










Incidence of glycemic alterations in the immediate postoperative period of cardiac surgery: an observational study

Incidência de alterações glicêmicas no pós-operatório imediato de cirurgia cardíaca: estudo observacional

Incidencia de alteraciones glucémicas en el postoperatorio inmediato de cirugía cardíaca: estudio observacional

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ABSTRACT

Objective: To identify the incidence of glycemic variability in the immediate postoperative period among adult and older patients undergoing cardiac surgery. **Methodology:** An observational, longitudinal, quantitative study conducted at a large teaching hospital in the interior of the state of Rio Grande do Sul, Brazil. Patients aged 18 years or older who were hospitalized during the preoperative period of elective cardiac surgery were included. Data collection took place from March to November 2024 using a structured questionnaire in three stages: preoperative, intraoperative, and immediate postoperative periods. Data analysis was performed using simple descriptive and inferential statistics. **Results:** The study included 109 participants, mostly male (66.1%). The most frequently performed surgery was valve replacement (51.4%). An incidence of hypoglycemia of 2.8% and hyperglycemia of 76.1% was identified, with a median immediate postoperative period blood glucose level of 169.0 mg/dL. **Conclusion:** An incidence of hypoglycemia of 2.8% and hyperglycemia of 76.1% was identified among adults and older patients undergoing cardiac surgery in the immediate postoperative period.

DESCRIPTORS:

Glycemic Control; Hyperglycemia; Hypoglycemia; Thoracic Surgery; Postoperative Complications.

Article Information:

Received: 02/06/2026

Accepted: 04/17/2026

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RESUMO

Objetivo: Identificar a incidência de alterações glicêmicas no pós-operatório imediato em pacientes adultos e idosos submetidos à cirurgia cardíaca. **Metodologia:** Estudo observacional, longitudinal e quantitativo, realizado em um hospital escola de grande porte do interior do estado do Rio Grande do Sul. Foram incluídos pacientes com idade igual ou maior que 18 anos e internados durante o pré-operatório da cirurgia cardíaca eletiva. A coleta de dados ocorreu de março a novembro de 2024, utilizando um questionário estruturado em três etapas: período pré-operatório, intraoperatório e pós-operatório imediato. A análise foi realizada por meio de estatística descritiva simples e inferencial. **Resultados:** Foram incluídos 109 participantes, sendo a maioria do sexo masculino (66,1%). Identificou-se que a cirurgia mais realizada foi a de troca valvar (51,4%). Identificou-se incidência de hipoglicemia de 2,8% e hiperglicemia de 76,1%, sendo a glicemia mediana no pós-operatório imediato de 169,0 mg/dL. **Conclusão:** Identificou-se uma incidência de hipoglicemia de 2,8% e hiperglicemia de 76,1% em adultos e idosos submetidos à cirurgia cardíaca.

DESCRIPTORIOS:

Controle Glicêmico; Hiperglicemia; Hipoglicemia; Cirurgia Torácica; Complicações Pós-operatórias.

RESUMEN

Objetivo: Identificar la incidencia de las alteraciones glucémicas en el período postoperatorio inmediato en adultos y adultos mayores sometidos a cirugía cardíaca. **Metodología:** Estudio observacional, longitudinal y cuantitativo, realizado en un hospital universitario de gran porte del interior del estado de Rio Grande do Sul, Brasil. Se incluyeron pacientes con edad igual o superior a 18 años, hospitalizados durante el período preoperatorio de cirugía cardíaca electiva. La recolección de datos se llevó a cabo entre marzo y noviembre de 2024, utilizando un cuestionario estructurado en tres etapas: preoperatoria, intraoperatoria y postoperatoria inmediata. El análisis se realizó mediante estadística descriptiva simple e inferencial. **Resultados:** Se incluyeron 109 participantes, en su mayoría de sexo masculino (66,1%). La cirugía más realizada fue el reemplazo valvular (51,4%). Se identificó una incidencia de hipoglucemia del 2,8% e hiperglucemia del 76,1%, con una glucemia mediana en el postoperatorio inmediato de 169,0 mg/dL. **Conclusión:** Se identificó una incidencia de hipoglucemia del 2,8% e hiperglucemia del 76,1% en adultos y adultos mayores sometidos a cirugía cardíaca en el postoperatorio inmediato.

DESCRIPTORIOS:

Control Glucémico; Hiperglucemia; Hipoglucemia; Cirugía orácica; Complicaciones Posoperatorias.

INTRODUCTION

Cardiac surgery, especially when performed with extracorporeal circulation (ECC), represents a highly complex procedure associated with physiological and metabolic aggression⁽¹⁾. Surgery activates the release of stress hormones, such as glucagon, cortisol, growth hormone, and epinephrine, and inflammatory cytokines, which promote insulin resistance and dysregulation of glucose metabolism⁽²⁾.

In this context, stress hyperglycemia stands out, which is considered a metabolic condition that occurs in response to critical situations, such as surgeries, infections, or inflammations⁽²⁾. This is a common metabolic alteration in patients undergoing ECC, occurring in more than half of patients undergoing cardiac surgery⁽³⁾, with hospital hyperglycemia defined by capillary or plasma glucose levels

greater than 140 mg/dL⁽⁴⁾, and it is recommended to optimize glycemic control in patients with a prior diagnosis of diabetes in the preoperative period⁽⁵⁾.

In addition to isolated hyperglycemia, acute glycemic variability in the postoperative period of cardiac surgery represents a significant concern due to its association with worse clinical outcomes, including myocardial infarction, pneumonia, stroke, renal failure, surgical site infection, and valvular dysfunction⁽⁶⁾. Furthermore, these glycemic alterations can increase the risk of death in the postoperative period⁽⁶⁻⁸⁾, up to one year after cardiac surgery^(7,9).

Although the importance of adequate management of hyperglycemia is recognized, it is emphasized that the treatment of this condition itself can trigger episodes of hypoglycemia. In this context, treatment protocols conducted by nursing staff play an important role in the intensive care unit (ICU) environment, by promoting the reduction of glycemic variability and mitigating the risk of hypoglycemia⁽¹⁰⁾.

Despite the role of nursing in this context, a qualitative study with 27 nursing professionals working in the ICU identified that one of the critical issues in relation to specific patient care in the postoperative period of cardiac surgery is the recognition of complications in the immediate postoperative period (IPP)⁽¹¹⁾. It is emphasized that nursing care directed to the care of patients undergoing cardiac surgery is an important measure for the prevention and control of complications, in addition to contributing to the promotion of safe practices⁽¹²⁾.

Therefore, understanding the incidence of glycemic changes in the immediate postoperative period is important for the development of safe and effective clinical protocols in patients undergoing cardiac surgery. Additionally, the recent meta-analysis that evaluated the association between acute glycemic variability and in-hospital outcomes of patients after cardiac surgery indicated that further studies on the subject are still needed⁽⁶⁾.

OBJECTIVE

To identify the incidence of glycemic changes in the immediate postoperative period in adult and elderly patients undergoing cardiac surgery.

METHODS

Study design, site and period

This is an observational, longitudinal, and quantitative study, developed according to the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative⁽¹³⁾. The research was carried out in a large, philanthropic university hospital located in the interior of the state of Rio Grande do Sul, regionally recognized for performing highly complex procedures, with emphasis on the area of hemodynamics and cardiac surgery. Data collection for the matrix project was carried out from March to November 2024.

Sample

Sample size calculation was performed using Epi Info™ software version 7.2.5.0, considering a statistical power of 80%, a significance level of 95% ($\alpha < 0.05$), a reference population of 202 patients (number of individuals undergoing cardiac surgery at the institution between August 2022 and August 2023), an expected frequency of complications of 58.0%⁽¹⁴⁾, and a margin of error of five percentage points. The estimated minimum sample size was 89 patients, to which 30% were added to compensate for potential losses, totaling 116 participants.

Inclusion and exclusion criteria

The study included patients aged 18 years or older who were hospitalized in the preoperative period for elective cardiac surgery. Pregnant women or those suspected of being pregnant were excluded, as were patients who had difficulties with verbal communication without the presence of a companion or who had an altered level of consciousness without a companion.

Study protocol

For data collection, a structured questionnaire was used in three stages: preoperative (anamnesis to identify comorbidities, clinical history, and risk factors), intraoperative (procedure data, surgery time, and cardiopulmonary bypass time), and postoperative (IPP – 24 hours after surgery (occurrence of glycemic changes)). For the assessment of body mass index (BMI), participants were categorized as having adequate weight (18.5 to 24.9 kg/m²) and overweight (≥ 25.0 kg/m²)⁽¹⁵⁾. Regarding the American Society of Anesthesiologists (ASA) surgical risk assessment, participants were classified according to the recommendations of that society⁽¹⁶⁾.

Regarding age, participants were categorized as adults (up to 59 years) and elderly (60 years of age and older). Regarding surgery time, this was categorized from a cutoff point of 4.5 hours. Regarding ECC time, this was categorized from a cutoff point of 70 minutes. It is known that ECC time is associated with postoperative organ dysfunction and is common after cardiac surgery⁽¹⁷⁾.

In this study, the outcomes analyzed were the incidence of hypoglycemia and hyperglycemia in the postoperative period, calculated using the formulas presented below:

$$\text{Incidence of hypoglycemia} = \frac{\text{Number of participants with hypoglycemia}}{\text{Number of participants in the survey}} \times 100\%$$

$$\text{Incidence of hyperglycemia} = \frac{\text{Number of participants with hyperglycemia}}{\text{Number of participants in the survey}} \times 100\%$$

Capillary blood glucose was monitored every two hours, according to institutional protocol. All participants remained fasting during the immediate postoperative period, in accordance with hospital routine.

Hyperglycemia was defined by the presence of capillary or plasma blood glucose greater than 140 mg/dL and hypoglycemia was defined by the presence of blood glucose values less than 100 mg/dL⁽⁵⁾ in at least one of the measurements in 24 hours. These values were adopted based on evidence that recommends glycemic targets between 100 and 140 mg/dL for hyperglycemic patients without a prior diagnosis of diabetes mellitus in the perioperative period⁽⁵⁾.

Results and statistical analysis

The data obtained during data collection were entered independently in two separate entries in Microsoft Office Excel®. For data analysis, the free software Jamovi version 2.6.44 was used. The data were analyzed using simple descriptive statistics; quantitative variables were described using measures of central tendency (mean or median) and dispersion (standard deviation or interquartile range), according to the coefficient of variation; qualitative variables were described using absolute (n) and relative (%) frequencies.

Subsequently, inferential statistical analysis was performed to assess the association of independent variables with the incidence of hypoglycemia and hyperglycemia using the Chi-square test or Fisher's exact test (expected value less than five in at least one cell). A significance level of 5% was considered for all analyses.

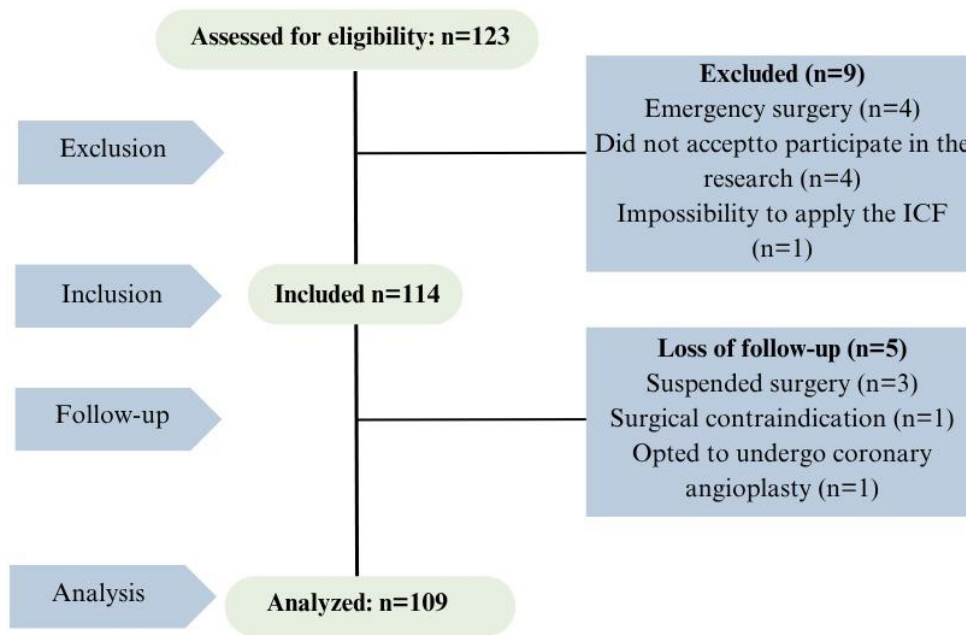
Ethical aspects

The matrix research project entitled "Complications in the Immediate Postoperative Period in Adult and Elderly Patients Undergoing Cardiac Surgery" was approved by the Research Ethics Committee (REC) under opinion number 6.744.804 and Certificate of Presentation for Ethical Review (CAAE) 77952224.7.0000.5342. To comply with the General Data Protection Law (GDPL), patient data were treated with confidentiality and respect for privacy. The research followed the ethical guidelines of the National Health Council (NHC) Resolution No. 466/2012, including the Informed Consent Form (ICF).

RESULTS

A total of 123 patients were assessed for eligibility during the data collection period. Of these, nine were excluded due to meeting exclusion criteria: four due to emergency surgery, four due to refusal to participate in the research, and one due to the impossibility of completing the informed consent form. Five were considered losses to follow-up because they did not undergo cardiac surgery; of these, three had surgery suspended, one had a surgical contraindication, and one opted for angioplasty. In the end, 109 patients were included in the analysis, as shown in the participant selection flowchart (Figure 1).

Figure 1. Flowchart for the selection of study participants. Rio Grande do Sul, Brazil, 2024



Most participants were male (n=72; 66.1%), white (n=96; 88.1%), with a median age of 65.0 years (Table 1).

Table 1. Distribution of sociodemographic variables of patients undergoing elective cardiac surgery. Rio Grande do Sul, Brazil, 2024. n=109

Variables	n (%)
Sex	
Female	37 (33.9%)
Male	72 (66.1%)
Race	
White	96 (88.1%)
Brown	7 (6.4%)
Black	5 (4.6%)
Yellow	1 (0.9%)
Variables	Median ± IQ (min.-max.)
Age (complete years)	65.0 ± 17.0 (28.0-83.0)

IQ – Interquartile range; min. – minimum value; max – maximum value.

Table 2 presents the distribution of clinical variables. It was identified that the majority of participants were sedentary (n=86; 78.9%) and hypertensive (n=82; 75.2%), with a significant portion being overweight (n=78; 71.6%). Furthermore, 35.7% presented with dyslipidemia (n=39) and 29.4% with diabetes mellitus (n=32). The most frequently performed surgery was valve replacement (n=56; 51.4%), with a mean duration of 4.5 hours, a median cardiopulmonary bypass (CPB) time of 81.7 minutes, an

ASA II surgical risk score (n=53; 48.6%), and they used norepinephrine postoperatively (n=80; 73.4%). The median postoperative blood glucose level was 169.0 mg/dL.

Table 2. Distribution of clinical variables in patients undergoing elective cardiac surgery. Rio Grande do Sul, Brazil, 2024. n=109

Variables	n (%)
Life habits	
Smoking	38 (34.9%)
Alcoholism	17 (15.6%)
Sedentary lifestyle	86 (78.9%)
Comorbidities	
Arterial Hypertension	82 (75.2%)
Diabetes Mellitus	32 (29.4%)
Dyslipidemia	39 (35.8%)
BMI Classification	
Adequate weight (18.5 - 24.9 Kg/m ²)	31 (28.4%)
Overweight (≥ 25 Kg/m ²)	78 (71.6%)
Type of surgery	
Valve Replacement	56 (51.4%)
IAC correction	4 (3.7%)
IVC correction	7 (6.4%)
PFO correction	2 (1.8%)
MRS	53 (48.6%)
ASA surgical risk score	
ASA I	10 (9.2%)
ASA II	53 (48.6%)
ASA III	20 (18.3%)
ASA IV	26 (23.9%)
IPP use of norepinephrine	80 (73.4%)
Variables	Median ± IQ (min.-max.)
Time of ECC (minutes)	81.7± 28.0 (28.0-83.0)
Glicemia (em mg/dL)	169.0±61.0 (53.0-404.0)

BMI – Body Mass Index; IAC – Interatrial communication; IVC –Interventricular communication; PFO – Patent foramen ovale; MRS – Myocardial revascularization surgery; ASA – American Society of Anesthesiologists; IPP – Immediate postoperative period; ECC – Extracorporeal circulation. IQ – Interquartile range; min. – minimum value; max – maximum value.

An incidence of hypoglycemia in the IPP of 2.8% (n=3) and hyperglycemia of 76.1% (n=83) was identified. Due to the low incidence of hypoglycemia, inferential analysis was performed only in relation to the occurrence of hyperglycemia (yes/no). Although there was no statistically significant association between diabetes mellitus and the occurrence of hyperglycemia, the incidence was 78.1% (n=25) among diabetics and 75.3% (n=58) among non-diabetics.

Table 3 presents the factors associated with the incidence of hyperglycemia in the POI in patients undergoing elective cardiac surgery. There was no statistically significant association between independent variables and the incidence of hyperglycemia in the IPP.

Table 3. Factors associated with the incidence of hyperglycemia in patients undergoing elective cardiac surgery. Rio Grande do Sul, Brazil, 2024. n=109

Variables	Hyperglycemia		p-value*
	Yes n (%)	No n (%)	
Sex			
Female	27 (32.5%)	10 (38.5%)	0.577
Male	56 (67.5%)	16 (61.5%)	
Age			
Adult	27 (32.5%)	12 (46.2%)	0.206
Elder	56 (67.5%)	14 (53.8%)	
BMI			
Adequate weight (18.5 - 24.9 Kg/m ²)	26 (31.3%)	5 (19.2%)	0.233
Overweight (≥ 25 Kg/m ²)	57 (68.7%)	21 (80.8%)	
Smoking			
Yes	28 (33.7%)	10 (38.5%)	0.659
No	55 (66.3%)	16 (61.5%)	
Alcoholism			
Yes	14 (16.9%)	3 (11.5%)	0.513
No	69 (83.1%)	23 (88.5%)	
Sedentary lifestyle			
Yes	67 (80.7%)	20 (76.9%)	0.674
No	16 (19.3%)	6 (23.1%)	
Arterial Hypertension			
Yes	63 (75.9%)	19 (73.1%)	0.771
No	20 (24.1%)	7 (26.9%)	
Diabetes Mellitus			
Yes	25 (30.1%)	7 (26.9%)	0.755
No	58 (69.9%)	19 (73.1%)	
Dyslipidemia			
Yes	32 (38.6%)	7 (26.9%)	0.280
No	51 (61.4%)	19 (73.1%)	
Use of norepinephrine			
Yes	62 (74.7%)	18 (69.2%)	0.582
No	21 (25.3%)	8 (30.8%)	
Surgery time			
< 4.5 hours	32 (38.6%)	13 (50.0%)	0.301
≥ 4.5 hours	51 (61.4%)	13 (50.0%)	
Time of ECC			
< 70 minutes	16 (19.3%)	6 (23.1%)	0.674
≥ 70 minutes	67 (80.7%)	20 (76.9%)	

* Chi-square test or Fisher's exact test; p-value significant at a significance level of 5%; BMI – Body mass index; ECC – Extracorporeal circulation.

DISCUSSION

Postoperative hyperglycemia is prevalent. One study demonstrated an incidence of dysglycemia of 48.72%⁽¹⁸⁾, making it one of the main complications in patients undergoing cardiac surgery. These findings corroborate the results of the present study, in which an even higher incidence of hyperglycemia was identified, reaching 76.1%, indicating a significant impact of endocrine changes in this clinical context. In addition, higher levels of glycemic variability may be associated with a higher risk of mortality⁽⁷⁾.

In this sense, the literature shows that postoperative hyperglycemia not only occurs with high frequency, but is also associated with unfavorable clinical outcomes, including a higher incidence of acute kidney injury, delirium and pulmonary infection, as well as longer duration of mechanical ventilation, longer stay in the intensive care unit, prolonged hospital stay and increased mortality rate⁽³⁾.

A low incidence of hypoglycemia was identified in the immediate postoperative period (2.8%), in contrast to the high frequency of hyperglycemia. This finding may be related to the adoption of less aggressive glycemic targets and frequent glycemic monitoring in the postoperative period, strategies that reduce the risk of sharp drops in glucose. Although hypoglycemia is less frequent, it is a clinically relevant event due to its association with mortality in critically ill patients⁽¹⁹⁾.

The clinical profile identified among the study participants, marked by the predominance of hypertensive (75.2%), sedentary (78.9%) and overweight (71.6%) patients, is consistent with a higher metabolic risk. These factors are known to be related to the occurrence of hyperglycemia^(20,21). Although no statistically significant association was observed between these variables, there is clinical plausibility that supports the relationship between this clinical profile and the greater propensity for glycemic changes in the postoperative period.

Although 29.4% of the sample had a prior diagnosis of diabetes mellitus, no statistically significant association was observed between diabetes and the occurrence of hyperglycemia in the postoperative period. It is noteworthy that the incidence of hyperglycemia was similar between diabetic (78.1%) and non-diabetic (75.3%) patients, showing that the glycemic elevation was not restricted to the presence of previous disease. Thus, the results suggest that hyperglycemia in the IPP constitutes a pathophysiological response to surgical stress, regardless of a prior diagnosis of diabetes, reinforcing the hypothesis of stress hyperglycemia.

Furthermore, it is important to highlight that cardiac surgery is associated with hyperglycemia in non-diabetic patients due to several factors. Among these, the use of gluconeogenic drugs (catecholamines), desensitization of insulin receptors, administration of exogenous glucose, hyperoxia, hypothermia, use of exogenous heparin, hemodilution, and hypoperfusion during ECC stand out⁽²²⁾.

Although there was no statistically significant association, 73.4% of patients used norepinephrine in the immediate postoperative period, a common practice in cardiac surgery. The literature indicates that

its use is associated with greater clinical severity and a higher incidence of serious postoperative complications, making it a risk marker⁽²³⁾. Under physiological conditions, norepinephrine increases energy metabolism, stimulates glucose release by glycogenolysis and gluconeogenesis, and inhibits the action of insulin on glycogenesis⁽²⁴⁾.

Hyperglycemia in the postoperative period has been associated with adverse outcomes, including higher rates of postoperative infections in cardiac surgery⁽²⁵⁾, including surgical site infection⁽²⁵⁻²⁷⁾. Although this outcome was not evaluated in the present study, its clinical relevance reinforces the importance of glycemic monitoring in the postoperative period.

The glycemic target adopted in this study (100-140 mg/dL) is within a narrower control range when compared to current recommendations in the perioperative period⁽⁵⁾. It is worth noting that the probability of hypoglycemia increases significantly when glycemic targets are more aggressive, and is associated with unfavorable clinical outcomes and mortality⁽²⁸⁾.

The median blood glucose level identified (169 mg/dL) is above the therapeutic target established in the study (100-140 mg/dL), suggesting suboptimal glycemic control from this perspective. However, this value is within the ranges currently recommended by the guidelines (140-180 mg/dL) during the perioperative period⁽⁵⁾, indicating that, although the strict target was not reached, the observed glycemic levels remained within a range considered safe in the context of the risk of hypoglycemia associated with more intensive control strategies.

Glycemic control can be used as an indicator of quality of care in intensive care units, since mortality⁽²⁹⁾. In this context, the role of the nurse in conducting glycemic management in ICUs is highlighted, with this action being associated with a reduction in glycemic variability and a decrease in the incidence of hyperglycemia and hypoglycemia⁽³⁰⁾.

Most management protocols are based on continuous intravenous insulin infusion and include strategies for managing hypoglycemia, as well as establishing monitoring intervals that can vary from 15 minutes to four hours, depending on the type of protocol adopted⁽³⁰⁾. Therefore, it is important to improve the knowledge levels of ICU nurses regarding glycemic management of critically ill patients, through training and the development of protocols⁽³¹⁾.

Study Limitations

Among the main limitations of the present study, the following stand out: the analysis of data from an already established database, which prevented the collection of other variables of interest; the absence of control for possible confounding factors, such as the use of specific medications and previous glycemic control; the analysis restricted to the immediate postoperative period, without longitudinal follow-up to assess the persistence or evolution of glycemic changes.

Moreover, the absence of statistically significant associations in the bivariate analysis limited the

identification of variables with potential for inclusion in a multivariate model. Therefore, it was decided not to perform logistic regression, which may have restricted the adjustment for possible confounding factors and the identification of independent associations between the variables analyzed.

Contributions for the Nursing Area, Health or Public Policy

The results of this study contribute to the fields of nursing, health, and public policy by highlighting the high incidence of hyperglycemia in the immediate postoperative period of patients undergoing elective cardiac surgery, even in the absence of prior diabetes, reinforcing the need for systematic and continuous glycemic monitoring as an essential component of perioperative care in cardiac surgery.

For nursing, the findings strengthen the nurse's role in clinical surveillance, early identification of metabolic changes, and implementation of evidence-based care protocols aimed at preventing complications and ensuring patient safety. In the health field, the data support the organization of more integrated care practices between hemodynamic and metabolic control, while, from the perspective of public policy, they offer evidence for improving institutional guidelines and strategies aimed at improving the quality of care in highly complex services, with a potential impact on reducing complications, length of stay, and healthcare costs.

CONCLUSION

The study identified an incidence of hypoglycemia of 2.8% and hyperglycemia of 76.1% in adults and elderly patients undergoing cardiac surgery. Most patients were male, white, and had a history of sedentary lifestyle, hypertension, and were overweight. There was no statistically significant association between diabetes mellitus and the incidence of hyperglycemia in the postoperative period.

Future studies should include longitudinal assessments to investigate the evolution of glycemic changes in the postoperative period and their relationship with clinical outcomes, investigations that include additional clinical variables, specific analyses in subgroups with and without a prior diagnosis of diabetes mellitus, in order to better understand the factors associated with hyperglycemia or glycemic changes in different patient profiles.

REFERENCES

1. Kant S, Banerjee D, Sabe SA, Sellke F, Feng J. Microvascular dysfunction following cardiopulmonary bypass plays a central role in postoperative organ dysfunction. *Front Med (Lausanne)* [Internet]. 2023 [citado 02 mar 2026]; 14(10):1110532. Disponível em: <https://doi.org/10.3389/fmed.2023.1110532>
2. Sreedharan, R, Khanna S, Shaw A. Perioperative glycemic management in adults presenting for elective cardiac and non-cardiac surgery. *Perioper Med (Lond)* [Internet]. 2023 [citado 02 mar 2026]; 12(1):13. Disponível em: <https://doi.org/10.1186/s13741-023-00302-6>

3. Xiang Y, Luo T, Zeng L. Risk factors and clinical outcome of postoperative hyperglycemia after cardiac surgery with cardiopulmonary bypass. *Front Cardiovasc Med* [Internet]. 2025 [citado 02 mar 2026]; 12:1479922. Disponível em: <https://doi.org/10.3389/fcvm.2025.1479922>
4. Marino EC, Momesso D, Toyoshima MTK, Almeida MFO, Schaan BD, Negretto LAF, et al. Screening and management of hospital hyperglycemia in non-critical patients: a position statement from the Brazilian Diabetes Society (SBD). *Diabetol Metab Syndr* [Internet]. 2025 [citado 13 abr 2026] 12;17(1):54. Disponível em: <https://doi.org/10.1186/s13098-025-01585-z>
5. Marino EC, Negretto L, Ribeiro RS, Momesso D, Feitosa ACR. Rastreamento e controle da hiperglicemia no perioperatório. *Diretriz Oficial da Sociedade Brasileira de Diabetes* [Internet]: São Paulo; 2023 [citado 02 mar 2026]. Disponível em: <https://doi.org/10.29327/5238993.2023-7>
6. Chang S, Xu M, Wang Y, Zhang Y. Acute Glycemic Variability and Early Outcomes After Cardiac Surgery: A Meta-Analysis. *Horm Metab Res* [Internet]. 2023 [citado 02 mar 2026]; 55(11):771-780. Disponível em: <https://doi.org/10.1055/a-2106-5539>
7. Yao, F, Yang F, Chen X, Liu L, He Z. Glycemic variability and postoperative mortality following cardiac surgery: evidence from a real-world ICU cohort. *BMC Cardiovasc Disord* [Internet]. 2025 [citado 02 mar 2026]; 25(1):787. Disponível em: <https://doi.org/10.1186/s12872-025-05259-6>
8. Liu T, Wang L, Zhang H, Dai Q. Stress hyperglycemia ratio linked to all-cause mortality in critically ill patients with ischemic heart disease. *BMC Cardiovasc Disord* [Internet]. 2025 [citado 02 mar 2026]; 25(1):374. Disponível em: <https://doi.org/10.1186/s12872-025-04831-4>
9. Ma J, Qin J, Mao F, He C, Ma D, Zhu J. Postoperative glycemic variability as a predictor for one-year mortality following coronary artery bypass grafting: a retrospective cohort study. *BMC Cardiovasc Disord* [Internet]. 2025 [citado 02 mar 2026]; 25(1):845. Disponível em: <https://doi.org/10.1186/s12872-025-05326-y>
10. Elpasiony NMA, Hafez AA, Hendy A, Ibrahim RK, Kotp MH, Baghdadi NA, et al. Nurse-led insulin protocol efficacy for control of hyperglycemia in critically ill patients. *BMC Nurs* [Internet]. 2025 [citado 02 mar 2026]; 24(1):924. Disponível em: <https://doi.org/10.1186/s12912-025-03553-4>
11. Reisdorfer AP, Leal SMC, Mancia JR. Nursing care for patient in postoperative heart surgery in the Intensive Care Unit. *Rev Bras Enferm* [Internet]. 2021 [citado 02 mar 2026]; 74(2):e20200163. Disponível em: <https://doi.org/10.1590/0034-7167-2020-0163>
12. Bezerra FMC, Brunori EHFR, Simonetti SH. Preditores clínicos de complicações em cirurgia cardíaca e os principais padrões de enfermagem na assistência. *Saúde Coletiva* [Internet]. 2022 [citado 02 mar 2026]; 12(75). Disponível em: <https://doi.org/10.36489/saudecoletiva.2022v12i75p10197-10212>
13. Malta M, Cardoso LO, Bastos FI, Magnanini MMF, Silva CMFP. STROBE initiative: guidelines on reporting observational studies. *Rev Saúde Pública* [Internet]. 2010 [citado 13 abr 2026]; 44(3). Disponível

em: <https://doi.org/10.1590/S0034-89102010000300021>

14. Soares GMT, Ferreira DCS, Gonçalves MPC, Alves TGS, David FL, Henriques KMC, et al. Prevalência das principais complicações pós-operatórias em cirurgias cardíacas. Rev Bras Cardiol [Internet]. 2011 [citado 02 mar 2026];24(3):139-46. Disponível em: http://sociedades.cardiol.br/socerj/revista/2011_03/a_2011_v24_n03_01prevalencia.pdf
15. Rubino F, Cummings DE, Eckel RH, Cohen RV, Wilding JPH, Brown WA, et al. Definition and diagnostic criteria of clinical obesity. Lancet Diabetes Endocrinol [Internet]. 2025 [citado 02 mar 2026];13(3):221-62. Disponível em: [https://doi.org/10.1016/S2213-8587\(24\)00316-4](https://doi.org/10.1016/S2213-8587(24)00316-4)
16. American Society of Anesthesiologists Committee on Oversight: Economics. Statement on ASA Physical Status Classification System. Anesthesiol Open [Internet]. 2026 [citado 02 mar 2026];1(1):e0002. Disponível em: <https://doi.org/10.1097/ao9.000000000000002>
17. Velho TR, Pereira RM, Guerra NC, Ferreira R, Pedroso D, Neves-Costa A, et al. The impact of cardiopulmonary bypass time on the Sequential Organ Failure Assessment score after cardiac surgery. Interdiscip Cardiovasc Thorac Surg [Internet]. 2024 [citado 02 mar 2026];38(5):ivae082. Disponível em: <https://doi.org/10.1093/icvts/ivae082>
18. Santos RS, Serra LS, Gomes JR, Santos DM, Gomes RS. Cirurgias cardíacas com circulação extracorpórea: características dos pacientes e suas principais complicações pós-operatórias. Enferm Foco [Internet]. 2024 [citado 02 mar 2026];15:e2024123. Disponível em: <https://doi.org/10.21675/2357-707X.2024.v15.e-2024123>
19. Yeh HF, Chao WC, Wu CL, Chan MC. Hypoglycemia and hospital mortality in critically ill patients. Sci Rep [Internet]. 2025 [citado 02 mar 2026];15(1):2642. Disponível em: <https://doi.org/10.1038/s41598-025-87163-9>
20. Ouyang X, Gu L, Xu T, Deng T, Xu H, Xu Y, et al. The combined associations of excess body weight, hypertension, and hypertriglyceridemia with hyperglycemia among nondiabetic older adults in regional China. Sci Rep [Internet]. 2025 [citado 02 mar 2026];15(1):30999. Disponível em: <https://doi.org/10.1038/s41598-025-16879-5>
21. Gerage AM, Bezerra JB, Tomicki C, Coneglian JC, Souza PV, Mendes BG, et al. High sedentary behavior and low light physical activity are associated with worse glucose rates in cardiometabolic diseases' subjects. J Bodyw Mov Ther [Internet]. 2024 [citado 02 mar 2026];40:295-9. Disponível em: <https://doi.org/10.1016/j.jbmt.2024.04.021>
22. Najmii S, Redford D, Larson DF. Hyperglycemia as an effect of cardiopulmonary bypass: intra-operative glucose management. J Extra Corpor Technol [Internet]. 2006 [citado 02 mar 2026];38(2):168-73. Disponível em: <https://pmc.ncbi.nlm.nih.gov/articles/PMC4680756/pdf/ject-38-168.pdf>
23. Guinot PG, Durand B, Besnier E, Mertes PM, Bernard C, Nguyen M, et al. Epidemiology, risk factors

- and outcomes of norepinephrine use in cardiac surgery with cardiopulmonary bypass: a multicentric prospective study. *Anaesth Crit Care Pain Med* [Internet]. 2023 [citado 02 mar 2026];42(3):101200. Disponível em: <https://doi.org/10.1016/j.accpm.2023.101200>
24. Barth E, Albuszies G, Baumgart K, Matejovic M, Wachter U, Vogt J, et al. Glucose metabolism and catecholamines. *Crit Care Med* [Internet]. 2007 [citado 02 mar 2026];35(9 Suppl):S508-18. Disponível em: <https://doi.org/10.1097/01.CCM.0000278047.06965.20>
25. Järvelä KM, Khan NK, Loisa EL, Sutinen JA, Laurikka JO, Khan JA. Hyperglycemic Episodes Are Associated With Postoperative Infections After Cardiac Surgery. *Scand J Surg* [Internet]. 2018 [citado 13 abr 2026]; 107(2):138-44. Disponível em: <https://doi.org/10.1177/1457496917731190>
26. Bellusse GC, Ribeiro JC, de Freitas ICM, Galvão CM. Effect of perioperative hyperglycemia on surgical site infection in abdominal surgery: A prospective cohort study. *Am J Infect Control* [Internet]. 2020 [citado 13 abr 2026];48(7):781-5. Disponível em: <https://doi.org/10.1016/j.ajic.2019.11.009>
27. Castro H, Barbieri BM, Rezende LDA, Sipolatti WGR, Fiorin BH. Medidas de prevenção de infecção de sítio cirúrgico na cirurgia cardíaca com esternotomia. *Enferm Bras* [Internet]. 2024 [citado 13 abr 2026];23(1):1399-411. Disponível em: <https://doi.org/10.62827/eb.v23i1.2729>
28. Duggan EW, Carlson K, Umpierrez GE. Perioperative Hyperglycemia Management: An Update. *Anesthesiology* [Internet]. 2017 [citado 15 abr 2026];126(3):547-60. Disponível em: <https://doi.org/10.1097/ALN.0000000000001515>
29. Lu Z, Tao G, Sun X, Zhang Y, Jiang M, Liu Y, et al. Association of Blood Glucose Level and Glycemic Variability With Mortality in Sepsis Patients During ICU Hospitalization. *Front Public Health* [Internet]. 2022 [citado 15 abr 2026];10:857368. Disponível em: <https://doi.org/10.3389/fpubh.2022.857368>
30. Han E, Park E, Oh EG. Nurse-led glycemic control protocols in intensive care units: a scoping review. *Acute Crit Care* [Internet]. 2026 [citado 15 abr 2026];41(1):58-67. Disponível em: <https://doi.org/10.4266/acc.003225>
31. Zhang H, Zeng Z, Xie S, Yang X, Yan F, Liang Z, et al. ICU nurses' knowledge, attitude, and practice regarding blood glucose management in critically ill patients: A multicenter cross-sectional study. *Medicine (Baltimore)* [Internet]. 2026 [citado 15 abr 2026];104(49):e46132. Disponível em: <https://doi.org/10.1097/MD.00000000000046132>

Acknowledgments: None.

Funding: None.

Data Availability: All data are included in the manuscript.

Authors' contributions: Research conception and design: Carol Andrade Bolzani, Thaís Dresch Eberhardt. Data acquisition: Carolina Miriam Barbosa, Jacqueline Boeira do Nascimento, Raquel da Silva Baggio, Carol Andrade Bolzani, Thaís Dresch Eberhardt. Data analysis and interpretation: Carolina Miriam Barbosa, Jacqueline Boeira do Nascimento, Raquel da Silva Baggio, Tarzie Hübner da Cruz, Eduarda Angélica Andrade Sertoli, Carol Andrade Bolzani, Thaís Dresch Eberhardt. Manuscript writing: Carolina Miriam Barbosa, Jacqueline Boeira do Nascimento, Raquel da Silva Baggio, Tarzie Hübner da Cruz, Eduarda Angélica Andrade Sertoli, Carol Andrade Bolzani, Thaís Dresch Eberhardt. Critical review of the manuscript regarding intellectual content: Carolina Miriam Barbosa, Jacqueline Boeira do Nascimento, Raquel da Silva Baggio, Tarzie Hübner da Cruz, Eduarda Angélica Andrade Sertoli, Carol Andrade Bolzani, Thaís Dresch Eberhardt.

Editor-in-Chief: André Luiz Silva Alvim 