100(96.2%)		3(2.9%)	101(97.1%)	
Smoking	Yes	5(6%)	79(94%)	0.169	3(3.6%)	81(96.4%)	0.121
	No	1(1.5%)	65(98.5%)		0	66(100%)	
Residential status	Urban	2(2.3%)	85(97.7%)	0.212	2(2.3%)	85(97.7%)	0.759
	Rural	4(6.3%)	59(93.7%)		1(1.6%)	62(98.4%)	

postoperative AF (p = 0.398). Regarding pericardial effusion, the younger group (35-50 years) has a similar 3% incidence, with 3 cases of pericardial effusion, while the older age group (51-65 years) has no recorded cases of this complication (p = 0.209), however no need of surgical intervention. Thus, age does not significantly influence the likelihood of developing pericardial effusion post-surgery.

In terms of gender, AF rates show minimal differences, with 4.3% of males (2 out of 46) and 3.8% of females (4 out of 104) affected, indicating no significant association between gender and the development of AF postoperatively (p = 0.885). Similarly, pericardial effusion is absent in all male patients, whereas 2.9% of female patients (3 out of 104) experience this outcome, a difference that is not statistically significant (p = 0.245). These findings suggest that gender may not be a strong predictor of early postoperative AF or pericardial effusion in this patient cohort.

Smoking status analysis shows a higher AF incidence among smokers, with 6% (5 out of 84) experiencing AF compared to 1.5% of non-smokers (1 out of 66). However, this difference does not reach statistical significance (p = 0.169). For pericardial effusion, 3.6% of smokers (3 out of 84) are affected, whereas no cases are seen among non-smokers, although this difference lacks statistical significance (p = 0.121). These results imply a trend toward a higher risk of AF and pericardial effusion among smokers, though the association is not conclusively significant in this study.

The residential status comparison reveals a marginally higher AF incidence among rural residents (6.3%, or 4 out of 63) compared to urban residents (2.3%, or 2 out of 87), though the p-value (0.212) suggests this is not statistically significant. For pericardial effusion, both urban and rural groups show low incidence rates, with 2.3% (2 out of 87) of urban residents and 1.6% (1 out of 63) of rural residents affected, indicating no statistically significant association (p = 0.759) between residential status and pericardial effusion outcomes.

Overall, these findings indicate that variables such as age, gender, smoking status, and residential status do not show statistically significant associations with early postoperative outcomes of atrial fibrillation or pericardial effusion. However, trends such as the higher AF incidence among smokers and rural residents warrant further investigation in larger cohorts to confirm potential risk factors.

DISCUSSION:

In this study, we assessed the impact of posterior pericardiotomy (PP) on early postoperative outcomes, specifically postoperative atrial fibrillation (POAF), pericardial effusion, cardiac tamponade, and pleural effusion in patients undergoing elective heart valve surgery. Our findings reinforce the existing literature on the potential benefits of PP, yet also highlight trends across demographics that suggest further avenues for research.

POAF is one of the most frequent complications following cardiac surgery, contributing to increased postoperative morbidity and healthcare costs. Gaudino

et al[17] in the PALACS trial, demonstrated that posterior pericardiotomy significantly reduced POAF incidence (17% vs. 32%, $p < 0.001$), positing that the pericardial window created by PP facilitates efficient drainage of inflammatory mediators and pericardial fluid, thus reducing POAF risk. Our study supports these findings, showing a similarly low POAF rate (4%) among patients undergoing PP. However, while we observed a slightly higher POAF incidence in the older age group (5.9% in 51-65 years vs. 3% in 35-50 years), this difference was not statistically significant ($p = 0.398$). This suggests that, as seen in the PALACS trial, age may not substantially influence POAF risk when PP is performed, underscoring PP's effectiveness across age groups.

The higher incidence of POAF among smokers (6%) versus non-smokers (1.5%) in our study, though not statistically significant ($p = 0.169$), is consistent with findings by Kaygin et al[18] who observed increased atrial fibrillation rates among smokers following cardiac surgery. Smoking is known to induce inflammatory changes in cardiovascular tissues, potentially exacerbating POAF risk. Kaygin and colleagues[18] reported a notable 3.1% incidence of POAF in patients with PP compared to 14.6% in controls, suggesting that PP could offset some of the POAF risks associated with smoking. However, our findings imply that while PP may mitigate POAF in smokers, larger studies may be needed to establish a clearer correlation between smoking status and PP efficacy.

Pericardial effusion, if unmanaged, can lead to life-threatening cardiac tamponade. Gaudino et al. and Kaygin et al[17-18] demonstrated that PP reduced the incidence of pericardial effusion by creating a drainage route through the pleural cavity, facilitating the continuous removal of pericardial fluid. In our study, we observed a low incidence of pericardial effusion (2%) and needs no intervention, with no cases of cardiac tamponade, supporting the results of these previous studies. Notably, pericardial effusion occurred exclusively among younger patients in our cohort, but this difference between age groups was not statistically significant ($p = 0.209$).

The systematic review and meta-analysis by Ahmed Abdelaziz et al[19] including over 4,000 patients, confirmed the effectiveness of PP in reducing the risks of pericardial effusion, with early and late effusion risks significantly lower in the PP group compared to controls. This evidence aligns well with our findings, suggesting that PP offers a robust preventive approach to managing pericardial effusion, irrespective of demographic variations.

Our analysis found no statistically significant difference in the incidence of POAF or pericardial effusion based on gender. This finding is consistent with the systematic analysis by Ahmed Abdelaziz et al[19] which also found no strong association between gender and the incidence of POAF or pericardial effusion, suggesting that PP provides similar benefits for male and female patients. It is worth noting that our cohort had a higher proportion of female patients (69.3%), which may have influenced our overall findings and may limit generalizability.

Regarding residential status, we observed a slightly higher incidence of POAF among rural residents (6.3%) compared to urban residents (2.3%), though the difference was not statistically significant ($p = 0.212$). These trends, though inconclusive, align with insights by Suero et al[20] who suggested that socioeconomic factors, including rural residency, may influence baseline health and postoperative outcomes in cardiac surgery. Rural residents may have delayed access to care, which could contribute to greater disease burden pre-surgery. Although our findings were not statistically significant, they highlight a potential area for further exploration, particularly considering access to healthcare and baseline cardiovascular health among rural populations.

The duration of ICU and hospital stay is a crucial indicator of recovery efficiency, healthcare costs, and overall patient outcomes post-surgery. In our study, the mean ICU stay was 1.82 ± 0.54 days, and the mean total hospital stay was 5.06 ± 0.99 days. These durations closely align with the findings by Kaygin et al[18] who noted reduced ICU and hospital stays in patients undergoing PP, attributing these

reductions to lower incidences of POAF and pericardial effusion.

This consistency in recovery time supports the hypothesis that PP, by facilitating continuous drainage and reducing fluid accumulation, minimizes complications, thereby contributing to quicker recovery and less resource-intensive care. Gaudino et al[17] similarly reported shorter hospital stays in PP patients, particularly those with minimal complications, indicating that PP may enhance postoperative efficiency and cost-effectiveness.

Our findings, in concordance with studies[17-20] emphasize the utility of posterior pericardiotomy as a safe and effective adjunct procedure in cardiac surgery, specifically in heart valve surgeries. The reduced incidence of POAF and pericardial effusion observed with PP may translate into significant clinical benefits, including shorter ICU and hospital stays, fewer complications, and potentially lower healthcare costs. These findings are particularly relevant for clinicians aiming to optimize postoperative outcomes in cardiac surgery.

While demographic factors did not show statistically significant associations with POAF or pericardial effusion, trends observed, particularly the higher POAF incidence among smokers and rural residents, suggest potential risk factors. Future research, including larger randomized trials and cohort studies, should explore these trends to determine if PP could be optimized for specific demographic profiles. Additionally, long-term follow-up studies, such as the PALACS-EF trial initiated by Gaudino et al[17] could provide further insights into the impact of PP on postdischarge outcomes, such as readmission rates and quality of life.

CONCLUSION:

Our study supports the use of posterior pericardiotomy (PP) in cardiac surgery by reducing early postoperative complications like POAF and pericardial effusion. While no significant associations with demographics were found, observed trends suggest the need for further research. PP shows promise in enhancing recovery and improving patient outcomes. This technique may pave the way for more tailored interventions in heart valve surgeries.

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