Thirty-day readmission rates and associated risk factors after coronary artery bypass grafting

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Abstract

Objectives: Coronary artery bypass grafting (CABG) is among the most frequently performed cardiac surgical procedures. However, it is associated with high readmission rates for a plethora of causes, which can substantially increase healthcare costs. This study aimed to assess the rates and associated risk factors of 30-day readmissions for CABG patients.

Methods: We conducted this retrospective cohort study at King Abdulaziz Medical City. The study targeted adult patients who underwent CABG between January 1, 2016, and January 31, 2019. Data were extracted from the BEST Care system. Frequencies and percentages were generated for categorical variables. Mean and standard deviation were calculated for quantitative variables. Bivariable and multivariable logistic regressions were used to detect readmission risk factors.

Results: Among 534 adult patients, the overall 30-day readmission rate was 16.1% (n = 86). The multivariable logistic regression analysis showed that diabetes mellitus (P = .002), amiodarone use (P = .04), statin use (P = .04), amiodarone and statin use (P < .001), and hyperlipidemia (P = .04) were significantly correlated with 30-day readmission.

Conclusions: Our study showed an estimated 16.1% 30-day readmission rate after CABG. Diabetes mellitus, asthma, hyperlipidemia, and use of medications such as amiodarone, statins, and amiodarone were associated with readmission. Further studies are needed to develop tailored and practical strategies to reduce CABG readmissions and mitigate patient and health care facility burdens.

Keywords: Cardiac surgery; Coronary artery bypass grafting; KSA; Prevalence; Readmissions
Introduction

Coronary artery bypass grafting (CABG) is a surgical procedure in which a section of a blood vessel is grafted into the coronary artery to bypass the blocked section of its circulation.1 With a reported annual rate of 4,00,000 procedures and an average incidence of 62 per 100,000 citizens in western European countries,2,3 CABG is among the most common cardiac surgical procedures performed. Severe blockages in the coronary circulation are the main indication for CABG, notably when medical treatment or percutaneous coronary intervention (PCI) fails to clear the arterial blockage.4 CABG can involve a variety of complications that increase morbidity and mortality. According to a study conducted in Bologna, Italy, the risk of stroke post-CABG varies across studies is 0–5.2%. Strokes can cause disability and increase the risk of death by up to 6-fold.5

Globally, CABG has a high rate of short-term readmissions.3,4 Readmissions can burden both the healthcare system and the patient, especially when the average cost of readmission equals US $14,674.70.6 Many global studies have discussed the rates and risk factors of short-term readmissions. In fact, some developed evidence-based strategies that adequately address these risk factors.8 However, no peer-reviewed study conducted in KSA to date has used hospital population-based data to identify the rates and readmissions of CABG or develop strategies to lower them despite it being a region with a high prevalence of heart disease. Thus, due to a lack of local studies discussing the subject, the present study aimed to assess the 30-day readmission rate and associated risk factors for adult patients undergoing CABG. Assessing and managing the risk factors to adequately lower readmission rates could remove or at least mitigate an enormous burden on both patients and health care facilities.

Materials and Methods

Study design and participants

This retrospective cohort study was conducted at King Abdulaziz Medical City (KAMC). Inclusion criteria were used to select all adult patients who underwent CABG at KAMC with a complete medical history between January 1, 2016, and January 31, 2019. The exclusion criteria were: those who had undergone CABG and follow-up outside KAMC and those readmitted for reasons not directly related to the CABG procedure. Finally, 534 patients were included.

Data collection method

The patients’ medical records were accessed in the BEST Care system. All adult patients who underwent CABG surgery and met the inclusion criteria were enrolled. The primary outcome variable was 30-day readmission. The variables were grouped according to age, sex, body mass index (BMI), length of hospital stay, any comorbidities, discharge medications used, and non-routine discharge. The research team retrospectively analyzed all of the included medical records.

Statistical analysis

The data were managed in Microsoft Excel 2010 (Microsoft Ltd., USA) and were analysed using SPSS version 20.0 (IBM Corporation, NY, USA). Frequencies and percentages were generated for categorical variables, while mean and standard deviation were calculated for quantitative variables. Bivariable and multivariable logistic regression analyses were used to investigate factors that were significantly associated with 30-day readmission.

In the bivariable logistic regression analysis, a backward elimination method was used to eliminate the less relevant variables. The significant variables were detected, and those variables with values of \( P \leq .20 \) were included in the final multivariable logistic regression analysis. For the multivariable analysis, the binary logistic regression equation was used. A 5% significance level was set as the basis to reject the null hypothesis. The Hosmer and Lemeshow test was used to assess model fitness at a 5% level of significance.

Results

Baseline characteristics

Of the 534 adult patients, 85.6% (n = 457) were male and 14.4% (n = 77) were female. Overall, 97.8% (n = 522) were routinely discharged. The all-cause mortality rate during the index admission was 2.2% (n = 12). Among the population, 9.7% (n = 52) were \( \leq 50 \) years old, 31.1% (n = 166) were 51–60 years old, 36.0% (n = 192) were 61–70 years old, and 23.2% (n = 124) were \( \geq 71 \) years old. The mean patient age was 62.7 \( \pm 10.2 \) years for men and 62.7 \( \pm 9.2 \) years for women. Overall, 1.7% (n = 9) were underweight, 17% (n = 91) were of normal weight, 37.8% (n = 202) were overweight, and 43.4% (n = 232) were obese. The mean BMI was 28.7 \( \pm 5.2 \) kg/m\(^2\) for the men and 31.8 \( \pm 5.2 \) kg/m\(^2\) for the women. Length of stay was \( \leq 1 \) week for 11% (n = 6), 1–2 weeks for 48.9% (n = 261), 3–4 weeks for 38.6% (n = 206), 5–8 weeks for 9% (n = 48), and \( > 8 \) weeks for 2.4% (n = 13). The mean length of stay was 19.1 \( \pm 17.3 \) (7–234) days overall, 18.4 \( \pm 16.5 \) (range, 7–234) days for the men, and 22.9 \( \pm 20.8 \) (range, 8–147) days for the women. The overall 30-day readmission rate was 16.1% (n = 86); of the cohort, .7% (n = 4) had \( > 1 \) readmission during the 30-day period (Table 1).

Comorbidities

The most prevalent comorbidity was diabetes mellitus, identified in 75.3% (n = 402), followed by hypertension (67.8% [n = 362]), dyslipidaemia (34.8% [n = 186]), and chronic kidney disease (6.2% [n = 33]) (Table 2).
Discharge medications

The most common prescribed discharge medications were aspirin (90.1% [n = 481]), statins (88.2% [n = 471]), clopidogrel (73.8% [n = 394]), and furosemide (37.8% [n = 202]) (Table 3).

Table 1: Patients’ baseline characteristics (N = 534).

| Variable                              | Category             | n (%)   |
|---------------------------------------|----------------------|---------|
| Sex                                   | Male                 | 457 (85.6) |
|                                       | Female               | 77 (14.4) |
| Age, years, mean ± SD                 | 62.5 ± 9.9 (range, 31–87) |
| Age, years                            | ≤50                  | 52 (9.7) |
|                                       | 51–60                | 166 (31.1) |
|                                       | 61–70                | 192 (36.0) |
|                                       | ≥71                  | 124 (23.2) |
| Overall body mass index, kg/m², mean ± SD | 29.2 ± 6.0 (range, 17.0–94.4) | |
| Body mass index group                 | Underweight (≤18)    | 9 (1.7) |
|                                       | Normal weight (18.5–24.9) | 91 (17.0) |
|                                       | Overweight (25–29.9)  | 202 (37.8) |
|                                       | Obese (≥30)          | 232 (43.4) |
| Number of 30-day readmissions per patient | None                | 442 (82.8) |
|                                       | 1                    | 82 (15.4) |
|                                       | 2                    | 4 (.7) |
| Mortality rate                        | Routinely discharged | 522 (97.8) |
|                                       | Deceased             | 12 (2.2) |
| Overall length of hospital stay, weeks | 19.1 ± 17.3 (range, 7–234) | |
| Length of hospital stay, weeks        | <1                   | 6 (.1) |
|                                       | 1–2                  | 261 (48.9) |
|                                       | 3–4                  | 206 (38.6) |
|                                       | 5–8                  | 48 (9.0) |
|                                       | >8                   | 13 (2.4) |
| Male patients only                    | Age, years, mean ± SD | 62.7 ± 10.2 (range, 21–87) |
|                                       | Body mass index, kg/m², mean ± SD | 28.7 ± 5.2 (range, 17–54) |
|                                       | Length of stay, weeks | 18.4 ± 6.5 (range, 7–234) |
| Female patients only                  | Age, years, mean ± SD | 62.7 ± 9.2 (range, 39–83) |
|                                       | Body mass index, kg/m², mean ± SD | 31.8 ± 5.2 (range, 18–49) |
|                                       | Length of stay, weeks | 22.9 ± 20.8 (range, 8–147) |

Table 2: Overall patient comorbidities (N = 534).

| Comorbidity                          | n (%)   |
|--------------------------------------|---------|
| Diabetes mellitus                    | 402 (75.3) |
| Hypertension                         | 362 (67.8) |
| Dyslipidaemia                        | 186 (34.8) |
| Chronic kidney disease               | 33 (6.2) |
| Smoking                              | 24 (4.5) |
| Hyperlipidaemia                      | 19 (3.6) |
| Hypothyroidism                       | 24 (4.5) |
| Hyperparathyroidism                  | 14 (2.6) |
| End-stage renal disease              | 9 (1.7) |
| Asthma                               | 15 (2.8) |
| Decompensated heart failure          | 2 (.4) |
| Dyspnoea                             | 2 (.4) |
| Psoriasis                            | 3 (6) |
| Anaemia                              | 5 (9) |
| Epilepsy                             | 3 (6) |
| Vitiligo                             | 2 (4) |
| Hepatitis                            | 3 (6) |
| Rheumatoid arthritis                 | 18 (3.4) |

Bivariable analysis

The variables diabetes mellitus (P = .002), amiodarone use (P = .03), statin use (P = .04), amlodipine use (P = .012), asthma (P < .001), and hyperlipidaemia (P = .03) were significantly correlated with readmission within 30 days on the bivariable analysis (Table 4).

Multivariable logistic regression

The binary logistic regression equation was used. Diabetes mellitus (P = .002), amiodarone use (P = .04), statin use (P = .04), amlodipine use (P = .006), asthma (P < .001), and hyperlipidaemia (P = .04) were significant predictors of readmission within 30 days (Table 5).

Table 3: Discharge medications (N = 534).

| Medication    | n (%)   |
|---------------|---------|
| Amiodarone    | 44 (8.2) |
| Furosemide    | 202 (37.8) |
| Aspirin       | 481 (90.1) |
| Statin        | 471 (88.2) |
| Apisaaban     | 22 (4.1) |
| Warfarin      | 45 (8.4) |
| Amlodipine    | 56 (10.5) |
| Heparin       | 14 (2.6) |
| Clopidogrel   | 394 (73.8) |
The study aimed to assess the 30-day readmission rates and associated predictors of patients who underwent CABG procedures at the KAMC. The results revealed a readmission rate of 16.1% after the index admission. The estimated rate was similar to those reported elsewhere, including 16.1%, 8.9%, 16.9%, 12.2%, 16%, and 9.2% in the United States; 14.4% and 15.2% in Australia; 12.0% in Korea; and 10.7% in Taiwan. In our region, the Middle East, one study conducted in Lebanon reported a readmission rate of 9.8%, similar to those described in global studies.

Although the CABG procedure has been in use since the 1960s, it has not been thoroughly explored in the Middle East. Few efforts have been made to enhance it to achieve the most desirable short- and long-term outcomes.

Unlike a previous American multicentre study that found patients with a BMI >40 kg/m² were at higher risk of readmission, the current study did not find a significant association between any BMI group and risk for readmission in the final analysis. Additionally, the present study found no association between age and an increased likelihood of readmission. The results are inconsistent with many American multiple centre studies that included more abundant populations. On the other hand, the findings are similar to those reported in a single-centre American study with a similarly sized population that reported no association between age and 30-day readmission rate.

Moreover, the current study found that length of hospital stay was not associated with 30-day readmission, contradicting an Australian multicentre study reporting that a longer length of stay was a potential predictor for 30-day readmission and an American multicentre study that reported that length of stay was associated with a higher risk of readmission.

The present study found no correlation between sex and risk of readmission. These findings are inconsistent with those of an American study that reported a similar readmission rate of 16%. The finding was also inconsistent with that of a study in Australia but similar to that of a study in Korea that reported no significant correlation between sex and readmission.

Regarding comorbidities, in the multivariable analysis, the present study identified diabetes mellitus as a predictor of 30-day readmission. Similarly, an American study reported that patients with diabetes were more likely to be readmitted. On the other hand, our study found no significant correlation between chronic renal failure and 30-day readmission, which contradicts the results of an American study that identified chronic renal failure as a predictor.

Moreover, complementing our negative findings, a study with a similarly sized population found no significant relationship between hypertension and the likelihood of readmission after CABG. However, a South Korean study that compared readmission rates for CABG and PCI found that hypertension can be a predictor of post-CABG readmission. On the other hand, this same study reported that hyperlipidaemia can be a predictor of readmission, as demonstrated here.

Addressing risk factors can markedly reduce the readmission rates. For instance, a study conducted at the Intermountain Medical Center (Murray, UT, USA) that aimed to reduce 30-day readmission rates after CABG formed a three-stage reduction strategy that was divided into pre-procedure, during hospitalization, and post-procedure phases. The pre-procedure strategy used the Society of Thoracic Surgeons risk calculator, European System for Cardiac Operative Risk Evaluation, 5-m walk test, and dysphagia screening test to detect patients at high risk for readmission. The strategies used during hospitalization involved not discharging the patient if their weight was >3 kg above the admission weight.

### Table 4: Results of bivariable logistic regression analysis.

| Variable          | B    | P    | Odds Ratio | 95% Confidence Interval |
|-------------------|------|------|------------|-------------------------|
| Gender            | .210 | .548 | 1.234      | 5.612 - 2.450            |
| Age               | -.018| .156 | .982       | .958 - 1.007             |
| Height            | -.486| .349 | .615       | .222 - 1.701             |
| Weight            | -.012| .388 | .988       | .961 - 1.015             |
| Body mass index   | .019 | .572 | 1.019      | .954 - 1.088             |
| Length of stay    | .006 | .410 | 1.006      | .992 - 1.021             |
| Diabetes mellitus | -.127| .002 | .886       | .564 - 1.398             |
| Hypertension      | -.101| .750 | .904       | .487 - 1.679             |
| Dyslipidaemia     | -.497| .070 | .608       | .355 - 1.041             |
| Hypothyroidism    | -.138| .123 | .194       | .024 - 1.559             |
| End-stage renal disease | -.752| .411 | .471       | .078 - 2.838             |
| Amiodarone        | -.863| .033 | .422       | .191 - .933              |
| Statin            | -.131| .037 | .768       | .078 - .924              |
| Amlodipine        | -.872| .012 | .418       | .211 - .829              |
| Asthma            | -.259| .000 | .074       | .019 - .287              |
| Hyperlipidaemia   | -.126| .028 | .284       | .092 - .874              |
| Model Fitness Test|     |      |            |                        |

### Table 5: Results of multivariable logistic regression analysis.

| Variable          | B    | P    | Odds Ratio | 95% Confidence Interval |
|-------------------|------|------|------------|-------------------------|
| Age               | -.018| .157 | .982       | .959 - 1.007             |
| Diabetes mellitus | -.124| .002 | .886       | .130 - .638              |
| Dyslipidaemia     | -.471| .075 | .624       | .372 - 1.049             |
| Hypothyroidism    | -.163| .110 | .195       | .026 - 1.444             |
| Amiodarone        | -.821| .037 | .440       | .203 - .953              |
| Statin            | -.127| .038 | .281       | .084 - .933              |
| Amlodipine        | -.948| .006 | .387       | .198 - .758              |
| Asthma            | -.250| .000 | .081       | .021 - .310              |
| Hyperlipidaemia   | -.161| .038 | .313       | .105 - .935              |
| Model Fitness Test|     |      |            |                        |

### Discussion

The study aimed to assess the 30-day readmission rates and associated predictors of patients who underwent CABG procedures at the KAMC. The results revealed a readmission rate of 16.1% after the index admission. The estimated rate was similar to those reported elsewhere, including 16.1%, 8.9%, 16.9%, 12.2%, 16%, and 9.2% in the United States; 14.4% and 15.2% in Australia; 12.0% in Korea; and 10.7% in Taiwan. In our region, the Middle East, one study conducted in Lebanon reported a readmission rate of 9.8%, similar to those described in global studies.

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Moreover, the current study found that length of hospital stay was not associated with 30-day readmission, contradicting an Australian multicentre study reporting that a longer length of stay was a potential predictor for 30-day readmission and an American multicentre study that reported that length of stay was associated with a higher risk of readmission.

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Addressing risk factors can markedly reduce the readmission rates. For instance, a study conducted at the Intermountain Medical Center (Murray, UT, USA) that aimed to reduce 30-day readmission rates after CABG formed a three-stage reduction strategy that was divided into pre-procedure, during hospitalization, and post-procedure phases. The pre-procedure strategy used the Society of Thoracic Surgeons risk calculator, European System for Cardiac Operative Risk Evaluation, 5-m walk test, and dysphagia screening test to detect patients at high risk for readmission. The strategies used during hospitalization involved not discharging the patient if their weight was >3 kg above the admission weight.
or they had no bowel movements were absent, were not yet at step 5 of the cardiac rehabilitation program, had increased oxygen needs, had a haematocrit <22, had an irregular heart rhythm, or had a heart rate <120 beats/min. The post-procedure strategy included assigning physician assistants to monitor patients discharged to skilled nursing facilities and encouraging surgeons to visit these facilities and educate the staff about readmissions. After implementing the triple-aim reduction strategy, the initial readmission rate of 8.9% decreased by 64%—5.5%.6

There were some limitations to this study. First, the data registered in the BEST Care system may be incomplete. Second, the research team could not directly observe the cases; as such, they had to rely on other individuals for accurate recordkeeping. Third, because this was a retrospective study, selection bias may have been unavoidable. In terms of strengths, the current study is the first of its kind in KSA and encourages further exploration of readmission rates and risk factors for CABG patients and other patient populations. In addition, the study included only unplanned readmissions. This is especially important given that tertiary centres such as KAMC are more likely to experience planned readmissions for surgical procedures such as CABG.

Conclusion

Our findings suggest that the estimated 30-day readmission rate was similar to those reported in other countries. Diabetes mellitus, asthma, hyperlipidaemia, and the use of drugs such as amiodarone, statins, and amlodipine were associated with a higher risk of readmission. These risk factors must be considered in the development of effective strategies for reducing readmission rates after CABG. Such actions would remove or at least mitigate the enormous financial burden readmission inflicts on patients and health care facilities.

Recommendations

Post-CABG readmission is a complex dilemma that requires a plethora of interventions in the preoperative, perioperative, and post-discharge surgery periods. The formation of a multi-aim framework for the development of practical strategies for reducing readmissions is recommended. Further studies are necessary to better detect the underlying factors that increase patient risk of readmissions after CABG. Furthermore, a risk scoring system that is specifically tailored to this region’s CABG population should be developed and used to ensure the best possible outcomes.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

The study was approved by the Institutional Review Board of King Abdullah International Medical Research Center, Ministry of National Guard Health Affairs, Riyadh, KSA (approval number RC19/262/R). Patient confidentiality was ensured, and the patients’ data were collected and used by the research team only. Serial numbers were used instead of medical record numbers to ensure anonymity. Due to the retrospective nature of the study and the use of anonymized patient data, the requirement for informed consent was waived.

Authors contributions

MAG, SAJ, and NAS developed the idea and designed the methods. LKS, IFS, and EAS acquired and analysed the data and interpreted and presented the results. MAG, SAJ, and NAS wrote the manuscript. LKS, IFS, and EAS critically revised the final manuscript for important intellectual content. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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References

1. Diodato M, Chedrawy EG. Coronary artery bypass graft surgery: the past, present, and future of myocardial revascularisation. Surg Res Pract 2014; 2014: 1–6. https://doi.org/10.1155/2014/726158.

2. Melly L, Torregrossa G, Lee T, Jansens J-L, Puskas JD. Fifty years of coronary artery bypass grafting. J Thorac Dis 2018; 10: 1960–1967. https://doi.org/10.21037/jtd.2018.02.43.

3. Alexander JH, Smith PK. Coronary-artery bypass grafting. N Engl J Med 2016; 375: 1954–1964.

4. Palmieri T, Savini C. Risks of stroke after coronary artery bypass graft surgery – recent insights and perspectives. Intervent Cardiol 2011; 9: 77.

5. Feng TR, White RS, Gaber-Baylis LK, Turnbull ZA, Rong LQ. Coronary artery bypass graft readmission rates and risk factors - a retrospective cohort study. Int J Surg 2018; 54: 7–17.

6. Buckway J, Roberts C, Benuzzo J, Hsieh L, Bowles J, Mitchell J. Triple-aim framework helped develop effective strategies for reducing readmission following coronary artery bypass graft surgery. Salt Lake City: Intermountain Heart Institute; [n.d].

7. Hannan EL, Zhong Y, Lahey SJ, Culliford AT, Good JP, Smith CR, et al. 30-Day readmissions after coronary artery bypass graft surgery in New York state. JACC Cardiovasc Interv 2011; 4: 569–576.

8. Shah RM, Zhang Q, Chatterjee S, Cheema F, Loor G, Lemaire SA, et al. Incidence, cost, and risk factors for readmission after coronary artery bypass grafting. Ann Thorac Surg 2019; 107: 1782–1789.

9. Price JD, Romeiser JL, Gnerre JM, Shroyer ALW, Rosengart TK. Risk analysis for readmission after coronary artery bypass surgery: developing a strategy to reduce readmissions. J Am Coll Surg 2013; 216: 412–419.
10. 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. Gen Thorac Cardiovasc Surg 2019; 67: 661–668.

11. Murphy BM, Elliott PC, Grande MRL, Higgins RO, Ernest CS, Goble AJ, et al. Living alone predicts 30-day hospital readmission after coronary artery bypass graft surgery. Eur J Cardiovasc Prev Rehabil 2008; 15: 210–215.

12. Slamowicz R, Erbas B, Sundararajan V, Dharmage S. Predictors of readmission after elective coronary artery bypass graft surgery. Aust Health Rev 2008; 32: 677.

13. Kim YM, Lee T, Lee HJ, Yang YL, Oh EG. Readmission of high-risk discharged patients at a tertiary hospital in Korea. J Healthc Qual 2019; 41.

14. Tseng H-S, Chao Z-H, Huang S-K, Tung T-H, Chien C-W. Utilization of emergency and hospitalization care after coronary artery bypass surgery for patients with ischemic heart disease. Int Heart J 2018; 59: 941–950.

15. Saab S, Nouredine S, Dumit NY. Readmission rates and emergency department visits after coronary artery bypass graft surgery and related factors. Leb Med J 2014; 61: 155–160.

16. Konstantinov IE, Robert H. Goetz: the surgeon who performed the first successful clinical coronary artery bypass operation. Ann Thorac Surg 2000; 69: 1966–1972.

17. Shahian DM, He X, O’Brien SM, Grover FL, Jacobs JP, Edwards FH, et al. Development of a clinical registry-based 30-day readmission measure for coronary artery bypass grafting surgery. Circulation 2014; 130: 399–409.

18. Zywot A, Lau CS, Glass N, Bonne S, Hwang F, Goodman K, et al. Preoperative scale to determine all-cause readmission after coronary artery bypass operations. Ann Thorac Surg 2018; 105: 1086–1093.

19. Stewart RD, Campos CT, Jennings B, Lollis S, Levitsky S, Lahey SJ. Predictors of 30-day hospital readmission after coronary artery bypass. Ann Thorac Surg 2000; 70: 169–174.

20. Roh J-H, Kim Y-H, Ahn J-M, Yun S-H, Lee J-B, Ge J, et al. Readmission rate after coronary artery bypass grafting versus percutaneous coronary intervention for unprotected left main coronary artery narrowing. Am J Cardiol 2014; 113: 1639–1646.

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