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Incidence and Causes of Early Hospital Readmissions after Cardiac Surgery. One Year Experience at Tertiary Care Hospital, Multan

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ABSTRACT

The increased costs, morbidity, and mortality associated with readmissions after cardiac surgery pose a substantial issue for the healthcare system. **Objective:** To observe the incidence, causes, and outcome of hospital readmissions within two months of discharge after cardiac surgery. **Methods:** An observational descriptive cohort study was conducted at Chaudhary Pervaiz Elahi Institute of Cardiology, Multan, Pakistan. From September 2023 to August 2024, 1406 patients undergoing cardiac surgery were observed for readmission in the hospital within two months after discharge. Patients who were operated at other facility and those who admitted after 2month were excluded from the study. Perioperative data, reasons for readmission, and outcomes were recorded and analyzed using SPSS version 25.0. Descriptive statistics were applied to continuous and categorical variables. **Results:** The incidence rate of readmission was 7.5% (n=106). 85.8% readmissions occurred within 30 days after discharge. Common causes of readmission were anticoagulation-related issues (23.6%), wound infections (21.7%), pleural effusion (15.1%), pericardial effusion (9.4%), and sternal dehiscence (6.6%). Surgical intervention was required in 35.8% of readmitted patients.The mean length of readmission hospital stay was 4 ± 2.80 days. Mortality in readmitted patients was 4.7% (n=5). **Conclusions:** Nearly every 13th patient needs hospital readmission. Early hospital readmission is most common in patients who needs anticoagulation after valve replacement surgery. Early readmission after cardiac surgery, adversely impacts patient outcomes. Improved anticoagulation management, infection control, and postoperative diuretics, are critical for reducing incidence of hospital readmission.

INTRODUCTION

In cardiac surgery, early hospital readmission (within two months) is a common issue, with an incidence of 8 to 21% reported in the literature [1, 2]. Readmissions to the hospital shortly after discharge significantly increase the overall burden on healthcare costs. Research on Medicare fee-for-service beneficiaries revealed that early hospital readmissions accounted for 17% of additional healthcare expenditures [3]. Early hospital readmission increases both the cost of treatment and is associated with multiplied morbidity and mortality, which affects the immediate and long-term outcome of surgery [4, 5]. An unscheduled early readmission to the Intensive Care Unit (ICU) after discharge is considered a health indicator by "The Quality Indicators Committee of the Society of Critical Care Medicine" [6]. Higher readmission rates are often associated with suboptimal hospital performance [7]. Various factors contribute to hospital readmissions, including heart failure, arrhythmias, chest pain, pleural or pericardial effusion, wound complications, and infections [8, 9]. Postoperative care following cardiac surgery is a critical period that requires meticulous monitoring and management to prevent complications leading to readmission. Studies suggest that inadequate post-discharge care, patient non-compliance with medications, and the presence of multiple comorbidities significantly contribute to hospital readmissions. Additionally, healthcare disparities, including limited access to follow-up care and rehabilitation services, further exacerbate the

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risk, especially in developing countries. Effective post-discharge strategies, such as structured follow-up programs, early outpatient assessments, and patient education, can help reduce unnecessary readmissions. Moreover, multidisciplinary collaboration among surgeons, cardiologists, nurses, and rehabilitation specialists is essential to enhance recovery and ensure continuity of care.

By identifying key predictors of readmission, healthcare providers can implement targeted interventions to improve patient outcomes and reduce the economic burden on healthcare systems. As there is limited local data available on early readmission after cardiac surgery, therefore, it is important to evaluate characteristics of readmitted patients in under developed country like Pakistan. The objective of the study was to observe the readmission rate, causes of early hospital readmission, treatment, especially in terms of surgical intervention, and outcome after readmission.

METHODS

From September 2023 to August 2024, all patients who underwent heart surgery at Chaudhary Pervaiz Elahi Institute of Cardiology Multan were observed for early readmission. Patients who were readmitted within two months of discharge were included in the study. The following patients were excluded from the study group: Exclusion criteria: (a) Patients who were operated on at any other government institute or at a private hospital. (b) Patients presenting late after 2 months of discharge. This study was conducted as an observational cohort study using data from the cardiac surgery database at Chaudhary Pervaiz Elahi Institute of Cardiology, Multan. Ethical approval was obtained from the Institutional Review Board (IRB) of Chaudhary Pervaiz Elah Institute of Cardiology Multan (reference# 13). Since the study involved patient data, informed consent was obtained from all participants, following the ethical principles outlined in the World Medical Association Declaration of Helsinki [10]. The on-duty staff was advised to inform the principal investigator whenever a readmission was made. Perioperative data was recorded from medical records. Patients were investigated, and their clinical symptoms, diagnosis, and treatment, either conservative or any intervention, were recorded. The outcome of patients, discharged, or mortality was recorded. All the data were entered in an Excel sheet. SPSS version 25.0 was used for data analysis.

RESULTS

From September 2023 to August 2024, 1450 patients underwent cardiac surgery. 848 patients (58%) underwent isolated Coronary Bypass Grafting (CABG), 204 (14%) had mechanical valve replacement, 279 (19%) had congenital heart disease surgery, and 119 (8%) underwent surgery such as aortic dissection repair, VSR repair, pericardiotomy, and concomitant surgery. 44 (3.5%) patients died in the perioperative period and 1406 patients were discharged home in a satisfactory condition. Patients were followed up for two months after discharge. A total of 106 patients (7.5%) were readmitted to CPEIC Multan, with 71 men and 35 women (2:1). According to procedure type, readmission rate was 5.8% in isolated coronary artery bypass surgery and 24.5% in mechanical valve replacement surgery. In readmitted patients, 18.9% were smokers, 22.6% were hypertensive, and 17.9% had diabetes. 91 patients (85.8%) were readmitted within 30 days of their discharge. Most patients (37.7%) presented with symptoms of shortness of breath and 22.6% with seropurulent discharge from the wound. 23.6% of patients were presented with prolonged international normalization ratio (INR) or bleeding-related complication. Causes of readmission were surgical site wound infection (21.7%), pleural effusion (15.1%), large pericardial effusion (9.4%), supra ventricular tachyarrhythmias (5.7%), sternal dehiscence (6.6%), chest complication other than pleural effusion like pneumothorax or pneumonia (2.83%) and aortic pseudoaneurysm (1.89%) (Figure 1).

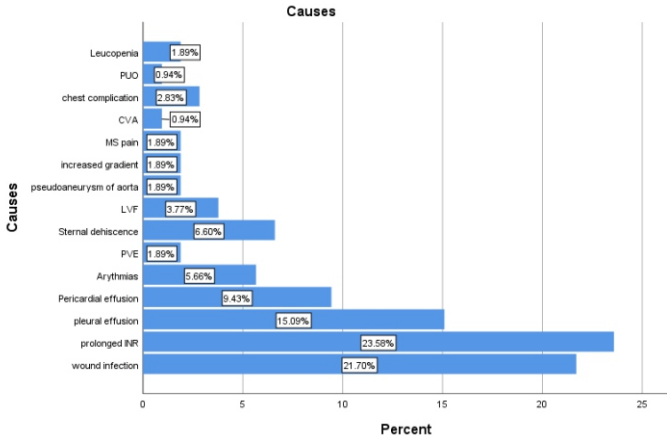

Figure 1: Causes of readmission (PUO = Pyrexia of Unknown Origin, CVA= Cerebrovascular Accident, MS pain= Musculoskeletal Pain, LVF =Left Ventricular Failure, PVE= Prosthethic Valve Endocarditis

The analysis of readmission causes across different surgical procedures highlighted several important patterns. Wound infections were predominantly seen in CABG patients, making up 82.6% of cases (19 out of 23), with a statistically significant association ($p = 0.0018$). Similarly, prolonged INR, a key factor in anticoagulation-related readmissions, was most common in valve surgeries particularly MVR (40.0%), DVR (32.0%), and AVR (12.0%) with strong statistical significance ($p = 0.001$). On the other hand, pleural effusion did not show a significant link to surgery type ($p = 0.109$), even though it was more frequently observed in CABG patients. Pleural effusion was more commonly seen in CABG patients, affecting 22.0% (11 out of 50 cases), compared to 11.1% (5 out of 45 cases) in those who underwent valvular surgeries (MVR, DVR, AVR). While

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CABG patients experienced pleural effusion at nearly twice the rate of valvular surgery patients, the statistical test (χ^2 = 2.58, p = 0.109) suggests that this difference is not significant. Pericardial effusion was more evenly distributed across valve surgeries (MVR 40.0%, DVR 40.0%, AVR 20.0%), but the association was not statistically significant (p = 0.089). Sternal dehiscence was found only in CABG patients (7 out of 7 cases), with a strong association (p = 0.004), suggesting that this complication is closely tied to CABG procedures. Arrhythmias were more common among CABG (66.7%) and DVR (33.3%) patients, but there was no strong statistical evidence (p = 0.909) to link them specifically to any surgery type. Finally, Prosthetic Valve Endocarditis (PVE), which was observed in ARR and AVR surgeries (50% each), was not significantly associated with surgery type (p = 0.011). The mean readmission day after discharge was 16.33±13.62 days. The mean hospital stay after readmission was 4±2.80 days. 38 patients (35.8%) needed some form of surgical intervention for their therapy. The duration of hospital stay following readmission varied based on the type of complication. Patients with pleural effusion had an average readmission stay of 2.94 ± 0.99 days, while those with prolonged INR stayed for 2.36 ± 0.81 days. In contrast, individuals with wound infections had a longer mean hospital stay of 4.26 ± 1.68 days, whereas patients with other complications exhibited the longest readmission duration, averaging 5.24 ± 3.76 days. The other complications category includes conditions such as sternal dehiscence, pericardial effusion, Prosthetic Valve Endocarditis (PVE), increased gradient across prosthetic valves, pseudoaneurysm of the aorta, leucopenia, chest complications, Cerebrovascular Accident (CVA), Left Ventricular Failure (LVF), Musculoskeletal (MS) pain, and Pyrexia of Unknown Origin (PUO). Among these, pseudoaneurysm of the aorta led to the longest hospital stays, increasing readmission duration by 11.17 days (p < 0.001), followed by increased gradient (+8.67 days, p < 0.001), sternal dehiscence (+4.81 days, p < 0.001), and PVE (+4.17 days, p = 0.011). A multiple linear regression analysis was conducted to examine the relationship between specific post-surgical complications and readmission hospital stay. The overall model was statistically significant (F = 8.78, p < 0.001) and explained 57.5% of the variance in readmission duration (R^2 = 0.575). The results indicated that sternal dehiscence was associated with a 4.81-day increase in hospital stay (β = +4.81, p < 0.001), while increased gradient (+8.67 days, p < 0.001) and pseudoaneurysm of the aorta (+11.17 days, p < 0.001) were the strongest predictors of prolonged hospitalization. Prosthetic Valve Endocarditis (PVE) also significantly increased hospital stay by 4.17 days (β = +4.17, p = 0.011). A large pericardial effusion (9.4%) was drained surgically in the operation theater under anesthesia by a subxiphoid incision. The pleural effusion was drained either by percutaneous aspiration (1.9%) or by inserting a small bore central venous line (10.4%) in the pleural cavity. In 3 patients a chest tube was passed in the chest cavity. Rewiring was done in 6 (5.7%) patients.3 patients needed redo on-pump surgery. 2 patients needed surgical wound debridement. A total of 5 patients (4.7%) expired following readmission. The primary complications associated with mortality were Prosthetic Valve Endocarditis (PVE) (n=2, 40%), followed by increased gradient (n=1, 20%), pericardial effusion (n=1, 20%), and leucopenia (n=1, 20%). PVE was the most frequently observed complication among deceased patients, suggesting a potential link between valve-related infections and adverse outcomes. Continuous and qualitative variables of all readmitted patients were shown in tables 1 and 2. The table 1 provided an overview of key clinical variables, including age, creatinine levels, Left Ventricle Dimensions (LVIDD and LVIDS), and Tricuspid Valve Pressure Gradient (TVPG). The length of hospital stays during the initial admission and the duration of readmission hospital stay are also included. The data show a mean age of 46.93 years, with a wide range of 15 to 72 years, indicating a diverse patient population. The mean hospital stay was approximately 5.86 days, while readmission occurred on average at 16.33 days' post-discharge.

Table 1: Patient Demographics and Clinical Variables

Variables	N	Minimum	Maximum	Mean ± SD
Age	106	15.00	72.00	46.93 ± 15.22
Creatinine	106	0.30	0.65	0.50 ±0.94
LVIDD	106	32.00	73.00	50.81 ± 8.57
LVIDS	106	22.00	58.00	33.28 ± 7.72
TVPG (mmHg)	62	0.00	140.00	43.51 ± 22.69
Hospital Stay (Days)	106	3.00	18.00	5.86 ± 2.21
Readmission Day	106	1.00	60.00	16.33 ± 13.61
Readmission Hospital Stay	106	1.00	19.00	4.00 ± 2.80

This table 2 categorized patients based on the type of cardiac surgery performed, symptoms leading to readmission, and the need for surgical intervention. The most common procedure among readmitted patients was coronary artery bypass grafting (CABG) (47.16%), followed by mitral valve replacement (MVR) (17.92%) and double valve replacement (DVR) (16.03%). The most frequently reported symptoms were shortness of breath (37.7%), wound discharge (22.6%), and prolonged INR-related complications (16%). Surgical intervention was required in 35.8% of readmitted cases, while the remaining 64.2% were managed conservatively. This data highlighted the need for improved anticoagulation management, infection control, and postoperative monitoring to reduce the risk of readmission after cardiac surgery.

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Table 2: Clinical Characteristics and Management of Readmitted Patients After Cardiac Surgery

Variables	Category	Frequency (%)
Operation	CABG	50 (47.16%)
	MVR	19 (17.92%)
	DVR	17 (16.03%)
	AVR	9 (8.49%)
	ARR	5 (4.71%)
	RSOV	2 (1.89%)
	AVR	1 (0.94%)
	ASD	1 (0.94%)
	TC	1 (0.94%)
	CABG+MVR	1 (0.94%)
Symptoms	SOB	40 (37.7%)
	Discharge From Wound	24 (22.6%)
	Prolonged INR	17 (16.0%)
	Prolonged INR Complication	6 (5.7%)
	Fever	5 (4.7%)
	Vomiting	2 (1.89%)
	Mixed	5 (4.7%)
	Chest Pain	3 (2.8%)
	Stroke	3 (2.8%)
	Palpitation	1 (0.94%)
Surgical Intervention	No	68 (64.2%)
	Yes	38 (35.8%)

DISCUSSION

The continuous increase in healthcare expenditures has shifted attention toward hospital readmission rates to enhance the quality and cost-efficiency of healthcare delivery. The literature review revealed a dearth of national research on readmissions following heart surgery in Pakistan. Despite advances in surgical technique and perioperative care, readmission following cardiac surgery still is not uncommon. The "Cardiothoracic Surgical Trials Network" investigated all-cause readmissions within 65 days following cardiac surgery in a cohort of 5,158 adults across 10 different sites. The study reported an overall readmission rate of 18.7%, with the primary causes being infections (17.1%), arrhythmias (17.1%), and volume overload (13.5%) [1]. While the present study showed readmission rate 7.5%. The decreased incidence could be because only patients readmitted at the CPE Institute of Cardiology, Multan have been recorded. The study has not included cases readmitted to another institute or private setup. Primary causes of readmission in the study were prolonged international normalization ratio (INR) or bleeding-related complication (23.6%), surgical site wound infection (21.7%), pleural effusion (15.1%), large pericardial effusion (9.4%), sternal dehiscence (6.6%) and supra ventricular tachyarrhythmia's (5.7%). The reason of different causes in readmitted patient from international literature being different disease pattern in patients undergoing cardiac surgery. The rheumatic heart disease is still common in underdeveloped countries like Pakistan [11, 12]. Patients undergo mechanical valve replacement surgery need lifelong anticoagulation. The readmission rate was highest (24.5%) in mechanical valve replacement surgery. The study revealed that complications related to over anticoagulation were seen in patients with mechanical valve replacement surgery. While pleural effusion, sternal wound infection and sternal dehiscence were observed in patients undergoing coronary artery bypass surgery. The complications of supratherapeutic INR included bleeding in various regions of the body. Patients reported skin bruises, hematomas in the calf and thigh muscles, gum bleeding, and pleural and pericardial effusions. Mortality rate was 4.7% (n=5) in readmitted patients. One patient readmitted with increased gradient across prosthetic valve, underwent redo surgery and remained in cardiac failure. One patient presented with cardiac tamponade having large pericardial effusion not revived after effusion drainage. Two patients died with prosthetic valve endocarditis. One post CABG surgery patient presented with leucopenia and expired. Therefore, mortality was high in readmitted patients with prosthetic valve surgery. Several studies have shown that many readmissions are potentially avoidable [13, 14]. Proper patient education, telemonitoring, posterior pericardiotomy in valve surgery patients, optimal sterilization, and rational use of antibiotics and diuretics may reduce the readmission rate [15]. Decreasing readmission rates is a key priority for future quality improvement initiatives [16-20]. The results of this study indicate that Prosthetic Valve Endocarditis (PVE) was the leading contributor to mortality, highlighting the importance of early detection and management of valve-related infections in post-operative care. Additionally, increased gradient and pericardial effusion were frequently observed in fatal cases, emphasizing the need for close monitoring of hemodynamic changes and timely interventions to prevent adverse outcomes.

The study has certain limitations. It was conducted at a single center and only includes readmissions to the same hospital. As a result, the observed readmission rate of 7.5% may not reflect the actual incidence of readmissions after cardiac surgery. Additionally, the study design does not account for patients who were not readmitted, making it difficult to determine associated risk factors. Future multicenter prospective studies with broader patient tracking systems are recommended to provide more generalizable national data. Additionally, structured postoperative follow-up programs, enhanced anticoagulation monitoring, infection prevention protocols, and patient education interventions should be evaluated to reduce avoidable readmissions and improve long-term surgical outcomes.

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CONCLUSIONS

It was concluded that early hospital readmission is most common in patients who need anticoagulation after valve surgery. Common causes of readmission are prolonged INR and its complications, surgical site infection, pleural effusion and sternal dehiscence. Early readmission after cardiac surgery, adversely impacts patient's outcome. Improved anticoagulation management, strategies to reduce surgical site infection, and postoperative diuretics, are critical for reducing incidence of hospital readmission.

Authors' Contribution

Conceptualization: MSIM
Methodology: MSIM, MHC
Formal analysis: MSIM, MHC, KH
Writing and Drafting: MSIM, MHC, KH
Review and Editing: MSIM, MHC, KH

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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