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# Clinical Outcomes and Postoperative Complications of Coronary Artery Bypass Grafting in Patients with Diabetes Mellitus: A Retrospective Cross-sectional Study

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## Abstract

# Background

Coronary artery disease is a leading cause of global mortality. Diabetes mellitus significantly increases the complexity of vascular disease and the risk of postoperative complications after coronary artery bypass grafting. This study aimed to evaluate the clinical profile, length of hospital stay, mortality rate, and spectrum of postoperative complications in patients with diabetes undergoing CABG at Dr. Hasan Sadikin General Hospital, Bandung.

# Methods

This descriptive, observational study with a retrospective cross-sectional design was conducted on patients with diabetes undergoing CABG at Dr. Hasan Sadikin General Hospital, Bandung, from January 2023 to June 2025. Sampling was conducted using a total sampling technique (n = 61). Data were systematically extracted from medical records. Statistical analysis was performed using SPSS version 26.0 to calculate frequency distributions, means with standard deviations, or median values according to data normality.

# Results

The majority of subjects were male (67.2%) with a mean age of 62.43 ± 7.04 years. The median preoperative HbA1c level was 7.95% (5.3–14.4%), indicating suboptimal long-term glycemic control. The off-pump technique was used in 83.6% of cases. The median postoperative length of stay was 6 days (range 0–42 days). The in-hospital mortality rate was 23.0% (n = 14). The most prevalent postoperative complication was acute renal failure (36.1%), followed by respiratory failure (26.2%) and the need for re-intubation (18.0%). No periprocedural stroke or myocardial infarction (0%) was observed in the entire study population.

# Conclusions

The median postoperative length of stay for patients with diabetes at this institution was 6 days. Findings indicated a clinical burden, with a 23.0% in-hospital mortality rate and high rates of acute renal failure and respiratory failure. The majority of subjects had suboptimal preoperative glycemic control, but no stroke or myocardial infarction was documented in this population.

## INTRODUCTION

Coronary artery disease (CAD) remains a major global health challenge, accounting for more than 17.9 million deaths, or approximately 32% of total deaths worldwide, in 2019.[1] In Indonesia, data from

the 2023 Indonesian Health Survey (SKI) showed a national prevalence of heart disease of 1.07%, with an estimated 668,000 cases.[2] Most of these cases are triggered by atherosclerosis, which causes narrowing of the coronary arteries, disrupting oxygen supply to the myocardium and potentially leading to myocardial infarction.[2–4] In the management of complex CAD revascularization, coronary artery bypass grafting (CABG) has become the gold standard procedure to restore blood flow and improve patient quality of life.[5]

Diabetes mellitus (DM) is a critical comorbidity that significantly worsens the clinical course of CAD patients.[5,6] The presence of DM increases the risk of more severe multivascular disease through mechanisms of oxidative stress, endothelial dysfunction, and chronic systemic inflammation. Large-scale international studies, such as the FREEDOM trial, confirm that although CABG offers lower mortality rates than percutaneous coronary intervention (PCI) in the DM population, the risk of postoperative complications in this group remains substantial.[6–8] Preoperative glycemic parameters, particularly HbA1c levels ≥ 7%, have been identified as strong predictors of increased risk of short-term mortality and prolonged hospital stay.[9]

Successful CABG outcomes in DM patients depend not only on surgical technique but also on comprehensive perioperative risk factor management.[1,3,8] Numerous studies indicate that DM patients are highly susceptible to systemic organ failure after CABG, with Acute Kidney Injury (AKI) and respiratory failure being the most common complications.[9,10] On the other hand, surgical techniques such as off-pump CABG have been proposed to reduce the systemic inflammatory response and protect neurological function, which are particularly relevant for the vulnerable profile of DM patients. However, variability in glycemic management and baseline risk profiles between institutions often results in significant differences in clinical outcomes.[8–14]

Dr. Hasan Sadikin General Hospital (RSHS) Bandung serves as the primary referral center for the West Java region of Indonesia. Internal data from 2019–2020 reported a general mortality rate for CABG patients of 11%.[15] However, significant data gaps remain regarding the risk factors, specific laboratory characteristics, and complication outcomes, particularly in the post-CABG diabetes mellitus population at this institution.

This study aims to provide an in-depth analysis of the clinical profile and postoperative outcomes of diabetes patients undergoing CABG at Dr. Hasan Sadikin General Hospital, Bandung. The primary focus of this study includes an evaluation of the length of stay, hospital mortality rate, and the spectrum of postoperative complications. The findings of this study are expected to provide a scientific basis for clinicians in optimizing perioperative management strategies and improving future care for cardiac patients with metabolic comorbidities.

# METHODS

# Research Design and Location

This study used a retrospective cross-sectional study design. The study was conducted at Dr. Hasan Sadikin General Hospital (RSHS) in Bandung, Indonesia, a major tertiary referral center in West Java. The study data covered the operational period from January 1, 2023, to June 30, 2025.

## Population and Selection Criteria

The study subjects were patients with comorbid diabetes mellitus undergoing CABG. Sampling was conducted using a total sampling technique. Inclusion criteria included all DM patients undergoing CABG at RSHS during the study period. Exclusion criteria included patients referred to other hospitals during treatment, patients with incomplete medical records, and patients undergoing additional cardiac surgery in addition to CABG. Of the 65 cases identified, 61 patients met the criteria and were included in the final analysis.

## Data Collection and Variables

The data collection process was conducted through a systematic search of secondary data sourced from patients' electronic and physical medical records. The variables collected included baseline demographic and clinical characteristics of the patients, including gender, age, body mass index (BMI), and medical history profiles, including active smoking status and comorbidities including hypertension, dyslipidemia, pulmonary disease, chronic kidney disease, and a family history of cardiovascular disease. Researchers also documented preoperative pharmacological therapy profiles, including the types of anti-diabetic medications used (such as metformin and insulin) and various categories of cardiovascular medications, including antiplatelets, angiotensin-converting enzyme inhibitors (ACE inhibitors/ARBs/ARNIs), beta-blockers, calcium channel blockers, diuretics, mineralocorticoid receptor antagonists, and nitrates.

Data related to surgical intervention procedures included the surgical technique used (both on-pump and off-pump), the type of graft conduit used (such as LIMA, SVG, or radial artery), the overall duration of surgery, and the time of cardiopulmonary bypass and aortic cross-clamp for patients undergoing procedures assisted by a heart-lung machine. Preoperative cardiac function was assessed using the left ventricular ejection fraction (LVEF) parameter. Furthermore, a comprehensive preoperative laboratory profile was collected, including routine hematology parameters, random blood glucose levels, nitrogen retention profiles (urea and creatinine), glomerular filtration rate (GFR), electrolyte levels, albumin, lipid profiles, and specific biomarkers such as glycated hemoglobin (HbA1c), troponin, and C-reactive protein (CRP). The main clinical outcomes analyzed in this study included postoperative hospitalization duration, in-hospital mortality status, and a spectrum of postoperative complications, including acute kidney injury (AKI), periprocedural myocardial infarction, cardiac arrhythmias (atrial fibrillation or ventricular tachycardia/fibrillation), stroke, significant bleeding, respiratory failure, and the need for re-intubation.

# Statistical Analysis

All data were processed using SPSS version 26.0 software. Univariate analysis was performed to describe the characteristics of each variable. Data normality was tested using the Kolmogorov-Smirnov or Shapiro-Wilk methods. Numerical data are presented as mean ± standard deviation (SD) for normal distributions, or median (minimum–maximum range) for non-normal distributions. Categorical data are presented as frequencies (n) and percentages (%). Given the retrospective nature of the data, a sub-analysis (available case analysis) was performed on variables with incomplete data (such as HbA1c and lipid profiles) by explicitly listing the number of available samples (n) in each report.

## Ethical Considerations

This study was approved by the Health Research Ethics Committee of Dr. Hasan Sadikin General Hospital, Bandung. Patient confidentiality was strictly maintained through the use of initials and medical record numbers without publicly disclosing personal information. In accordance with the retrospective nature of this study using secondary data, the requirement for written informed consent from each individual was waived by the relevant ethics committee.

## RESULTS

The final analysis was conducted on 61 medical records of patients with diabetes mellitus who underwent coronary artery bypass grafting at Dr. Hasan Sadikin General Hospital, Bandung, after excluding four individuals due to incomplete data. Based on the data in Tables 1 and 2, the majority of study subjects were male (67.2%, n = 41) with an average age of 62.43 ± 7.04 years. Nutritional status evaluation revealed a significant trend toward excess weight, with 60.6% of patients categorized as overweight (37.7%) or obese (22.9%), while only 34.4% had a normal body mass index.

The baseline characteristics profile summarized in Table 1 shows that hypertension was the most prevalent comorbidity (67.2%), followed by active smoking (52.4%) and dyslipidemia (36.1%). Regarding preoperative diabetes management, 50.8% of patients were already dependent on insulin therapy, while metformin use was only recorded in 11.5%. For cardiovascular pharmacological therapy, antiplatelet (90.2%) and beta-blocker (85.2%) regimens were the most commonly prescribed regimens for patients prior to surgery.

Preoperative laboratory parameters in Tables 2, 3, and 4 confirm suboptimal long-term glycemic control, with a median HbA1c level of 7.95%. Based on available data, 60% of patients were categorized as having uncontrolled diabetes (HbA1c ≥ 7%). Furthermore, patients' renal filtration function showed a mean GFR of 59.99 ± 56.78 mL/minute/1.73 m², while echocardiography assessed their heart pump function and recorded a mean LVEF of 49.29 ± 12.53%.

Table 1
Baseline Characteristics of CABG Patients with DM Comorbidity Based on Categorical Variables

| **Variables** | **Category** | **Frequency (n)** | **Percentage (%)** |
|---|---|---|---|
| Patient Characteristics | | | |
| Gender | Male | 41 | 67,2 |
| | Female | 20 | 32,8 |
| Body Mass Index (BMI) | Normal | 21 | 34,4 |
| | *Underweight* | 3 | 4,9 |
| | *Overweight* | 23 | 37,7 |
| | Obesity | 14 | 22,9 |
| On/Off Pump | *On* | 10 | 16,4 |
| | *Off* | 51 | 83,6 |
| Clinical History | | | |
| Hypertension | Yes | 41 | 67,2 |
| | No | 20 | 32,8 |
| Dysplipidemia | Yes | 22 | 36,1 |
| | No | 39 | 63,9 |
| Smoking | Yes | 32 | 52,4 |
| | No | 29 | 47,6 |
| Lung Disease | Yes | 4 | 6,6 |
| | No | 57 | 93,4 |
| Chronic Kidney Disease | Yes | 10 | 16,4 |
| | No | 51 | 83,6 |
| Family History | Yes | 4 | 6,6 |
| | No | 57 | 93,4 |
| Preoperative Anti-diabetic Drug Therapy | | | |
| Metformin | Yes | 7 | 11,5 |
| | No | 54 | 88,5 |
| Sulfonylurease | Yes | 0 | 0,0 |

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| | No | 61 | 100,0 |
| Insulin | Yes | 31 | 50,8 |
| | No | 30 | 49,2 |
| SGLT2 Inhibitor | Yes | 0 | 0,0 |
| | No | 61 | 100,0 |
| GLP-1 Receptor Agonist | Yes | 0 | 0,0 |
| | No | 61 | 100,0 |
| Preoperative Cardiovascular Drug Therapy | | | |
| Antiplatelet (Aspirin / P2Y12 Inhibitor) | Yes | 55 | 90,2 |
| | No | 6 | 9,8 |
| ACE Inhibitor / ARB / ARNI | Yes | 42 | 68,9 |
| | No | 19 | 31,1 |
| Variables | **Category** | **Frequency (n)** | **Percentage (%)** |
| Beta Blocker | Yes | 52 | 85,2 |
| | No | 9 | 14,8 |
| Calcium Channel Blocker | Yes | 28 | 45,9 |
| | No | 33 | 54,1 |
| Diuretic | Yes | 42 | 68,9 |
| | No | 19 | 31,1 |
| Mineralocorticoid | Yes | 14 | 23,0 |
| | No | 47 | 77,0 |
| Nitrates | Yes | 26 | 42,6 |
| | No | 35 | 57,4 |
| ACE Inhibitor / ARB / ARNI | Yes | 42 | 68,9 |
| | No | 19 | 31,1 |
| Graft Conduit | | | |
| LIMA | Yes | 58 | 95,1 |

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| | No | 3 | 4,9 |
| SVG | Yes | 55 | 90,2 |
| | No | 6 | 9,8 |
| Radial Artery | Yes | 2 | 3,3 |
| | No | 59 | 96,7 |

Table 2
Baseline Characteristics of CABG Patients with DM Comorbidity Based on Numerical Variables

| Variables | n | Mean ± SD | Median (Min – Max) | Unit/Notes |
|---|---|---|---|---|
| **Patient Characteristics** | | | | |
| Age | 61 | 62,43 ± 7,04 | | Year |
| Operation Duration | 61 | | 249,75 (90–480) | Minutes |
| Length of Hospitalization | 61 | | 9 (1–43) | Day |
| CPB Time | 11 | 139 ± 50,24 | | Minutes |
| AOX Time | 11 | | 106 (73–176) | Minutes/CPB time and AOX time were only analyzed in on-pump patients (n = 11). |
| LVEF | 61 | 49,29 ± 12,53 | | Percent (%) |
| **Preoperative Laboratory** | | | | |
| Hemoglobin | 61 | 11,73 ± 2,99 | | g/dL |
| Leukocyte Count | 61 | | 8,76 (1,071–27,6) | /mm³ |
| Platelet Count | 61 | | 254.000 (23.900–894.000) | 10³/µ L |
| Random Blood Glucose (RBS) | 61 | | 164 (75–432) | mg/dL |
| Urea | 61 | | 30,1 (12,9–143,5) | mg/dL |
| Serum Creatinine | 61 | | 1.14 (0,56–4,28) | mg/dL |
| Sodium | 61 | | 138,02 (126–146) | mEq/L |
| Potassium | 61 | | 4,2 (2,7–7,7) | mEq/L |
| Glomerular Filtration Rate | 61 | 59,99 ± 56,78 | | mL/minute/1,73 m² |

Table 3
Characteristics of CABG Patients with Diabetes Mellitus Comorbidity Based on Numerical Variables

| Variables | N | Mean ± SD | Median (Min – Max) |
|---|---|---|---|
| Albumin | 56 | | 3,81 (1,23–4,92) g/dL |
| Troponin | 30 | | 288 (0,01–11) ng/mL |
| C-reactive Protein | 25 | | 1.185,80 (0,6–30.55) mg/L |
| Trygliceride | 40 | | 171,16 (23–529) mg/L |
| LDL | 40 | | 92 (37–167) mg/dL |
| HDL | 27 | 33,74 ± 9,63 mg/dL | |
| Total Cholesterol | 27 | 147,41 ± 37,57 mg/dL | |

*Numerical data with normal distribution is presented in the form of Mean ± SD, while numerical data with non-normal distribution is presented in the form of median (Min-Max)

Table 4
HbA1c Overview of CABG Patients with Diabetes Mellitus Comorbidity Based on Numerical Variables

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| HbA1c | Controlled (HbA1c < 7% ) | 18 | 40,0 |
| | Uncontrolled (HbA1c ≥ 7% ) | 27 | 60,0 |

Table 5
Length of Hospitalization After CABG Operation in Patients with Diabetes Mellitus Comorbidity

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Length of Hospitalization | < 7 days | 32 | 52,4 |
| | 7–14 days | 25 | 40,9 |
| | > 14 days | 4 | 6,7 |

Table 6
Mortality During Treatment and Postoperative Complications of CABG in Patients with Comorbid Diabetes Mellitus

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Mortality | Yes | 14 | 23,0 |
| | No | 47 | 77,0 |
| Acute Kidney Injury | Yes | 22 | 36,1 |
| | No | 39 | 63,9 |
| Periprocedural Myocardial Infarction | Yes | 0 | 0,0 |
| | No | 61 | 100,0 |
| Atrial Fibrilation | Yes | 7 | 11,5 |
| | No | 54 | 88,5 |
| Ventricular Tachycardia/Ventricular Fibrilation | Yes | 4 | 6,6 |
| Ventricular Tachycardia/Ventricular Fibrilation | No | 57 | 93,4 |
| Stroke | Yes | 0 | 0,0 |
| | No | 61 | 100,0 |
| Hemmorhage | Yes | 3 | 4,9 |
| | No | 58 | 95,1 |
| Re-intubation | Yes | 11 | 18,0 |
| | No | 50 | 82,0 |
| Respiratory Failure | Yes | 16 | 26,2 |
| | No | 45 | 73,8 |

Table 7
Mortality and Length of Hospitalization After CABG Operation in Patients with Controlled and Uncontrolled Diabetes Mellitus Comorbidity.

| Variables | Category | Controlled | | Uncontrolled | |
|---|---|---|---|---|---|
| | | Frequency (n) | Percentage (%) | Frequency (n) | Percentage (%) |
| Mortality | Yes | 3 | 6,67% | 4 | 8,89% |
| | No | 15 | 33,33% | 23 | 51,11% |
| LOS | < 7 days | 9 | 20,00% | 15 | 33,33% |
| | 7–14 days | 2 | 4,45% | 1 | 2,22% |
| | > 14 days | 7 | 15,56% | 11 | 24,44% |

Regarding surgical technique, Tables 1 and 2 show a trend toward the use of the off-pump technique in the majority of cases (83.6%), with a median surgical duration of 249.75 minutes. For patients using the on-pump technique (n = 11), the average CPB time was 139 ± 50.24 minutes. Regarding conduit graft selection, LIMA was used at a very high rate of 95.1%, followed by SVG at 90.2%.

Clinical outcomes and the spectrum of postoperative complications presented in Tables 5, 6, and 7 indicate a median postoperative hospital stay of 6 days, with a wide distribution range of 0 to 42 days. The in-hospital mortality rate was 23.0% (n = 14). The most common systemic complications were AKI at 36.1%, respiratory failure (26.2%), and the need for re-intubation (18.0%), but this study recorded positive results with 0% incidence of stroke or periprocedural myocardial infarction in the entire study population.

# DISCUSSION

This study provides a comprehensive overview of the risk profile and clinical outcomes of diabetes mellitus patients undergoing CABG procedures at Dr. Hasan Sadikin General Hospital. The study population was predominantly male (67.2%) with a mean age of 62.43 years, a finding generally consistent with previous findings at RSHS by Saputri et al., but slightly younger than the study conducted by Ma et al.,.[16,17] In terms of nutritional status, the majority of subjects (60.6%) were classified as overweight or obese, a prevalence higher than that of the general CABG population at the same center. Furthermore, there was a trend toward the predominant use of off-pump techniques (83.6%) at RSHS, significantly different from the more balanced distribution of surgical techniques at international centers.

The preoperative clinical risk profile demonstrated a high comorbidity burden, characterized by a high prevalence of hypertension (67.2%) and active smoking (52.4%). The high percentage of active smokers at RSHS is a distinct distinguishing characteristic compared to reports from an international study by Ram et al..[18] Laboratory parameters confirmed a suboptimal metabolic condition, with a median HbA1c of 7.95%, and 60% of subjects had uncontrolled diabetes. Furthermore, the subjects' kidney function,

with a mean GFR of 59.99 mL/min/1.73 m², placed this population at a risk profile comparable to the chronic kidney disease group in the study by Domoto et al.[19]

The primary outcome, related to postoperative length of stay, was a median of 6 days, reflecting the efficiency of routine recovery for most patients. This median LOS at RSHS is relatively short compared to the findings of Navaratnarajah et al, who reported a mean of 7.2 to 9.0 days in a diabetic patient population.[15] However, the wide variability in length of stay, up to 42 days, suggests an extensive care burden for a small population. This variation in duration was also observed in a study by Saha et al., which highlighted the influence of glycemic control status on length of stay for diabetes patients.[20]

The in-hospital mortality rate was recorded at 23.0%, indicating a substantial clinical problem and far exceeding the 11% reported in RSHS internal data from 2019–2020. This mortality rate remains very high compared to international clinical trial benchmarks, such as the 4.2% study by Ram et al., and the 10.9% FREEDOM trial.[6,18] This high mortality rate is closely related to the high burden of systemic complications, particularly AKI, which reached 36.1% of subjects. The incidence of AKI in the diabetes cohort at RSHS is higher than the multicenter findings by Wang et al., which confirmed the physiological vulnerability of diabetes patients to a massive inflammatory response.[21]

In contrast, this study reported very positive results, with 0% incidence of stroke or periprocedural myocardial infarction in all subjects. This favorable neurological and ischemic protection profile aligns with the initial findings of Ram et al. and is likely influenced by the predominant use of off-pump techniques, which effectively suppress the risk of cerebral embolism.[18] Despite the limitations of a single-center study design and limited sample size, these data provide an important scientific basis for optimizing glycemic management and preoperative nephroprotective strategies. Survival of diabetic patients after CABG is highly dependent on efforts to stabilize systemic organ function to prevent multi-organ failure.Overall, these findings underscore the importance of more aggressive perioperative risk factor management, particularly in patients with HbA1c levels ≥ 7%. Although this study has limitations such as a single-center design, limited sample size, and retrospective nature that relies on complete medical records, these data provide an important scientific basis for clinical practice in Indonesia. More stringent nephroprotective strategies and optimization of preoperative HbA1c levels are crucial for reducing mortality and shortening hospital stays at regional referral centers. The survival of diabetic patients after CABG is highly dependent on efforts to stabilize systemic organ function to prevent multi-organ failure.

# CONCLUSION

This study provides a descriptive overview of the clinical outcomes of diabetes mellitus patients undergoing CABG procedures at Dr. Hasan Sadikin General Hospital, Bandung, with a median postoperative length of stay of 6 days. Key findings indicate a significant clinical burden, with an in-patient mortality rate of 23.0%, with the most frequently documented systemic complications being AKI (36.1%) and respiratory failure (26.2%). Furthermore, the majority of subjects (60%) had suboptimal

preoperative glycemic control (HbA1c ≥ 7%), yet this study demonstrated a positive outcome with zero periprocedural stroke or myocardial infarction (0%) in the entire analyzed population.

The significance of this study lies in identifying a high risk profile and complication frequency in the diabetes population at a regional tertiary referral center, which exceeds mortality rates in previous internal data and international benchmarks. The relevance of these findings is expected to provide a scientific basis for clinicians in optimizing perioperative management strategies and developing a standardized CABG registry to improve the quality of care for patients with metabolic comorbidities.

## Declarations

# Ethics approval and consent to participate :

The study was approved by the Health Research Ethics Committee of RSUP Dr. Hasan Sadikin Bandung. Due to the retrospective nature of the study, which utilized secondary data from medical records, the requirement for individual informed consent was waived by the ethics committee. All procedures were conducted in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki.

**Consent for publication :**

Not applicable. This manuscript does not contain any individual person's data in the form of identifiable images or videos.

**Clinical Trial**

Not applicable.

# Conflict of Interest :

The authors declare that they have no conflict of interests.

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# Author Contribution

Author ContributionsK.A. contributed to the conceptualization, data collection, data analysis, and drafting of the manuscript. N.L. and P.P.R. contributed to the supervision, interpretation of results, and

critical revision of the manuscript. All authors read and approved the final manuscript.


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# Availability of data and materials :

The datasets generated and/or analyzed during the current study are not publicly available due to hospital privacy regulations regarding patient medical records, but are available from the corresponding author on reasonable request.

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