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ORIGINAL ARTICLE

Frequency of unplanned re-admissions after coronary artery bypass grafting. Experience at a tertiary care hospital.

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ABSTRAT… Objective: To study the re-admission rate after coronary artery bypass grafting performed through a median sternotomy. **Study Design:** Retrospective study. **Setting:** Punjab Institute of Cardiology, Lahore. **Period:** January 2018 and December 2022. **Methods:** Patients above the age of 18 who underwent first time CABG were included in the study. Patients with additional procedures like valve surgery were excluded. Re-admission was defined as unplanned re-hospitalization within 30 days after discharge. Data was collected on Excel sheets from the available electronic medical record system of the hospital. The data was then transported to and analyzed using IBM SPSS software (version 23, SPSS Inc., Chicago, IL, USA). Patients were divided into re-admission group and no re-admission group and various perioperative variables were compared between the two groups. **Results:** After applying the exclusion criteria, the final analysis included 503 patients. Of the cohort, 29 (5.77%) were re-admitted. Mean age of the patients in readmission group was 54.3 ± 10 years while that in the no-readmission group 52 ± 8.3 years (p=0.144). The main reasons for readmissions were superficial chest wound infection (24.14%), pericardial effusion (24.14%) and deep sternal wound infection (10.34%). **Conclusion:** Coronary artery bypass grafting is associated with re-admissions after planned discharge of the patients. Wound infections are the commonest cause of re-admission. Large scale multi center studies are needed to study the rate as well as financial impact of re-admissions after CABG.

Key words: Coronary Artery Bypass Grafting, Perioperative Factors, Re-admission.

INTRODUCTION

Coronary artery bypass grafting (CABG) is considered the gold standard treatment for ischemic heart coronary artery disease in suitable patients. It has proven short term symptomatic and long-term prognostic benefits.[1] Although considerable improvements in perioperative care have been witnessed in recent years, a notable number of patients still require re-admission for various complications directly or indirectly related to the index procedure.

Cardiovascular diseases are the leading cause of death in Saudi Arabia.[2] The high prevalence of cardiovascular diseases carries high cost of health care. In a cost of care study conducted at Prince Sultan Cardiac Center, Riyadh, Saudi Arabia, the annual estimated cost for ischemic heart disease was reported to be SAR 39,520,949 or $ 10,538,920 in 2011.[3] We can expect that this rate would be even higher in the current times. The 2021 statistical yearbook of the ministry of health (MoH), Saudi Arabia, showed that about 48,865 cardiac, chest and vascular procedures were performed in various MoH cardiac hospitals and other government facilities.[4] Coronary artery bypass grafting (CABG) is the most common surgical procedure performed for ischemic heart disease but carries high cost burden. The minimum cost of a single CABG procedure was $ 44,824 in a random sample of US hospital.[5] This makes CABG a suitable target for cost evaluation and reducing the cost incurred on health care.

Re-admission after CABG is considered a quality indicator. Unplanned re-admission not only affect

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the quality of life after CABG but also increases the costs of health care significantly. It is estimated that with a median length of stay after re-admission of 6 days, the cost to health care is $ 13,499 ± 201.[6] In another study, the cost of re-admission per patient was $ 13,399 and annual cost of $ 250 million.[7] As part of the Affordable Care Act, HRRP (Hospital Readmission Reduction Program) was started in the United States to provide incentives to hospitals with lower re-admission rates as well as reduce reimbursements to those with rates higher than predicted. In 2017, CABG was added to the list of diagnoses for which the re-admission rate is monitored in the HRRP.[8]

Previous studies on re-admissions after CABG have reported hospital population-based data from government hospitals which are publicly run health facilities.[9,10] To the best of our knowledge, there is no data reported about readmissions after CABG from private insurance based corporate health system in the Kingdom. This study is an attempt to understand the rate of re-admission and its predictors for patients who had coronary artery bypass grafting in a private insurance-based health system at a tertiary care private hospital.

METHODS

Study design and patients

A retrospective study with case control design was conducted using the hospital records of the patients at a tertiary care private hospital after approval from ethical committee (RTPGME-202) (14-9-23). About 635 patients who underwent surgery in the cardiothoracic department between January 2018 and December 2022 were identified, out of which 503 patients who underwent only CABG were included for the final analysis (Figure-1). Individual patient consent was waivered for the use of de-identified and non-recognizable patient data.

Patients above the age of 18 years or above who had first time CABG and discharged alive were included in the study. Patients who had undergone multiple procedures like valve replacement or repair were excluded from the study. Those operated in emergency were also excluded although patients operated urgently were included in the final analysis.

Re-admission was defined as unplanned re-hospitalization within 30 days of discharge for reason directly or indirectly related to the index cardiac procedure. Patients who had re-admission for reason not related to the index cardiac procedure were excluded from the study (Figure-2). We used the 30-day re-admission as this is more directly related to the surgery and this time period has been used uniformly as a perioperative quality indicator.[11]

Surgical Technique

A team of 4 consultant operating surgeons was involved in operating all the patients using identical perioperative protocols. All the patients underwent CABG through median sternotomy and cardiopulmonary bypass. Left internal mammary artery was used in all the patients for grafting left anterior descending artery and vein grafts were used for bypassing other coronaries. Myocardial protection was done through intermittent cold blood cardioplegia at 4 °C. Postoperatively, patients were extubated in the ICU within 6 hours of surgery. All the patients were managed by the same anesthetic team using identical protocols for general anesthesia and postoperative care in the ICU for the first 24 hours.

Fast track protocols using ERAS (Enhanced Recovery after Cardiac Surgery Society) were used for the general perioperative management of all the patients. These included preoperative optimization and patient education, opioid sparing multimodal anesthesia, intraoperative measures like avoiding hypervolemia, minimum use of chest drains, post operative measures like extubation within 6 hours for most of the patients, early removal of chest drains and mobilization. All the patients were discharged 7 days after the surgery (delayed discharge strategy). After discharge, patients were scheduled for a follow up visit within 10 days.

Data Collection and Statistical Analysis

Patients were divided into two groups, readmission group and no readmission group with respect to

the dependent variable readmission. Perioperative variables were recorded form the manually maintained database of the unit and the data was arranged using Microsoft Excel (2022). Variables significantly associated with re-admission were included after a thorough search of the literature. The data was then transported to and analyzed in IBM SPSS software (version 23, SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean and median with standard deviation for variance and comparative analysis of these variables was done through student t test between readmission group and non-readmission group. Dichotomous variables were presented as frequencies and percentages and analyzed using Chi square test for significance.

RESULTS

The total number of patients included in the study were 503 after applying the exclusion criteria. Of the cohort, 29 (5.77%) were re-admitted. The main reasons for readmissions were superficial chest wound infection (24.14%), pericardial effusion (24.14%) and deep sternal wound infection (10.34%). Mean age of the patients in readmission group was 54.3 ± 10 years while that in the no-readmission group 52 ± 8.3 years (p=0.144) (Figure-1).

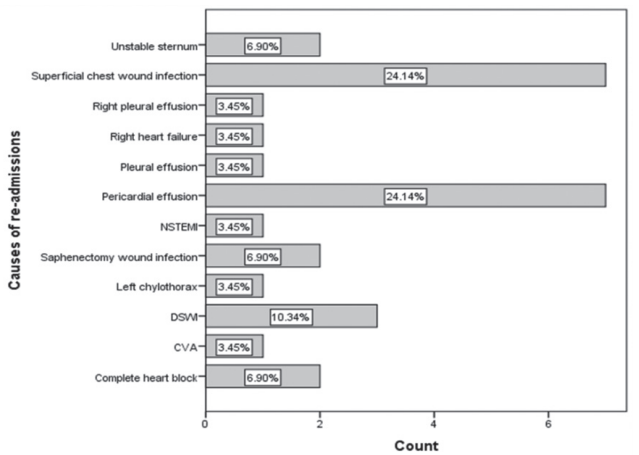

Figure-1

Diabetes mellitus (276 (58.1%) vs 20 (69%)) and hypertension (293 (61.7%) vs 19 (65.5%)) were the commonest comorbid conditions in readmission and no-readmission groups respectively (Table-I, II).

In the comparative univariate analysis, characteristics found significantly different in both the groups were NYHA class III or IV (p=0.001), stable angina (0.004), previous MI within 7 days (0.002), significant left main disease (0.001), preoperative platelet count (0.001) and urgent status of surgery (0.003). Postoperative characteristics significantly different in both the groups were postoperative superficial wound infection (3 (0.8%) vs 8 (27.6%), p=0.0001), postoperative saphenectomy wound infection (4 (0.8%) vs 2 (6.9%), p=0.042) in the no re-admission and re-admission groups respectively. Total length of stay in the hospital was numerically more in in the no-readmission group but this difference was non-significant (9.02 ± 3 vs 8.14 ± 2.5 days, p=0.364) respectively.

DISCUSSION

The 30-day re-admission rate has been used as a quality indicator for coronary artery bypass grafting and carries clinical and cost implications.[11] We observed a re-admission rate of 5.77% in our study population which is lower than the regional rates reported from public hopsitals.[9,10] Re-admission rates of 8% to 21% have been reported from public hospitals databases or Medicaid and Medicare based health system in the United States.[12,13] This rate is lower than private insurance-based health systems in United States.[14,15] The comparatively lower rate in our study can be attributed to two main reasons. The present study is based upon data collection from patients' medical records only and does not account for hospitalization in a different hospital. An administrative based database may provide a better picture of the actual rate of re-hospitalizations. Secondly, our results are reported from a private hospital with a largely private insurance-based health system. To the best of our knowledge, this is the first study about re-admissions after coronary artery bypass grafting in a private hospital in the region. Moreover, hospital to hospital variations have been observed in the reported rates of re-admissions in the literature.[5]

Non-cardiac complications were the predominant causes for readmission in our study.

Variable	Not re-admitted N=474	Re-admitted N=29	P-Value
Age (years)	52± 8.3	54.3±10	0.144
Diabetes mellitus	276 (58.1%)	20 (69%)	0.162
Hypertension	293(61.7%)	19 (65.5%)	0.423
Smoking	92 (19.4%)	6 (20.7%)	0.502
Dyslipidemia	250 (52.6%)	17 (58.6%)	0.334
Current smokers	67 (14.1%)	3 (10.3%)	0.406
Former smokers	32 (6.7%)	1 (3.40%)	0.415
COPD	20 (4.2%)	2 (6.9%)	0.363
NYHA class 3 or 4	58 (14%)	12 (46%)	0.001
CCS class 3 or 4	99 (24%)	4 (15.4%)	0.425
Previous CVA	7 (1.5%)	1 (3.40%)	0.654
Stable angina	50 (10.5%)	1 (3.40%)	0.004
Unstable angina	56 (11.8%)	4 (13.8%)	0.461
NSTEMI	221 (46.5%)	12 (41.4%)	0.362
STEMI	91 (19.2%)	3 (10.3%)	0.173
Previous MI	44 (9.3%)	3 (10.30%)	0.004
Previous MI in the last 24 hours	6 (1.3%)	1 (3.4%)	0.34
MI in 1 to 7 days	194 (40.8%)	6 (20.7%)	0.002
MI in 8 to 21 days	95 (20%)	6 (20.7%)	0.541
MI > 21 days	21 (4.4%)	1 (3.4%)	0.63
Preoperative cardiogenic shock	4 (0.8%)	1 (3.4%)	0.253
Preop arrhythmias	33 (6.9%)	2 (6.9%)	0.972
Preop ACEI	85 (17.9%)	0%	0.444
Preop β-blocker use	347 (73.1%)	18 (68.1%)	0.412
Preop clopidogrel	95 (20%)	3 (10.3%)	0.142
Left main disease >50%	114 (24%)	1 (3.4%)	0.004
Preop HB	14.05 ± 1.7	13.88 ± 1.7	0.143
Preop platelet count	255.35 ± 80.2	202.58 ± 84.99	0.001
Preop HBA1c	7.2 ± 3	7.4 ± 2.2	0.712
EF	49.92 ± 9.6	48.75 ± 10.3	0.536
EF below 35%	54 (11.5%)	3 (10.3%)	0.593
Preop fibrinogen	4.25 ± 0.53	4.2 ± 0.54	0.960

Table-I. Baseline demographic characteristics of the patients.

Variable	Not re-admitted N=474	Re-admitted N=29	P-Value
Urgent status of surgery	90 (18.9%)	3 (10.3%)	0.003
Total bleeding in first 24 hours	394.35 ± 342.76	476.75 ± 348.9	0.334
CPB time (minutes)	127 ± 42.7	131.09 ± 40.67	0.642
Cross clamp time (minutes)	81.31 ± 29.1	88.9 ± 33.5	0.174
New onset postoperative atrial fibrillation	28 (5.9%	3 (10.3%)	0.411
Perioperative stroke	5 (1.1%)	1 (3.4%)	0.301
Re-exploration for bleeding	24 (5.1%)	2 (6.9%)	0.450
Postoperative superficial sternotomy wound infection	3 (0.8%)	8 (27.6%)	0.0001
Postoperative saphenectomy wound infection	4 (0.8%)	2 (6.9%)	0.042
Length of stay in the hospital (days)	9.02 ± 3	8.14 ± 2.5	0.364

Table-II. Operative and postoperative characteristics

The most common causes were superficial wound infection (24.14%) and pericardial effusion (24.14%) followed by deep sternal wound infection (10.34%). In a systematic review and meta-analysis by Shawon et al, infection and sepsis were identified the most common causes of re-admission.[11] In a large study including 288,059 patients from United States National Readmission Database, Shah and colleagues reported infection, sepsis and heart failure as the commonest causes of 30-day re-admission after CABG. The overall re-admission rate in this large cohort was 12.2%.[6] Infection has been frequently reported as the leading cause of re-admissions as confirmed in our study as well. Hospital systems and policies directed at sterile techniques and infection control principles may mitigate these complications and hence re-admissions which may help reduce the cost of health care.

In a large cohort study including 177,229 patients, Feng at al described increasing age as a predictor of re-admission.[16] Iribarne and colleagues conducted a multicenter cohort study in Canada where they found diabetes mellitus, COPD as significant predictors of re-admission after open heart surgery.[17] Diabetes mellitus leaves the patients at high risk of infections which may lead to increased rate of re-admission. Similarly, COPD also increases the risk of sternal complications and pulmonary infections. Zea-Vera and colleagues developed a risk predictor score to predict re-admissions after CABG and they found increasing NYHA class and hence congestive heart failure an important risk factor for predicting post discharge re-admissions.[18]

Although postoperative complications like stroke and re-exploration for bleeding increase the length of index stay in the hospital, they do not predict increased rates of re-hospitalization. This was also reported by Afflu and colleagues in a single center study of 6327 patients where they found that patients who suffered from a perioperative complication did not have increased rate of re-admissions after being discharged from the hospital.[19] In their study by Fanari and colleagues, only the patient factors at admission predicted re-admissions better and addition of postoperative factors or data at discharge added minimal value to the predictive model.[20] Length of stay did have a positive correlation with increased 30 days re-admission in study by Slamowicz and colleagues but this correlation was weak.[21] On the other hand, Hannan and colleagues have argued that the increased rate of re-admission may actually be due to decrease length of stay in the hospital from 8.2 days in 1999 to 7.7 days in 2007.[22] The involvement of mainly preoperative factors in the increased rate of re-admissions provides an opportunity to devise policies and protocols directed at factors at the time of admission to reduce re-admissions after discharge.

LIMITATIONS

There are important limitations of this study. It involves experience from a single center with a retrospective design which introduces an inherent bias in the conduct of the study. Readmission rates after surgery varies from hospital to hospital and depends upon the local perioperative protocols and care principles. It is therefore important to conduct a large-scale study in the region involving many cardiac surgical facilities. Moreover, it is possible that patients may have emergency department visits. Even a single ED visit has been reported to be a predictor of 30 days re-admission.[21] Our data does not account for these visits which may have introduced selection bias. Also, the admission criteria for a particular patient were at the discretion of the admitting physician. This may have led to missing out patients who deserved admission and were not admitted. On the other hand, this may also have led to admitting patients who could otherwise be treated on outpatient basis. Hence a large-scale multicenter study is needed that may give a better picture of the local patient related as well as system-based factors such as hospital surgical volume and perioperative practices.

CONCLUSION

Preoperative factors like DM, heart failure and smoking are important risk factors associated with re-admission after CABG. The causes of re-admission are mostly infections and hospital and system-based interventions should address pathways to optimize patients perioperatively

and mitigate the rates of infection. Large scale multicenter studies are needed in the region to study the prevalence and cost implications of re-admissions after CABG. The use of centralized government database will address problems related to follow up in different hospitals and loss to follow up with the index hospital as well as inter-hospital variations in re-admission rates.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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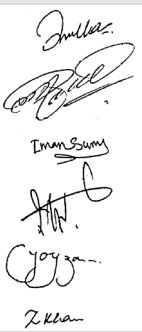
1	Imran Khan	Data collection, Study design, Manuscript writing, Statistical analysis.	
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