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Comparison of postoperative complications following CABG in diabetic and non-diabetic patients

Akram Ghadiri-Anari[1], Farnaz Bemaninejad[2], Seyedeh Mahdieh Namayandeh[3], Reyhaneh Azizi[1], Mohammadreza Ahi[3*]

1- Diabetes Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
2- Faculty of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
3- Clinical Research Development Center, Afshar Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Correspondence:

Mohammadreza Ahi;
Clinical Research Development Center, Afshar Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran;
Email: ahi.dvm@gmail.com

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Abstract

BACKGROUND: Diabetic patients face an elevated cardiovascular disease burden, often requiring coronary artery bypass grafting (CABG). However, evidence regarding post-CABG outcomes in diabetic versus non-diabetic patients is inconsistent, and data from the Iranian population are particularly scarce. This study was conducted to clarify this ambiguity by comparing short-term post-CABG complications between these groups..

METHODS: A retrospective cohort study analyzed data from the Yazd Cardiovascular Disease Registry (YCDR) for all CABG patients (2017–2018) at Afshar Hospital. Patients were stratified into diabetic (n=592) and non-diabetic (n=694) groups. We collected standardized data on demographics, comorbidities (including diabetes), and in-hospital major postoperative complications following CABG, such as reoperation, mortality, infections, renal complications, neurological complications (including TIA, stroke, and seizure), and pulmonary complications.

RESULTS: The frequency distribution of female sex (36.66% vs. 21.90%), hypertension (65.03% vs. 44.52%), and hyperlipidemia (39.02% vs. 23.20%) in diabetic patients was significantly higher than in non-diabetic patients ($p<0.001$). No statistically significant differences were observed between diabetic and non-diabetic groups in the incidence of major complications, including reoperation (2.1% vs. 2.3%), mortality (3.2% vs. 2.4%), and other major events (all $p>0.05$). However, seizure occurred exclusively in the diabetic group (1.1% vs. 0%; $p=0.049$). Logistic regression analysis demonstrated that diabetes mellitus was not an independent predictor of overall postoperative complications.

CONCLUSION: In this cohort, diabetes was not an independent risk factor for most short-term post-CABG complications. The exception was a higher seizure incidence in diabetic patients, warranting further mechanistic investigation. Larger prospective studies are needed to confirm these findings.

Keywords: Diabetes Mellitus; Coronary Artery Bypass; Postoperative Complications; Logistic Models; Seizures

Introduction

Diabetes represents a significant global health issue, with projections estimating 642.8 million cases by 2030[1]. In Iran, the prevalence among adults has reached 11.4%, marking a 35% increase since 2005, with Yazd province reporting some of the highest rates in the nation[2,3]. By 2030, approximately 7 million Iranians are anticipated to have diabetes[1]. Coronary artery bypass grafting (CABG) remains a primary intervention for coronary artery disease[4], and patients with diabetes mellitus constitute a substantial and challenging subgroup referred for CABG, characterized by a more diffuse and aggressive pattern of coronary disease[5,6]. This clinical profile inherently increases the complexity of surgical revascularization and elevates the perioperative risk profile.

The post-surgical trajectory for diabetic patients is a subject of intense clinical investigation, primarily due to their heightened susceptibility to a spectrum of complications. The pathophysiological milieu of diabetes, marked by chronic hyperglycemia, oxidative stress, and endothelial dysfunction, impairs innate immune responses and delays wound healing[7]. Consequently, these patients face a disproportionately higher risk of infectious morbidities, most notably deep sternal wound infections and mediastinitis, which are associated with prolonged hospitalization, increased healthcare costs, and significant mortality[8]. Beyond infectious concerns, diabetic patients are also vulnerable to a higher incidence of renal dysfunction, cerebrovascular events, and low cardiac output syndrome in the postoperative period[9].

While the increased risk of mortality in diabetic patients following CABG is well-documented, research comparing post-CABG morbidities between diabetic and non-diabetic patients yields conflicting results[10,11]. A study by Filho et al. found no significant differences in complication rates between diabetic and non-diabetic patients undergoing CABG surgery[12]. Furthermore, Bano et al. reported that patients with diabetes had a higher risk of acute kidney injury but no other postoperative complications compared to non-diabetic patients after coronary artery bypass grafting[13]. However, other studies demonstrate contrasting findings. A systematic review by He et al. showed that diabetic patients had significantly higher rates of surgical site infection and deep sternal wound infection compared to non-diabetic patients following CABG surgery[14]. Similarly, Pakzad et al. found that diabetic patients had higher odds of infection and renal complications compared to non-diabetic patients after off-pump CABG surgery[15].

A nuanced understanding of this risk disparity is critical for implementing targeted pre-operative optimization strategies, meticulous intraoperative surgical techniques, and rigorous post-operative management protocols. Given that the prevalence of diabetes in Yazd province (14.1%) is significantly higher than the national average in Iran (11.4%)[2,3], and considering the unresolved discrepancies in post-CABG outcomes, this study compares short-term post-CABG complications between diabetic and non-diabetic patients in Yazd, Iran.

Materials and Methods

Study Design and Population

This retrospective cohort study analyzed all CABG patients (2017–2018) from Afshar Hospital's Yazd Cardiovascular Disease Registry (YCDR). The sample size was calculated using the formula for comparing two proportions. Based on previous studies[10-15], we assumed a postoperative complication rate of approximately 15% in non-diabetic patients and expected a minimum clinically important difference of 5% (complication rate of 20% in diabetic patients). With a 95% confidence level (α=0.05) and 80% power (β=0.20), a minimum of 908 patients per group was required. To account for potential missing data and increase the study's power, we included all available patients during the study period, which exceeded the calculated minimum.

The patients were stratified into two groups: diabetic patients who underwent CABG and

non-diabetic patients who underwent CABG. The primary aim was to compare postoperative outcomes between diabetic and non-diabetic patients in a real-world clinical setting. To maximize the generalizability of our results and avoid selection bias, we intentionally employed a broad, inclusive approach. Thus, the only stratification criterion was the presence or absence of diabetes. We acknowledge that this design includes patients with diverse comorbidities; however, this reflects the actual clinical population referred for CABG. Potential confounding effects were addressed statistically using multivariable regression models (as reported in Table 3). Exclusion criteria were not applied due to the registry-based design.

Data Collection

A trained clinical team extracted data from YCDR using standardized forms. Variables included:

- **Demographics:** Age, sex
- **Comorbidities:** Diabetes, hypertension, hyperlipidemia, COPD, and thyroid disease
- **Postoperative complications (up to patient discharge):**
  - Reoperation
  - In-hospital mortality
  - Infections (surgical site, foot, sternum)
  - Renal failure (a 2-fold increase in creatinine from baseline), dialysis
  - Neurological complications (TIA, stroke, seizure)
  - Pulmonary complications (atelectasis, pneumonia, and other pulmonary issues)

Ethical Considerations

The Ethics Committee of Shahid Sadoughi University approved this study (IR.SSU.MEDICINE.REC.1399.099). The Yazd Cardiovascular Disease Registry at Afshar Hospital obtains informed consent from all participants at the time of enrollment, which includes permission for the use of their anonymized data in future research. For this retrospective analysis, the need for additional consent was waived by the ethics committee, as the data were analyzed in an anonymized and aggregated manner.

Statistical Analysis

SPSS software (Version 27) was used. Continuous variables were reported as mean ± SD, and categorical data as n (%). An independent t-test was used to compare the mean of quantitative variables between the two groups, and the Chi-square test/Fisher's exact test was used to compare the frequency distribution of qualitative variables between the two groups. Also, to evaluate the association of diabetes with the incidence of postoperative complications following CABG, logistic regression analysis (in both crude and adjusted models) was used, and the odds ratio values (with 95% CI) were reported. In all analyses, a significance level of less than 0.05 was considered.

Results

Of 1333 CABG patients, 1286 were analyzed: 592 (46%) diabetics and 694 (54%) non-diabetics. Mean age was 61.95 ± 10.03 years; 71.3% (n=917) were male. The frequency distribution of female sex (36.66% vs. 21.90%), hypertension (65.03% vs. 44.52%), and hyperlipidemia (39.02% vs. 23.20%) in diabetic patients was significantly higher than in non-diabetic patients ($p<0.001$). There were also significant differences in several laboratory findings, such as fasting blood sugar (FBS), hemoglobin (HB), sodium (Na), potassium (K), and blood urea nitrogen (BUN) ($p<0.05$) (Table 1).

Overall, 170 complications occurred in 120 patients. Comparison between groups revealed no statistically significant differences in reoperation (2.1% vs. 2.3%), mortality (3.2% vs. 2.4%), infections, renal failure, dialysis, stroke, TIA, or pulmonary complications (all $p>0.05$). Seizures occurred more frequently in diabetics (1.1% vs. 0%, $p=0.049$) (Table 2).

Based on the results of logistic regression in both the crude and adjusted models, having diabetes was not significantly associated with the occurrence of in-hospital postoperative complications following CABG (Table 3).

Table 1. Comparison baseline assessment between diabetic and non-diabetic patients

Assessment items		Diabetic group	Non-diabetic group	p-value
Age, mean (SD)	-	61.50 (8.83)	62.28 (10.70)	0.181*
Sex, n (%)	Male	375 (63.34%)	542 (78.10%)	<0.001**
	Female	217 (36.66%)	152 (21.90%)	
Smoke, n (%)	Yes	133 (22.47%)	181 (26.08%)	0.137**
	No	459 (77.53%)	513 (73.92%)	
Hypertension, n (%)	Yes	385 (65.03%)	309 (44.52%)	<0.001**
	No	207 (34.97%)	385 (55.48%)	
Hyperlipidemia, n (%)	Yes	231 (39.02%)	161 (23.20%)	<0.001**
	No	361 (60.98%)	533 (76.80%)	
COPD, n (%)	Yes	35 (9.91%)	56 (8.07%)	0.119**
	No	557 (90.09%)	638 (91.93%)	
Thyroid Disease, n (%)	Yes	29 (4.90%)	24 (3.46%)	0.202**
	No	563 (95.10%)	670 (96.54%)	
FBS (mg/dL), mean (SD)	-	195 (90.56)	117 (38.35)	<0.001*
HB (g/dL), mean (SD)	-	13.04 (1.87)	13.46 (1.88)	<0.001*
Na (mmol/L), mean (SD)	-	140 (3.48)	140 (2.85)	0.001*
K (mmol/L), mean (SD)	-	4.41 (0.49)	4.35 (0.43)	0.029*
Ca (mg/dL), mean (SD)	-	9.31 (0.63)	9.26 (0.79)	0.230*
Creatinine (mg/dL), mean (SD)	-	1.22 (0.52)	1.18 (0.65)	0.299*
BUN (mg/dL), mean (SD)	-	40.63 (17.98)	37.04 (12.67)	0.001*
INR (-), mean (SD)	-	1.12 (0.43)	1.14 (0.23)	0.236*
PTT (sec), mean (SD)	-	30.18 (8.36)	31.56 (12.18)	0.938*
PLT ($\times 10^3/\mu L$), mean (SD)	-	227 (73.34)	226 (60.05)	0.227*

* Independent t-test ** Chi-square test

Table 2. Comparison of in-hospital postoperative complications following CABG between the two study groups

Complications	Diabetic group	Non-diabetic group	p-value
Reoperation	12/571 (2.1%)	15/664 (2.3%)	0.850*
Infectious Complications			
Postoperative infection	7/563 (1.2%)	13/654 (2.0%)	0.308*
Foot infection	2/366 (0.5%)	2/412 (0.5%)	1**
Sternum infection	4/364 (1.1%)	7/413 (1.7%)	0.555**
Renal Complications			
Renal Failure	15/563 (2.7%)	9/652 (1.4%)	0.109*
Dialysis	9/562 (1.6%)	5/650 (0.8%)	0.176*
Neurological Complications			
TIA	1/369 (0.3%)	0/416 (0.0%)	0.470**
Seizure	4/364 (1.1%)	0/409 (0.0%)	0.049**
Stroke	4/366 (1.1%)	5/411 (1.2%)	1**
Pulmonary Complications			
Atelectasis	0/365 (0.0%)	1/411 (0.2%)	1**
Pneumonia	3/361 (0.8%)	2/408 (0.5%)	0.670**
Other pulmonary issues	9/360 (2.5%)	5/409 (1.2%)	0.186*
In-hospital mortality	19/592 (3.2%)	17/694 (2.4%)	0.410*

* Chi-square test ** Fisher's exact test Note: Denominators vary in Table 2 due to missing complication-specific data.

Table 3. Odds Ratios (OR) for in-hospital postoperative complications following CABG associated with diabetes

Model	Odds Ratios (OR)	95% CI	p-value	Adjusted variable
Model 1	1.028	0.706-1.499	0.884	-
Model 2	0.975	0.664-1.432	0.898	Age, Sex
Model 3	1.013	0.676-1.518	0.949	Age, Sex, Smoke, Hypertension, Hyperlipidemia, COPD, Thyroid Disease

Discussion

Evidence indicates a significant comorbidity burden between diabetes and coronary artery disease (CAD), with approximately 37% of CABG patients having diabetes and an estimated 28% of diabetic patients requiring CABG during their lifetime[16]. Diabetic patients not only exhibit a higher prevalence of CAD but often present with more extensive, multi-vessel, and rapidly progressive disease. Importantly, rigorous perioperative glycemic control has been associated with reduced in-hospital mortality following CABG[17].

The present study found no statistically significant differences in most short-term post-CABG complications (including in-hospital mortality, reoperation, infections, renal complications, stroke, TIA, and pulmonary complications) between diabetic and non-diabetic cohorts. This finding diverges from studies reporting elevated complication risks in diabetic patients[10,11,18]. However, it aligns with research demonstrating comparable outcomes after adjusting for confounders[19]. The sole exception observed was a higher incidence of seizures among diabetic patients (1.1% vs. 0%; p=0.049), which may be attributed to increased prevalence of factors such as blood glucose fluctuations, cerebrovascular injury, electrolyte disturbances, and renal disease in this population.

Diabetic individuals are particularly susceptible to significant blood glucose variability. Hypoglycemia may arise from diminished hepatic glycogen reserves or insufficient administration of insulin or other glucose-lowering agents, directly precipitating seizures[20]. Conversely, hyperglycemia elevates the risk of electrolyte imbalances and seizures by inducing a hyperosmolar state and severe dehydration[21]. Chronic diabetes results in microangiopathy, damaging cerebral microvasculature and potentially compromising cerebral perfusion, thereby predisposing patients to seizures[22]. Furthermore, these individuals face an elevated risk of intraoperative or postoperative mild ischemic strokes, which may manifest as seizures[23]. Additionally, diabetes is associated with electrolyte imbalances, such as hyponatremia, which are common etiologies of seizures[24]. It is also noteworthy that diabetic patients frequently experience renal impairment (diabetic nephropathy), which hinders drug excretion and heightens the risk of anesthetic toxicity[25].

Crucially, logistic regression analysis confirmed that diabetes mellitus itself was not an independent predictor of complications after adjusting for covariates, suggesting that comorbidities or variations in perioperative care quality may exert greater influence on outcomes than diabetic status alone.

Most studies conducted in Iran report elevated postoperative complications following CABG in diabetic patients. An investigation demonstrated significantly higher rates of chronic renal failure, infection, one-year mortality, and pneumonia among diabetic compared to non-diabetic counterparts[10]. Similarly, a study documented increased overall postoperative complications in diabetic cohorts[11]. Research at Imam Khomeini Hospital (Ardabil) by Hosseinian et al. further indicated substantially higher mortality, infection, and respiratory complications (including atelectasis, pleural effusion, and ventilator dependence) in diabetic patients. Notably, however, that study observed no significant intergroup differences

in cardiac complications, renal impairment, postoperative bleeding, or neurological outcomes[18]. Complementary evidence from Rouhandeh et al. identified wound infection (5.1%), cerebrovascular events (2.96%), and 6-month mortality (1.4%) as the most prevalent complications post-CABG[26]. Critically, their analysis revealed that patients with preoperative HbA1c >7% experienced increased cerebrovascular events, wound infections, intra-aortic balloon pump requirements, and low cardiac output.

The heterogeneity in reported CABG outcomes for diabetic patients across studies likely stems from multiple factors. These include differences in preoperative diabetes control (e.g., HbA1c levels, duration of disease), institutional variations in surgical protocols and postoperative management, the rigor of glycemic control during hospitalization, and the presence of unmeasured or inadequately controlled confounding variables (e.g., BMI, concomitant conditions). The absence of elevated complication rates in our diabetic cohort may reflect stringent institutional protocols for perioperative glucose management and specialized nursing care, mitigating traditional diabetes-related risks. Alternatively, confounding factors prevalent in non-diabetic patients within this specific cohort may have attenuated observable differences.

While these findings suggest comparable short-term safety of CABG in carefully managed diabetic patients within this setting, the observed seizure association necessitates mechanistic clarification. Given the limitations of single-center retrospective data and the low overall complication rates observed (which may constrain statistical power), future prospective, multicenter studies with extended follow-up periods are essential. Such research should stratify diabetic patients by disease severity, treatment modality (e.g., insulin dependence), and glycemic control, and rigorously account for confounders to definitively compare early and late complication profiles.

Limitations

1. Retrospective design with missing complication data.
2. Low event rates for several complications (e.g., TIA: 0.1%), limiting power to detect differences (Type II error).
3. Unmeasured confounders (BMI, diabetes duration/control).
4. No stratification by HbA1c or insulin therapy.

Conclusions

In this Yazd cohort, diabetes was not an independent risk factor for short-term post-CABG complications after adjusting for confounders. The exception (increased seizures in diabetics) requires mechanistic study. Standardized care may mitigate diabetes-related risks, but larger prospective studies with longer follow-up are needed to confirm this.

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Conflict of interests

The authors declare no conflict of interest.

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Author's Contributions

Study Conception or Design: AGA
Data Acquisition: FB; RA
Data Analysis or Interpretation: MN; MA
Manuscript Drafting: AGA; FB; RA
Critical Manuscript Revision: AGA; MN; MA
All authors have approved the final manuscript and are responsible for all aspects of the work.

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