REDUCTION OF PREOPERATIVE FASTING IN PATIENTS UNDERGOING ELECTIVE CARDIAC SURGERY

ABREVIAÇÃO DE JEJUM PRÉ-OPERATÓRIO EM PACIENTES SUBMETIDOS À CIRURGIA CARDÍACA ELETIVA

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ABSTRACT

Prolonged fasting in the preoperative period of elective cardiac surgeries causes metabolic changes, such as increased insulin resistance, infections, discomfort, and more extended hospital stays, resulting in high public health costs. The objective of this study was to evaluate the preoperative fasting abbreviation protocol, introduced in April 2023, and compare it to conventional fasting. This is a retrospective analytical study conducted in a hospital in the northwest region of Espírito Santo, utilizing data collection from electronic medical records and the institutional database, which were subsequently analyzed using SPSS software, version 21.0. Patients undergoing elective cardiac surgery 8 months before the protocol, subject to conventional fasting of at least 8 hours, were included, compared to those who adopted the fasting abbreviation in the 8 months following the implementation of the protocol, with suspension of solid food 6 hours before surgery and restricted liquid diet 3 hours before. There was no difference in the length of Intensive Care Unit (ICU) stay or mortality between the groups. Regarding glycemic variation, there was an increase in

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glycemic levels in the fasting abbreviation group compared to the conventional fasting group [F(157) = 0.155, p<0.01], with a small effect size of the difference (Cohen's d = 0.3902). The glycemic increase is demonstrated to have low clinical relevance, and further studies, including randomized clinical trials, are needed to better understand the variables involved in fasting abbreviation in cardiac surgeries and to optimize health services.

Keywords: Fasting abbreviation, Cardiac surgery, Hyperglycemia, Glycemic control, Perioperative.

RESUMO

O jejum prolongado no pré-operatório de cirurgias cardíacas eletivas provoca alterações metabólicas, como aumento da resistência insulínica, infecções, desconforto e maior tempo de internação hospitalar, resultando em custos elevados para a saúde pública. Esforços docentes e discentes são necessários para melhorar tais desfechos. O objetivo deste estudo foi avaliar o protocolo de abreviação de jejum pré-operatório, instituído em abril de 2023, comparando-o ao jejum convencional. Trata-se de um estudo analítico retrospectivo, realizado em um hospital na região noroeste do Espírito Santo, com coleta de dados por meio de prontuários eletrônicos e do banco de dados institucional, posteriormente analisados no software SPSS, versão 21.0. Foram incluídos pacientes submetidos à cirurgia cardíaca eletiva 8 meses antes do protocolo, sujeitos ao jejum convencional de no mínimo 8 horas, comparados àqueles que adotaram a abreviação de jejum nos 8 meses subsequentes à implantação do protocolo, com suspensão da alimentação sólida 6 horas antes da cirurgia e da dieta líquida restrita 3 horas antes. Não houve diferença estatística no tempo de permanência na UTI e na mortalidade entre os grupos. Quanto à variação glicêmica, houve um aumento glicêmico no grupo da abreviação de jejum em comparação ao grupo do jejum convencional [F(157) = 0,155, p<0,01], apresentando tamanho de efeito da diferença pequeno (d de Cohen = 0,3902). Dessa forma, o aumento glicêmico demonstrou ter baixa relevância clínica, sendo necessários mais estudos, incluindo ensaios clínicos randomizados, para melhor compreender as variáveis envolvidas na abreviação de jejum em cirurgias cardíacas e otimizar os serviços de saúde.

Palavras-chave: *Abreviação de jejum, Cirurgia cardíaca, Hiperglicemia, Controle glicêmico, Perioperatório.*

1 INTRODUCTION

In the 20th century, preoperative fasting was instituted based on reports of pulmonary aspiration of gastric contents during anesthetic induction (Diógenes; Costa; Rivanor, 2019). Consequently, it was established that to ensure safe anesthetic induction, a maximum limit of 25 mL of gastric content was necessary (Aguilar-Nascimento, 2016).

Empirically, preoperative fasting for elective surgeries was defined as a minimum period of food and liquid restriction, known as *"nil per os"* after midnight (Diógenes; Costa; Rivanor, 2019). However, scientific evidence indicates that prolonged fasting (8 to 16 hours) is uncomfortable and contributes to insulin resistance, metabolic stress, adynamic ileus, poor wound healing, and infectious complications (Kotfis *et al.*, 2020).

Implemented in Brazil in 2005, the ACERTO Project - *Aceleração da Recuperação Total Pós-operatória* (Acceleration of Total Postoperative Recovery) - is a multimodal protocol based on ERAS (Enhanced Recovery of patients After Surgery) concepts and prior studies on surgical nutritional therapy. It was designed to reduce preoperative fasting and to implement early postoperative refeeding, demonstrating particular efficacy in accelerating recovery for patients undergoing medium to large surgical procedures (Aguilar-Nascimento *et al*., 2021).

Fasting abbreviation represents a significant advancement in perioperative care, as it is a safe practice that does not increase the risk of pulmonary aspiration during anesthetic induction. By mitigating the deleterious effects of prolonged fasting, it effectively minimizes insulin resistance and the endocrine-metabolic response after cardiac surgery, thus promoting early postoperative recovery (Aguilar-Nascimento, 2016; Feguri *et al*., 2019). Cardiac surgery is a major surgical procedure capable of inducing insulin resistance and a pronounced metabolic response to surgical trauma, particularly in surgeries requiring extracorporeal circulation (ECC) (Marcarini *et al*., 2017).

Extracorporeal circulation, widely used in cardiovascular surgeries, is associated with an increased metabolic response to surgical stress, potentially leading to perioperative hyperglycemia. This effect occurs primarily due to blood contact with the ECC machine, triggering the release of inflammatory mediators that impair insulin signaling pathways. Studies indicate that hyperglycemia resulting from surgical trauma may compromise wound healing and intensify postoperative inflammatory responses, contributing to prolonged hospitalization and increased mortality (Bravo; Casarotti, 2020).

Recently, the Brazilian Society of Anesthesiology (SBA) stated that fasting can be abbreviated with clear liquids containing maltodextrin supplemented with nitrogen sources, such as glutamine and/or whey protein, when consumed up to 3 hours before surgery. The American Society of Anesthesiologists (ASA) recommends maintaining

traditional fasting and suspending abbreviated fasting with clear liquids in patients with gastrointestinal motility disorders that impair gastric emptying, to reduce the risk of regurgitation and pulmonary aspiration (Aguilar-Nascimento, 2016).

Therefore, this retrospective analytical study, conducted at a hospital in the northwest region of Espírito Santo, aimed to compare, through medical record analysis, two fasting protocols: conventional and abbreviated fasting. The objective was to assess whether there was an improvement in postoperative glycemic variability in these patients, given that this procedure induces significant metabolic stress that may increase mortality.

2 METHODS

This is a retrospective analytical study conducted at a hospital in the northwest region of Espírito Santo, Brazil, with the objective of evaluating the preoperative fasting abbreviation protocol implemented in this hospital in April 2023. The sample included patients undergoing cardiac surgeries, such as coronary artery bypass grafting, valve replacement, atrial-septal defect repair, and patent foramen ovale closure. Data analysis encompassed a total period of 18 months, from July 2022 to December 2023, allowing for a comparison of an eight-month pre-implementation period with an eight-month post-implementation period of the aforementioned protocol.

In the conventional fasting group, the discontinuation of solid and liquid intake commenced 8 hours before the surgical procedure. In the fasting abbreviation group, solid food and milk were suspended 6 hours before surgery. The first dose of a restricted liquid diet (400 mL of a 12.5% Maltodextrin solution supplemented with 15g of Whey Protein) was administered 5 hours before the procedure. The final preoperative meal was offered 3 hours before surgery, consisting of 200 mL of restricted liquid diet, 25g of maltodextrin, and 10-15g of Glutamine or Whey Protein.

The study was approved by the Research Ethics Committee of the University Center of Espírito Santo (UNESC) – Campus Colatina (CAAE number 80516924.3.0000.5062).

2.1 INCLUSION AND EXCLUSION CRITERIA

The study consisted of two groups: one group whose medical records indicated they had undergone conventional fasting and another group that underwent abbreviated fasting. The participants in the conventional fasting group followed an 8-hour fasting period. Those in the abbreviated fasting group followed a protocol in which solid foods were stopped 6 hours before surgery and clear liquids 3 hours before the procedure.

Patients included were those undergoing cardiac surgery for myocardial revascularization, valve replacement, atrial septal defect repair, and patent foramen ovale closure, over 18 years of age and of both sexes.

Exclusion criteria were: pregnant women; patients with inability to use the gastrointestinal tract; patients with significant gastroesophageal reflux; patients with megaesophagus; patients with esophageal and/or intestinal obstruction; patients with gastroparesis and pyloric stenosis; patients with previous gastrointestinal surgery that compromised gastric emptying.

The variables analyzed were: pre-existing comorbidities, demographic data (sex and age), glycemic variability, and other variables related to ICU stay. Participant recruitment was conducted through electronic medical records using the *SoulMv*® system, with assistance from the hospital's computerized database (*Magma*®, Version 4.0).

Glycemic values were collected preoperatively and in the immediate postoperative period, with the intensive care units at the institution where the study was conducted following a specific insulin therapy protocol according to obtained capillary blood glucose values. For capillary blood glucose up to 180 mg/dL, no subcutaneous insulin is administered. For capillary blood glucose levels of 181-230, 231-280, 281-330, and 331-380 mg/dL, patients receive 4, 6, 8, and 10 units of insulin, respectively; if levels exceed 381 mg/dL, continuous insulin infusion via pump is initiated immediately.

2.2 RISKS AND BENEFITS

The risk assessments were conducted by the attending physician and the patient's assigned nutritionist. The abbreviated fasting protocol could potentially cause

discomfort or negatively interfere with the surgery only if it did not comply with the previously outlined exclusion criteria.

2.3 DATA ANALYSIS

The database was exported to SPSS (*Statistical Package for the Social Sciences*) version 21.0 software, where statistical analyses were performed. Data normality was assessed using the *Kolmogorov-Smirnov* and *Shapiro-Wilk* tests. The *Friedman ANOVA* test, followed by the *Wilcoxon Signed Rank* test, was used to evaluate whether there were glycemic differences at different time points. The *Student's t-test* for independent samples with *bootstrapping* (95% BCa CI) was employed to investigate potential differences in blood glucose levels between groups at different time points. The *chi-square test of independence* (2×2) was used to assess the number of hyperglycemic events between groups. Continuous variables are presented as mean ± standard deviation. For all analyses, a *p-value*<0.05 was considered statistically significant.

3 RESULTS

The study included a total of 159 patients, comprising 66 in the conventional fasting group and 93 in the abbreviated fasting group. Male participants predominated in the sample, accounting for 41 (62%) in the conventional fasting group and 54 (58%) in the abbreviated fasting group. No statistically significant differences were observed in any baseline demographic characteristics among the included patients (**Table 1**).

Table 1 - Demographic characteristics of participants in conventional fasting (n = 66) and abbreviated fasting (n = 93) groups.

Variables Sample size (n)		Conventional Fasting (n = 66)	Abbreviated Fasting (n = 93)
Age (median (min-max))		63 (33-79)	61 (28-83)
Sex (%)			
	Male	41 (62%)	54 (58%)
	Female	25 (38%)	39 (42%)
Alcohol Use (%)			
	No	63 (95%)	82 (88%)
	Yes	3 (5%)	11 (12%)
Smoking (%)			
	No	49 (74%)	69 (74%)
	Yes	17 (26%)	24 (26%)
SAH (%)			
	No	20 (30%)	29 (31%)
	Yes	46 (70%)	64 (69%)
Obesity (%)			
	No	63 (95%)	83 (89%)
	Yes	3 (5%)	10 (11%)
NIDDM (%)			
	No	49 (74%)	70 (75%)
	Yes	17 (26%)	23 (25%)

Caption: SAH - Systemic Arterial Hypertension; DMNID - Non-Insulin Dependent Diabetes Mellitus; med (min-max) - median (minimum-maximum).
Source: Author, 2025.

Regarding ICU length of stay and mortality rates, no statistically significant differences were found between the groups. Analysis of sample sizes revealed that the conventional fasting group (n = 66) contained fewer patients compared to the abbreviated fasting group (n = 93), which might explain the longer ICU stays and higher mortality rate observed in the abbreviated fasting group (**Table 2**).

Table 2 - ICU length of stay and mortality in patients undergoing abbreviated fasting compared to conventional fasting.

	Length of ICU Stay (Mean ± SD)	Mortality n (%)	Discharge n (%)
Conventional fasting	6.2 ± 6.3	8 (12%)	58 (88%)
Abbreviated fasting	9.9 ± 17.2	13 (14%)	80 (86%)

Caption: SD - Standard Deviation.
Source: Author, 2025.

The normality of glycemic variability scores was assessed using the *Kolmogorov-Smirnov* and *Shapiro-Wilk* tests. The results demonstrated that the data were not normally distributed (K-S = 0.936, $p<0.001$; S-W = 0.105, $p<0.001$). Therefore, the *Friedman ANOVA* test was performed, which revealed significant differences in blood glucose levels when comparing the different time points: preoperative, ICU admission, first 12 hours postoperative, and between 12 and 24 hours after surgery ($\chi^2(3) = 108.443$, $p<0.001$). The data is described in the following table (**Table 3**).

Table 3 - *Friedman ANOVA test* for blood glucose levels at different time points in the preoperative and postoperative periods for both groups.

	Blood glucose in preoperative period	**Blood glucose at ICU admission**	**Blood glucose in first 12 hours after surgery**	**Blood glucose between 12 and 24 hours after surgery**
Conventional Fasting				
Mean ± SD	112.3 ± 33.3	190.8 ± 70.9	184.1 ± 49.6	149.1 ± 42.1
95% CI (Lower-Upper)	104.06 – 120.45	173.33 – 208.21	171.85 – 196.24	138.68 – 159.38
Abbreviated Fasting				
Mean ± SD	122.6 ± 47.7	219.6 ± 75.9	188.8 ± 48.2	150.4 ± 49.6
95% CI (Lower-Upper)	112.77 – 132.41	203.97 – 235.22	178.88 – 198.71	140.22 – 160.64

Caption: SD - Standard Deviation; 95% CI (Lower - Upper) - 95% Confidence Interval (Lower limit - Upper limit). A result was considered significant when the *p-value*<0.05.
Source: Author, 2025.

The *Wilcoxon Signed Rank test* demonstrated that in the conventional fasting group, blood glucose levels during the preoperative period were significantly lower than at ICU admission ($z = -8.798$, $p<0.001$). Immediately after this increase in blood glucose, the levels remained stable until 12 hours after surgery, at approximately 190 mg/dL ($z = -0.236$, $p>0.05$). By 24 hours, blood glucose levels had decreased compared to those at ICU admission ($z = 3.978$, $p<0.001$), returning to an average of

149 mg/dL, although still elevated when compared to preoperative blood glucose, which averaged 112 mg/dL (z = -4.821, $p<0.01$).

A similar statistically significant result was observed in the abbreviated fasting group ($\chi^2(3) = 156.003$, $p<0.001$), where blood glucose levels during the preoperative period were significantly lower than at ICU admission (z = -11.247, $p<0.001$). Blood glucose levels remained stable, at approximately 220 mg/dL, immediately after surgery and up to 12 hours postoperatively (z = 2.556, $p>0.05$). However, by 24 hours after surgery, blood glucose had decreased compared to ICU admission (z = 7.866, $p<0.001$), returning to an average of 150 mg/dL, though still elevated when compared to preoperative blood glucose, which averaged 122 mg/dL (z = -3.408, $p<0.01$).

Subsequently, an independent samples *Student's t-test* was performed to investigate whether there would be a difference in glycemic variability between patients who underwent conventional fasting and those who underwent abbreviated fasting.

As mentioned previously, the data were not normally distributed. Therefore, *bootstrapping* procedures (1000 resamples; 95% BCa CI) were conducted to obtain greater reliability of the results, to correct for deviations from normality in the sample distribution and differences between group sizes, and to present a 95% confidence interval for the differences between means (Haukoos; Lewis, 2005).

The results showed no statistical difference in blood glucose levels between the groups during the preoperative period, ICU admission, the first 12 hours, or up to 24 hours after cardiac surgery (**Figure 1**).

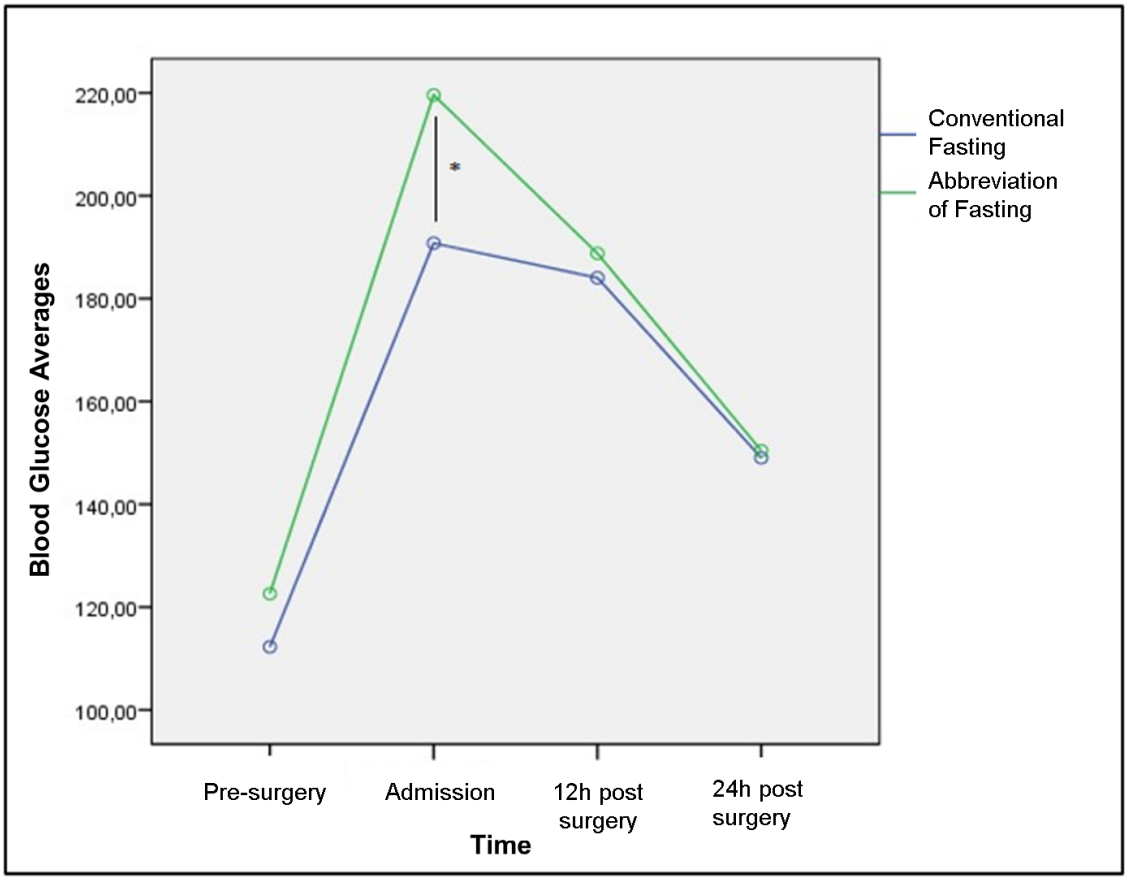

Figure 1 - The graph displays mean blood glucose levels during the preoperative period, at admission, and at 12 and 24 hours postoperatively in patients who underwent either conventional fasting or abbreviated fasting as preparation for cardiac surgery.
Caption: $p<0.05$ when comparing conventional fasting with abbreviated fasting.
Source: Author, 2025

Only at the time of ICU admission was there an increase in blood glucose levels in the abbreviated fasting group compared to the conventional fasting group [F(157) = 0.155, $p<0.01$]. However, the effect size of this difference was small (*Cohen's d* = 0.3902).

The number of hyperglycemic episodes (blood glucose level >180 mg/dL) and hypoglycemic episodes (blood glucose level <70 mg/dL) was also verified (**Table 4**).

Table 4 - Glycemic variability of participants in conventional fasting (n = 66) and abbreviated fasting (n = 93) groups.

Glycemic Variability		Conventional Fasting (n = 66)	Abbreviated Fasting (n = 93)
Preoperative (%)			
	Hypoglycemia	6 (9%)	10 (11%)
	Normoglycemia	58 (88%)	73 (78%)
	Hyperglycemia	2 (3%)	10 (11%)
ICU Admission (%)			
	Hypoglycemia	0	0
	Normoglycemia	37 (56%)	33 (35%)
	Hyperglycemia	29 (44%)*	60 (65%)*
First 12h Postop (%)			
	Hypoglycemia	0	0
	Normoglycemia	39 (59%)	46 (49%)
	Hyperglycemia	27 (41%)	47 (51%)
12-24h Postop (%)			
	Hypoglycemia	0	0
	Normoglycemia	58 (88%)	81 (87%)
	Hyperglycemia	8 (12%)	12 (13%)

Caption: *$p<0.05$ when comparing conventional fasting with abbreviated fasting.
Source: Author, 2025

Through the *chi-square test of independence* (2×2), a significant association was observed only during the ICU admission period, where there was an increase ($\chi^2(1) = 6.63$, $p<0.01$; $f = 0.204$), indicating a small effect size, as observed in the *Phi test*.

The odds ratio analysis demonstrated that patients with abbreviated fasting had a 2.32 times greater likelihood of presenting with hyperglycemia compared to conventional fasting patients during the admission period after the procedure. However, 12 hours after surgery, the number of hyperglycemic episodes returned to showing no difference between fasting types.

4 DISCUSSION

The emergence of cardiovascular diseases is associated with multiple risk factors, including obesity, diabetes, hypertension, smoking, alcohol consumption, physical inactivity, family history, and inadequate diet, among others (Gomes *et al.*, 2021). Both groups in the present study included participants with these risk factors related to the development of cardiovascular diseases. Another study involving patients undergoing cardiovascular surgery also identified these risk factors in participants from both groups (Bravo; Casarotti, 2020).

Diabetes Mellitus (DM) and hyperglycemia constitute significant risk factors for perioperative complications (Marino *et al*., 2023). However, the results of the present study indicated that 119 participants were non-diabetic, while only 40 presented with this comorbidity. Nevertheless, no correlation was found between the presence of DM or hyperglycemia and perioperative complications in the analyzed patients. It is important to emphasize that most available evidence does not specifically discriminate patients undergoing cardiac surgery, which complicates the generalization of results and recommendations regarding the implementation of abbreviated fasting.

The majority of patients undergoing cardiac surgery in this study were male (58%). According to the literature, men had considerably higher cardiovascular mortality rates compared to women (Brant *et al*., 2017). This may be explained by health-averse behaviors more commonly expressed by men (Mussi; Teixeira, 2018).

Regarding ICU length of stay and mortality rates, no statistical differences were observed between groups. However, a 2011 study of 5,974 participants undergoing various general surgeries reported reduced hospitalization time and postoperative mortality with abbreviated fasting (Bicudo-Salomão *et al*., 2011). Although the present study showed longer ICU stays and higher mortality rates in the abbreviated fasting group, it is important to note that the conventional fasting group had a smaller sample size, which may help explain the longer ICU stays and increased mortality observed in the abbreviated group.

The findings of this study show that patients admitted to the ICU after cardiac surgery who underwent preoperative abbreviated fasting presented higher blood glucose levels compared to the conventional fasting group. It was observed that 65% of patients in this group had blood glucose levels exceeding 180mg/dL upon ICU admission. However, 12 hours post-surgery, glucose levels showed no statistical difference between groups. Furthermore, both groups exhibited reduced blood glucose levels between 12-24 hours after cardiac surgery, with no significant intergroup differences. Therefore, this transient hyperglycemic effect immediately post-surgery in the abbreviated fasting group appears to have minor clinical significance.

A prospective, non-randomized interventional study by Furnary, Wu, and Bookin (2004) involving 4,864 cardiac surgery patients found that perioperative hyperglycemia was associated with increased infection rates, hospitalization duration, and hospital costs. This may be explained by the surgical procedure itself inducing metabolic and hormonal changes - inherent physiological responses to surgical trauma - which can

trigger insulin resistance and consequent hyperglycemia (Marcarini *et al*., 2017). Glycemic alterations were also observed in the clinical practice of this study, where nursing staff, alongside the multidisciplinary team, were involved. Despite preoperative abbreviated fasting administration, blood glucose levels in cardiac surgery patients increased upon ICU admission. However, these levels normalized within 24 hours in both groups, showing no significant impact on ICU length of stay or mortality when comparing abbreviated versus conventional fasting.

This study had several limitations. Although the total sample included 159 patients, a more significant number could enhance statistical validity, particularly with longer-term data analysis; additional variables like prior insulin use, intraoperative glucose control, and anesthetic management variations - not detailed in this study - might influence glycemic responses and postoperative outcomes.

5 CONCLUSION

The present study demonstrated that abbreviated fasting in patients undergoing elective cardiac surgery did not show a significant impact on ICU length of stay or mortality when compared to conventional fasting. Regarding glycemic levels following ICU admission, although they were higher in the abbreviated fasting group, this difference was transient, with normalization occurring within 24 hours postoperatively, thus lacking considerable clinical relevance.

The absence of correlation between DM and perioperative complications in this study suggests that the observed hyperglycemia largely stems from metabolic responses triggered by surgical trauma, as previously described in the literature. The findings presented here reinforce that abbreviated fasting constitutes a safe practice for cardiac surgery patients, provided adequate postoperative glycemic monitoring is implemented.

It is imperative that additional robust studies, particularly randomized clinical trials, be conducted to further elucidate the effects of abbreviated fasting in cardiac surgeries. With proper implementation of this protocol, it becomes possible to optimize perioperative care, reducing complications and enhancing patient recovery, ultimately leading to significant improvements in healthcare service quality.

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DECLARATION OF CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest linked to this research.

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