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Original Article

Risk factors of readmission after coronary artery bypass graft surgery: A case-control study

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ABSTRACT

Background & Aim: Reducing readmissions is a major goal of health care systems. This study aimed to identify readmission risk factors following coronary artery bypass graft surgery.
Methods & Materials: This case-control study analyzed 540 patients who underwent coronary artery bypass graft surgery between January 2016 and December 2019 at Shahid Beheshti Hospital in Qom, Iran. The case group contained 270 patients who were readmitted to the hospital during the 30-day after discharge and the control group comprised 270 non-readmitted patients.
Results: Readmit patients suffered from higher rates of cardiac failure, myocardial infarction, hypertension, myocardial dysrhythmia, and using antiplatelet coagulant medication (P<0.05). Compared with non-readmitted patients, readmitted patients were more likely to have emergency surgery (OR 1.62; CI 1.11-2.38), cardiac arrest (OR 2.52; CI 2.39-2.85), and massive intraoperative hemorrhage during surgery (OR 2.36; CI 2.13-2.67). Postoperative disorders such as surgical site infection, pleural effusion, dysrhythmias, and myocardial infarction were independent risk factors for readmission (P<0.05).
Conclusion: Patients at risk for readmission should be closely monitored. Furthermore, careful decision-making about surgical criteria by a multidisciplinary team can help improve outcomes as well as reduce readmissions.

Introduction

Coronary heart disease (CHD) is a major cause of death and disability in developing and developed nations (1). Although mortality rates of CHD have declined over the last decades in developed countries, it remains responsible for more than 30% of all deaths in individuals over age 35 (2). At least 80% of global deaths due to CHD occurred in developing low- and middle-income countries (3). The coronary artery bypass graft (CABG) is a surgical revascularization procedure performed to improve symptoms and survival in patients with CHD (4-6). CABG has been shown to relieve incapacitating chest pain and dyspnea (7) and to improve quality of life (8) and functional capacity (9). Despite the positive outcomes of CABG, it can lead to complications such as surgical wound infections, pneumonia, venous thromboembolism, graft failure (6), atrial fibrillation (10), pulmonary hypertension, pericardial effusion, strokes, renal dysfunction, gastrointestinal complications, and hemodynamic instability in the early postoperative period (11). Therefore, CABG is known to be associated with relatively high short-term readmission rates (12) Up to 15% of these patients are readmitted within 30 days of discharge (13). Readmissions contribute to known and documented increases in health care costs and adversely affect hospital reimbursement and quality measures (14).

Previous studies have characterized readmission after CABG as a major clinical burden. Also, these studies have analyzed the causes of readmission to surgery and

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found many modified risk factors that could lead to improved outcomes and reduced health care costs if prevented. (14,15). Therefore, reducing hospital readmissions is a major goal of health care systems (16). The key to preventing readmission depends on providing high-quality care in the inpatient setting (17) and improving transitional care before hospital discharge (18). Early identification of patients at risk for readmission following CABG is crucial for improving hospital quality of care and reducing readmission (19).

Different studies in different countries have suggested different risk factors for readmission after CABG. Therefore, due to a lack of prior research studies on the topic in Iran, it is necessary to examine the risk factors of readmission in the current context. Therefore, this study aimed to identify readmission risk factors following CABG in Shahid Beheshti Hospital in Qom, Iran.

Method

This case-control study was conducted to investigate risk factors of hospital readmission in patients who underwent CABG between January 2016 and December 2019 at Shahid Beheshti Hospital in Qom, Iran. The case group contained 270 patients who were readmitted to the hospital during the 30-Day after discharge. And the control group comprised 270 patients who were not readmitted during the 30-Day after discharge. Random sampling was used for the selection of the case and control group.

Patients≥18 years of age who underwent isolated CABG and survived to discharge were included. The exclusion criteria included having concomitant operations (eg. valve repair/replacement, aortic arch interventions, ventricular assist device, or transplant) and readmission to hospitals in other states. Cases and controls were well groups matched for the number of bypass grafts, duration of aortic cross-clamp, and cardiopulmonary bypass time.

A complete median sternotomy was performed in all patients. Saphenous veins and the internal thoracic artery were used as conduits for myocardial revascularization. Body cooling techniques and cold crystalloid cardioplegia were used to protect myocardial function during cardiac surgery. After surgery, all the patients were admitted to the intensive care unit for three to four days, then they were transferred to the cardiac surgery ward and discharge after approximately one week.

Data was collected using a checklist containing demographic information (e.g. age, gender, BMI, and history of underlying disease) operative factors (e.g. type of surgery, surgical technique, and cardiac arrest and massive hemorrhage during surgery), and postoperative factors (e.g. surgical site infection, pleural effusion, dysrhythmia, and myocardial infarction). Statistical analysis was performed using the SPSS version 20 statistical software package (SPSS Inc., Chicago, IL, USA). Chi-square test and bivariate logistic regressions were used to compare the cases and controls to examine the risk factors associated with readmission. Finally, multiple logistic regression was applied to adjust the effect of confounding variables, controlling significant variables in the bivariate analysis. In other words, Independent variables with a P value less than 0.05 in the simple regression model were included in the final model. The 95% confidence interval (CI) is used to estimate the precision of the OR.

This study approved by the Research Ethics Committee of Qom University of Medical Sciences approved the study (no: IR.MUQ.REC.1398.012).

Results

The baseline characteristics of the participants are shown in table 1. The mean ages and Body Mass Index (BMI) of the patients in the case and control groups were 59.72±10.62 vs. 60.67±9.91 years, and 26.24±4.64 vs. 26.23±4.82 kg/m2,

respectively. Most of the participants were male (67%). Readmit patients suffered from higher rates of cardiac failure, myocardial infarction, hypertension, myocardial dysrhythmia, and using antiplatelet coagulant medication (P<0.05). However, there was no significant difference between the case and control groups in the terms of age, BMI, renal disease, liver disease, diabetes, respiratory disease, and hyperlipidemia (P>0.05).

Compared with non-readmitted patients, readmitted patients were more likely to have emergency surgery (OR 1.62; CI 1.11-2.38), cardiac arrest (OR 2.52; CI 2.39-2.85), and massive intraoperative hemorrhage during surgery (OR 2.36; CI 2.13-2.67). However, most patients in the case and control groups underwent similarly on-pump surgery (Table 2).

Table 1. Comparing the baseline characteristics of case and control groups

Variable	Group		P-Value
	Case (N=270)	Control (N=270)	
Age	59.72±10.62	60.67±9.91	0.28
Gender, Male	175 (65.1)	190 (70.4)	0.18
BMI	26.24±4.64	26.23±4.82	0.97
Cardiac failure	118 (43.7)	98 (36.3)	0.04
Myocardial infarction	20 (7.4)	8 (3)	0.01
Hypertension	207 (77.2)	181 (67)	<0.01
Renal disease	19 (7)	10 (3.7)	0.06
Liver disease	2 (7)	1 (4)	0.51
Diabetes	128 (47.4)	131 (48.5)	0.43
Respiratory disease	9 (3.3)	5 (1.9)	0.20
Hyperlipidemia	141 (52.2)	127 (47)	0.13
Myocardial dysrhythmia	42 (16.9)	24 (9.9)	0.01
Antiplatelet coagulant medication	30 (11.1)	17 (6.3)	0.03
Data are presented as the Mean ± SD, and N(%); BMI: Body Mass Index			

Table 2. Comparing the operative factors of the participants between case and control groups

Variable		Group		OR (CI 95% OR)	P Value
		Case (N=270)	Control (N=270)		
Type of surgery	Emergency	86 (32.2)	61 (22.7)	1.62 (1.11-2.38)	<0.01
	Elective	181 (67.8)	208 (77.3)		
Surgical Technique	On-Pump	238 (88)	232 (36.6)	1.14 (0685-1.89)	0.35
	Off-Pump	32 (12)	36 (13.4)		
Cardiac arrest	Yes	66 (27.7)	1 (0.4)	2.52 (2.39-2.85)	<0.001
	No	172(72.3)	269(99.6)		
Massive hemorrhage (>2L)	Yes	72 (26.7)	2 (0.8)	2.36 (2.13-2.67)	<0.001
	No	198(73.3)	268(99.2)		
Data are presented as the N (%)					

Postoperative disorders such as surgical site infection, pleural effusion, dysrhythmias, and myocardial infarction were independent risk factors of readmission. However, the frequency of postoperative pneumonia was similar in the case and control groups (Table 3).

Any variable demonstrating a p-value of 0.2 or less was entered into the model. The results of multiple logistic regression showed that the previous history of CABG (OR: 6.69; 95% CI: 3.54-13.24, P>0.001) and non-elective surgery (OR:1.26, 95% CI: 1.12-2.37, P>0.001) were associated with increased readmission rates (Table 4).

Table 3. Post-operative factors of the participants among case and control groups

Variable		Group		OR (CI 95% OR)	P-Value
		Case (N=270)	Control (N=270)		
Surgical Site Infection	Yes	40 (14.8)	1 (4)	2.12(1.91-2.35)	<0.001
	No	230(85.2)	269(99.6)		
Pleural Effusion	Yes	34 (12.6)	2 (0.7)	2.15(1.95-2.36)	<0.01
	No	235(87.4)	268(91.3)		
Pneumonia	Yes	8 (3)	0 (0)	NA*	0.06
	No	262(97)	270(100)		
Dysrhythmia	Yes	116 (43)	0 (0)	NA	<0.001
	No	154(57)	270(100)		
Myocardial Infarction	Yes	8 (3)	1 (4)	1.81(1.41-2.31)	0.01
	No	262(97)	269(99.6)		

*Not Assessed

Table 4. The results of multiple logistic regression

Variable	β	SE (β)	Odds Ratio (OR)	CI 95% OR	P-value
Previous history of CABG	2.81	0.61	6.69	**3.54-13.24**	<0.001
Non-elective surgery	0.78	0.26	1.26	**1.12-2.37**	0.039

Discussion

Hospital readmissions occur frequently and add substantial costs to the healthcare system (14). Decreasing readmissions within a short period after initial discharge are one of the targets in our health care system for reducing unnecessary costs. The main purpose of this study was to investigate the risk factors of 30-day readmissions following CABG operations. According to the results of this study age, gender, and BMI did not show a significant correlation to hospital readmission. However, Fanari et al. and Shah et al. found that older patients had a high risk for readmission (17). Moreover, Benetis et al. showed that the age>70 years and BMI>30 kg/m2 are predictors for hospital readmission (20). Fanari, Shah, and Benetis' difference in results with the current study may be related to differences in participants' age. In these studies, the participants were older than the present study (> 65 years vs. <60 years). As the world's population gets older, the average age of patients undergoing CABG also increases (21). Surgical comorbidities are more prevalent among elderly patients (22). Given this, health care providers should analyze the perioperative course features to improve their care (23).

The independent preoperative predictors of readmission in this study were a cardiac failure, myocardial infarction, hypertension, myocardial dysrhythmia, and using antiplatelet coagulant medications. Hannan et al. found that patients who were at the highest risk for 30-day readmission included elderly patients with comorbidities such as cerebrovascular disease, congestive heart failure, shock, COPD, diabetes, and immune system deficiency (14). Another study also

showed that congestive heart failure, COPD, and diabetes are independently associated with higher readmission rates (24). Lack of full investigation of the severity of participants' underlying diseases makes it difficult to compare results between studies. Renal and liver disease are multi-system disorders. Patients with renal disease are at increased risk of cardiovascular disease and susceptibility to infections, and diabetes mellitus (25). Also, patients with liver disease are at increased risk of infection, coagulopathy, and impaired wound healing (26). Given this, in patients with organ dysfunction, the health care providers should use the proper anesthetic techniques, antifibrinolytic agents, and careful surgical techniques to prevent the complications that lead to readmission.

The independent operative predicates of readmission in the current study were non-elective surgery, cardiac arrest, and massive hemorrhage. Earlier studies have also found that the patients who underwent emergency non-elective surgery were more likely to experience readmissions (23, 27). Among the operative factors, the surgical technique did not affect the readmission rate. Amouzeshi et al. also found that off-pump is not associated with any increase in readmission rates when compared with on-pump CABG (28). However, Barili et al. have shown that Off-pump CABG is associated with a higher risk of prehospitalization (29). Complete revascularization and graft patency are associated with long-term outcomes. It has been hypothesized that incomplete revascularization and/or poor graft patency with off-pump CABG is responsible for poor outcomes (30). Further studies are needed to elucidate the outcomes of off-pump and off-pump surgery.

The post-operative independent risk factors for readmission were surgical site infection, pleural effusion, dysrhythmias, and myocardial infarction were independent risk factors of readmission, which is consistent with reports of earlier study(6,11). Moreover, the present study found that the incidence of postoperative pneumonia was similar in the case and control groups. However, the incidence of pneumonia in the case group was more than that in the control group, and due to the clinical risks of pleural effusion, this incident, however low, cannot be ignored.

Limitations

Our study has several limitations. Since some people may have died after the CABG, the results cannot be generalized to all those who have undergone this surgery. Moreover, data on the severity of preoperative disorders such as renal, liver, or respiratory disease were not available. Despite these limitations, this study represents the first study in Iran that provides sufficient discrimination to identify those at risk for readmission after CABG that could provide major public health benefits.

Conclusion

This study has demonstrated that there are several risk factors associated with short-term readmissions after CABG surgery. Patients with any of these risk factors for readmission should be closely monitored. Furthermore, careful decision-making about surgical criteria by a multidisciplinary team, including cardiac surgeons, cardiologists, internists, and infectious disease specialists, can help improve outcomes as well as reduce readmissions.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. Mendis S, Puska P, Norrving B, World Health Organization., World Heart Federation., World Stroke Organization. Global atlas on cardiovascular disease prevention and control. Geneva: World Health Organization in collaboration with the World Heart Federation and the World Stroke Organization; 2011. vi, 155 p. p.
2. Sanchis-Gomar F, Perez-Quilis C, Leischik R, Lucia A. Epidemiology of coronary heart disease and acute coronary syndrome. Annals of translational medicine. 2016;4(13):256.
3. Markle WH, Fisher MA, Smego RA. Understanding Global Health, 2E. McGraw Hill Professional; 2013 Oct 22.
4. Barstow C, McDivitt JD. Cardiovascular Disease Update: Care of Patients After Coronary Artery Bypass Graft. FP essentials. 2017;454:29-33.
5. Hillis LD, Smith PK, Anderson JL, Bittl JA, Bridges CR, Byrne JG, et al. 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation. 2011;124(23):e652-735.
6. Abbasi M, Mohammadi N, Nikbakht Nasrabadi A, Sadegi T. Experiences of living with coronary artery bypass graft: a qualitative study. Journal of hayat. 2014;19(4):38-47.
7. Herlitz J, Brandrup-Wognsen G, Evander MH, Caidahl K, Hartford M, Karlson BW, et al. Symptoms of chest pain and dyspnoea during a period of 15 years after coronary artery bypass grafting. European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery. 2010;37(1):112-8.
8. Perrotti A, Ecarnot F, Monaco F, Dorigo E, Monteleone P, Besch G, et al. Quality of life 10 years after cardiac surgery in adults: a long-term follow-up study. Health and quality of life outcomes. 2019;17(1):88.
9. Nery RM, Martini MR, Vidor Cda R, Mahmud MI, Zanini M, Loureiro A, et al. Changes in functional capacity of patients two years after coronary artery bypass grafting surgery. Revista brasileira de cirurgia cardiovascular : orgao oficial da Sociedade Brasileira de Cirurgia Cardiovascular. 2010;25(2):224-8.
10. Abbasi M, Negarandeh R, Norouzadeh R, Mogadam ARS. The Challenges of living with an implantable cardioverter defibrillator: A Qualitative Study. Iranian Red Crescent Medical Journal. 2016;18(10) e25158.
11. Montrief T, Koyfman A, Long B. Coronary artery bypass graft surgery complications: A review for emergency clinicians. The American journal of emergency medicine. 2018;36(12):2289-97.
12. Feng TR, White RS, Gaber-Baylis LK, Turnbull ZA, Rong LQ. Coronary artery bypass graft readmission rates and risk factors - A retrospective cohort study. International journal of surgery (London, England). 2018;54(Pt A):7-17.
13. Fox JP, Suter LG, Wang K, Wang Y, Krumholz HM, Ross JS. Hospital-based, acute care use among patients within 30 days of discharge after coronary artery bypass surgery. The Annals of thoracic surgery. 2013;96(1):96-104.
14. Hannan EL, Zhong Y, Lahey SJ, Culliford AT, Gold JP, Smith CR, et al. 30-day readmissions after coronary artery bypass graft surgery in New York State. JACC Cardiovascular interventions. 2011;4(5):569-76.
15. Rosenblum JM, Lovasik BP, Hunting JC, Binongo J, Halkos ME, Leshnower BG, et al. Predicted Risk of Mortality Score predicts 30-day readmission after coronary artery bypass grafting. General thoracic and cardiovascular surgery. 2019;67(8):661-8.
16. Bradley EH, Curry L, Horwitz LI, Sipsma H, Wang Y, Walsh MN, et al. Hospital strategies associated with 30-day readmission rates for patients with heart failure. Circulation Cardiovascular quality and outcomes. 2013;6(4):444-50.
17. Gupta S, Zengul FD, Davlyatov GK, Weech-Maldonado R. Reduction in Hospitals' Readmission Rates: Role of Hospital-Based Skilled Nursing Facilities. Inquiry : a journal of medical care organization, provision and financing. 2019;56:46958018817994.
18. Rennke S, Ranji SR. Transitional care strategies from hospital to home: a review for the neurohospitalist. The Neurohospitalist. 2015;5(1):35-42.
19. Zywot A, Lau CSM, Glass N, Bonne S, Hwang F, Goodman K, et al. Preoperative Scale to Determine All-Cause Readmission After Coronary Artery Bypass Operations. The Annals of thoracic surgery. 2018;105(4):1086-93.
20. Benetis R, Sirvinskas E, Kumpaitiene B, Kinduris S. A case-control study of readmission to the intensive care unit after cardiac surgery. Medical science monitor : international medical

journal of experimental and clinical research. 2013;19:148-52.
21. Acton QA. Myocardial Ischemia: New Insights for the Healthcare Professional: 2013 Edition: ScholarlyBrief: ScholarlyEditions; 2013.
22. Chu CL, Chiou HY, Chou WH, Chang PY, Huang YY, Yeh HM. Leading Comorbidity associated with 30-day post-anesthetic mortality in geriatric surgical patients in Taiwan: a retrospective study from the health insurance data. BMC geriatrics. 2017;17(1):245.
23. Grocott MPW, Edwards M, Mythen MG, Aronson S. Peri-operative care pathways: re-engineering care to achieve the 'triple aim'. Anaesthesia. 2019;74 Suppl 1:90-9.
24. McNeely C, Kwedar K, Markwell S, Vassileva CM. Improving coronary artery bypass grafting readmission outcomes from 2000 to 2012 in the Medicare population. The Journal of Thoracic and Cardiovascular Surgery. 2017 Oct 1;154(4):1288-97.
25. Cheikh Hassan HI, Tang M, Djurdjev O, Langsford D, Sood MM, Levin A. Infection in advanced chronic kidney disease leads to increased risk of cardiovascular events, end-stage kidney disease and mortality. Kidney international. 2016;90(4):897-904.
26. Friedman LS. Surgery in the patient with liver disease. Transactions of the American Clinical and Climatological Association. 2010;121:192-204; discussion 5.
27. Anis HK, Sodhi N, Coste M, Ehiorobo JO, Newman JM, Garbarino LJ, et al. A comparison of peri-operative outcomes between elective and non-elective total hip arthroplasties. Annals of translational medicine. 2019;7(4):78.
28. Amouzeshi A, Amouzeshi Z, Abbasi Teshnizi M, Moeinipour AA, Hosseinzadeh Maleki M. Off-Pump Versus On-Pump Coronary Artery Bypass Graft Surgery Outcomes During 6 Years: A Prospective Cohort Study. Acta medica Iranica. 2017;55(9):578-84.
29. Barili F, Rosato S, D'Errigo P, Parolari A, Fusco D, Perucci CA, et al. Impact of off-pump coronary artery bypass grafting on long-term percutaneous coronary interventions. The Journal of thoracic and cardiovascular surgery. 2015;150(4):902-9.e1-6.
30. Rodrigues AJ, Evora PR, Tubino PV. On-pump versus off-pump coronary artery bypass graft surgery: what do the evidence show? Revista brasileira de cirurgia cardiovascular : orgao oficial da Sociedade Brasileira de Cirurgia Cardiovascular. 2013;28(4):531-7.