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Perioperative Blood Glucose Levels as a Predictor of Hospital Length of Stay in Complicated Appendicitis: A Prospective Cohort Study

Satrio Sarwo Trengginas[1*], Ida Bagus Budhi Surya Adnyana[1]

[1]Department of Surgery, Faculty of Medicine, Universitas Sebelas Maret/Dr. Moewardi General Hospital, Surakarta, Indonesia

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***Corresponding author:**
Satrio Sarwo Trengginas

E-mail address:
satriosarwo@gmail.com

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A B S T R A C T

Background: Complicated appendicitis presents significant management challenges. Perioperative blood glucose levels are emerging as potential prognostic indicators in surgery. This study aimed to evaluate the correlation between perioperative blood glucose levels and hospital length of stay in patients with complicated appendicitis. **Methods:** This prospective cohort study was conducted at Dr. Moewardi General Hospital, Indonesia, from October 2020 to October 2021. We enrolled 49 adult patients with complicated appendicitis. Preoperative and postoperative blood glucose levels were measured. The primary outcome was hospital length of stay. Spearman's correlation and ROC curve analyses were performed. **Results:** Significant positive correlations were found between hospital length of stay and preoperative blood glucose (r=0.324, p=0.023), postoperative blood glucose (r=0.484, p=0.000), age (r=0.324, p=0.023), and surgical site infection (r=0.360, p=0.011). Postoperative blood glucose showed the strongest correlation. ROC analysis identified a postoperative blood glucose level >123 mg/dL as a cut-off for prolonged hospitalization (>3 days), with 65.2% sensitivity and 65.4% specificity (AUC=0.71). **Conclusion:** Perioperative blood glucose levels significantly correlate with hospital length of stay in complicated appendicitis, with postoperative levels showing the strongest association. Monitoring postoperative blood glucose may help predict and potentially reduce the duration of hospitalization.

1. Introduction

Appendicitis is a common surgical emergency that poses a significant burden on healthcare systems worldwide. It is estimated that the lifetime incidence of appendicitis ranges between 6% and 8%. While uncomplicated appendicitis can often be effectively managed with prompt surgical intervention and a relatively brief hospital stay, complicated appendicitis presents a more challenging clinical scenario. Complicated appendicitis encompasses a spectrum of conditions, including perforated appendicitis, periappendicular abscess formation, gangrenous appendicitis, and peritonitis resulting from the appendiceal infection. These complex conditions are typically associated with increased morbidity, prolonged hospitalization, and elevated healthcare costs. The management of complicated appendicitis requires a multifaceted approach, often involving extended antibiotic therapy, more complex surgical procedures, and a longer recovery period compared to uncomplicated cases. In the context of surgical outcomes, perioperative blood glucose levels have emerged as potential predictors of patient recovery and the occurrence of adverse events. Blood glucose testing is a routine and readily accessible diagnostic tool utilized across various surgical procedures. The perioperative period, particularly the physiological stress induced by surgery, often leads to an elevation

in blood glucose levels, a phenomenon known as surgical stress hyperglycemia. This metabolic response is triggered by the body's inflammatory reaction to surgical trauma.[1,2]

Perioperative hyperglycemia, which has been defined in various studies as blood glucose levels exceeding 140 mg/dL or 180 mg/dL postoperatively, has been consistently associated with unfavorable surgical outcomes. Elevated blood glucose levels can impair essential physiological processes, including tissue healing and overall recovery. Studies have demonstrated that hyperglycemia can disrupt wound healing by damaging blood vessels, promoting inflammation, and disrupting collagen architecture. Additionally, hyperglycemia can reduce the glycocalyx on blood vessel endothelia, which can disrupt protective functions. This damage is thought to be mediated by the production of reactive oxygen species (ROS) under hyperglycemic conditions. The impairment of wound healing and tissue repair caused by hyperglycemia may contribute to a longer duration of hospitalization. Furthermore, poor glycemic control has been shown to increase the risk of postoperative infections due to its detrimental effects on leukocyte function, thereby compromising the body's ability to combat invading pathogens. The increased risk of postoperative infections can further contribute to prolonged hospitalization, increased healthcare costs, and a greater burden on the healthcare system. Consequently, the measurement and monitoring of perioperative blood glucose levels are increasingly recognized as important aspects of predicting surgical outcomes and identifying patients at risk for complications. Effective management of perioperative blood glucose levels may potentially mitigate adverse outcomes and improve patient recovery. Given the complexity of complicated appendicitis and the potential influence of metabolic factors on patient recovery, it is plausible to hypothesize that perioperative blood glucose levels could play a significant role in determining the clinical course and, specifically, the duration of hospital stay in these patients.[3-5]

Hospital length of stay is a critical indicator of patient recovery, resource utilization, and overall healthcare efficiency. It reflects the total duration of inpatient care required for the management of a specific condition, from admission to discharge. Understanding the factors that contribute to prolonged hospitalization in complicated appendicitis is essential for optimizing patient management strategies and improving healthcare delivery. A shorter hospital stay is generally associated with reduced healthcare costs, improved patient satisfaction, and efficient allocation of hospital resources. Conversely, a prolonged hospital stay can indicate a more challenging recovery, the development of postoperative complications, or the need for additional medical interventions. Identifying the factors that influence hospital length of stay can help clinicians to predict patient outcomes, allocate resources effectively, and implement targeted interventions to improve patient care and reduce the economic burden on the healthcare system. While the association between perioperative blood glucose levels and surgical outcomes has been explored in various surgical specialties and patient populations, specific data regarding this correlation in patients with complicated appendicitis, particularly within the Indonesian context, has been limited. Previous research has investigated the relationship between preoperative blood glucose levels and hospital length of stay in patients undergoing appendectomy. However, these studies often included both uncomplicated and complicated cases of appendicitis, making it difficult to isolate the specific impact of blood glucose levels on the outcomes of complicated appendicitis.[6-8]

Indonesia, with its diverse population and varying healthcare infrastructure, may present unique factors influencing the outcomes of surgical emergencies such as complicated appendicitis. Factors such as socioeconomic status, access to healthcare facilities, dietary habits, and genetic predispositions can potentially influence both the incidence and the outcomes of complicated appendicitis. Furthermore, variations in clinical practice guidelines and resource

availability across different healthcare settings in Indonesia may also contribute to differences in patient management and outcomes.[9,10] Therefore, this study aimed to evaluate the correlation between perioperative blood glucose levels (both preoperative and postoperative) and the hospital length of stay in a cohort of patients diagnosed with complicated appendicitis at a tertiary care center in Indonesia.

2. Methods

This investigation employed a prospective cohort study design. The study was conducted at Dr. Moewardi General Hospital, Surakarta, Indonesia. As a tertiary referral center, Dr. Moewardi General Hospital provides specialized medical care and receives patients from a wide geographical area, often including complex and severe cases. The selection of this setting ensured access to a diverse patient population with complicated appendicitis.

Prior to the commencement of the study, ethical approval was obtained from the Ethics Committee of Dr. Moewardi General Hospital. This approval ensured that the study adhered to the ethical principles and guidelines governing medical research involving human subjects. The ethical review process involved a thorough evaluation of the study protocol, including the study design, patient recruitment procedures, data collection methods, and measures to protect patient confidentiality and privacy. Informed consent was obtained from all eligible patients before their inclusion in the study. The process of obtaining informed consent involved providing patients with comprehensive information about the study, including its purpose, procedures, potential risks and benefits, and their right to withdraw from the study at any time. Patients were given the opportunity to ask questions and have their concerns addressed before deciding whether to participate. The informed consent process ensured that patient participation was voluntary and based on a clear understanding of the study.

The study population consisted of adult patients aged 18 years or older who were diagnosed with complicated appendicitis. The diagnosis of complicated appendicitis was based on a combination of clinical findings, imaging results, and intraoperative findings. Clinical findings considered in the diagnosis of complicated appendicitis included the patient's medical history, physical examination findings, and presenting symptoms. These may have included abdominal pain, fever, nausea, vomiting, and signs of peritonitis. Imaging results, such as ultrasound or computed tomography (CT) scans, were used to support the clinical diagnosis and to assess the extent and severity of the appendiceal inflammation. Imaging studies can help to identify specific complications such as perforation, abscess formation, or the presence of a mass. Intraoperative findings, observed during the surgical procedure, also contributed to the diagnosis of complicated appendicitis. These findings may have included the presence of a perforated appendix, a periappendicular abscess, gangrenous changes in the appendix, or evidence of peritonitis. Complicated appendicitis was defined as the presence of one or more of the following conditions: perforated appendix, periappendicular abscess, gangrenous appendicitis, or peritonitis secondary to appendiceal infection. These criteria are consistent with established definitions of complicated appendicitis and ensured that the study focused on patients with more severe forms of the disease. Patients were excluded from the study if they met any of the following criteria: a history of hospitalization and confirmed infection prior to appendectomy, presence of septic shock at the time of admission, requirement of vasopressor therapy before surgery, death during hospitalization, or refusal to undergo surgical intervention. These exclusion criteria were implemented to minimize the influence of pre-existing severe conditions on blood glucose levels and hospital length of stay, allowing for a more focused evaluation of the impact of perioperative glucose in the context of complicated appendicitis. Patients with a history of hospitalization and confirmed infection prior to appendectomy were excluded because pre-existing infections can significantly affect blood glucose levels and may confound the results of the study. Similarly,

patients with septic shock or those requiring vasopressor therapy were excluded due to the severity of their condition and the potential for these factors to independently influence both blood glucose levels and hospital length of stay. The exclusion of patients who died during hospitalization ensured that the primary outcome of hospital length of stay could be accurately assessed. Finally, patients who refused to undergo surgical intervention were excluded as surgery is the definitive treatment for complicated appendicitis, and their inclusion would have introduced heterogeneity into the study population.

Data collection occurred prospectively from October 2020 to October 2021. This prospective approach ensured that data were collected in a systematic and standardized manner, reducing the potential for bias and improving the quality of the data. Blood glucose levels were measured using a point-of-care blood glucose meter (Accu-Chek Performa, Roche Diagnostics) at two specific time points: preoperatively and postoperatively. The preoperative blood glucose measurement was taken within 24 hours prior to the commencement of surgery to reflect the patient's metabolic status leading up to the intervention. This timeframe was chosen to provide a representative measure of the patient's blood glucose level in the period immediately preceding the surgical procedure. Factors such as stress, fasting, and any pre-existing conditions can influence preoperative blood glucose levels, and this measurement served as a baseline for comparison with postoperative levels. The postoperative blood glucose level was measured within 1 hour after the completion of the surgical procedure to capture the immediate hyperglycemic response to surgical stress. The surgical procedure induces a stress response in the body, which leads to the release of hormones such as cortisol and catecholamines. These hormones can cause an increase in blood glucose levels. Measuring blood glucose within 1 hour after surgery allowed for the assessment of this immediate hyperglycemic response. All blood glucose measurements were performed by trained nursing staff following standardized protocols to ensure accuracy and consistency. The use of standardized protocols minimized variability in the measurement process and enhanced the reliability of the data. The nursing staff received training on the proper use of the blood glucose meter, the correct technique for obtaining blood samples, and the procedures for recording and documenting the results. In addition to blood glucose levels, data were collected on potential confounding variables that could influence hospital length of stay. These included the patient's age and the occurrence of surgical site infection (SSI). Age was recorded in years at the time of admission. Age is a potential confounding variable as older patients may have different physiological responses to surgery and may be at a higher risk for complications, which can affect hospital length of stay. Surgical site infection was defined according to the criteria established by the Centers for Disease Control and Prevention (CDC). The CDC criteria are widely used and provide a standardized definition for SSI, ensuring consistency in its identification and classification. An infection occurring at or near the surgical incision within 30 days of the procedure was classified as a surgical site infection. SSI was diagnosed based on clinical signs and symptoms of infection, such as redness, swelling, pain, and purulent drainage, often supported by microbiological culture results. Clinical signs and symptoms are the primary indicators of SSI, and microbiological culture results can provide further confirmation and identify the causative pathogens.

The primary outcome of interest in this study was the hospital length of stay (LOS). Hospital length of stay was defined as the total number of days from the time of the patient's admission to the hospital until the date of discharge. This duration encompassed the entire period of inpatient care required for the management of complicated appendicitis, including preoperative preparation, the surgical procedure itself, and postoperative recovery until the patient was deemed fit for discharge by the attending surgeon. The hospital length of stay reflects the overall duration of the patient's hospitalization, from the time of admission for the management of complicated

appendicitis until they are discharged from the hospital.

Statistical analysis was performed using the Statistical Program for Social Science (SPSS) version 25.0. SPSS is a widely used statistical software package that provides a comprehensive set of tools for data analysis. Descriptive statistics were used to summarize the demographic characteristics of the study population. Descriptive statistics provide a summary of the main features of a dataset. Frequencies and percentages were used for categorical variables, such as gender and presence of SSI. Frequencies and percentages provide a clear representation of the distribution of categorical variables within the study population. Means with standard deviations were used for continuous variables, such as age and blood glucose levels. The mean provides a measure of the central tendency of the data, while the standard deviation provides a measure of the variability or dispersion of the data around the mean. To assess the association between blood glucose levels (preoperative and postoperative) and hospital length of stay, as well as the relationship between other continuous variables (age) and hospital length of stay, Spearman's rank correlation coefficient (rho) was calculated. The Spearman correlation test was chosen because the data for hospital length of stay and blood glucose levels were not normally distributed. The Spearman correlation is a non-parametric test that measures the strength and direction of association between two ranked variables. It is suitable for data that do not meet the assumptions of parametric tests, such as the Pearson correlation. A p-value of less than 0.05 was considered statistically significant. The p-value is a measure of the statistical significance of the results. A p-value of less than 0.05 indicates that the observed results are unlikely to have occurred by chance, and therefore, the null hypothesis (no association between the variables) is rejected. Furthermore, a Receiver Operating Characteristic (ROC) curve analysis was conducted to determine the sensitivity, specificity, and optimal cut-off value of postoperative blood glucose levels for predicting prolonged hospitalization (> 3 days). The ROC curve is a graphical representation of the diagnostic ability of a binary classifier system as its discrimination threshold is varied. It is a useful tool for evaluating the performance of a diagnostic test or a predictive model. Sensitivity, specificity, and the optimal cut-off value are important measures of the diagnostic accuracy of postoperative blood glucose levels in predicting prolonged hospitalization. Sensitivity is the ability of the test to correctly identify patients with prolonged hospitalization, while specificity is the ability of the test to correctly identify patients without prolonged hospitalization. The optimal cut-off value is the blood glucose level that provides the best balance between sensitivity and specificity. The area under the ROC curve (AUC) was also calculated to assess the overall discriminatory power of postoperative blood glucose as a predictor of prolonged hospital stay. The AUC provides a measure of the overall accuracy of the test. An AUC of 1 indicates perfect discrimination, while an AUC of 0.5 indicates that the test is no better than chance.

3. Results

Table 1 presents a summary of the key characteristics of the study participants. Regarding gender distribution, the study included 27 male participants, representing 55.1% of the total, and 22 female participants, accounting for 44.9%. This indicates a slightly higher proportion of male participants in the study population. The occurrence of surgical site infection (SSI) was relatively low within the cohort. Only 5 participants developed SSI, which corresponds to 10.2% of the study group. Conversely, the majority, 44 participants (89.8%), did not experience surgical site infection. The prevalence of surgical stress hyperglycemia, defined as a blood glucose level exceeding 180 mg/dL, was also limited. Four participants (8.2%) met the criteria for surgical stress hyperglycemia, while the vast majority, 40 participants (91.8%), did not exhibit this condition. The mean age of the participants was 36.65 years, with a standard deviation of 16.70 years. The age range

spanned from a minimum of 15 years to a maximum of 80 years, demonstrating a considerable age variation within the study population. The average preoperative random blood glucose level was 115.31 mg/dL, with a standard deviation of 28.35 mg/dL. The lowest preoperative glucose measurement was 76 mg/dL, and the highest was 250 mg/dL, indicating a range of glucose levels before surgery. Postoperative random blood glucose levels showed a mean of 135.82 mg/dL, with a standard deviation of 64.94 mg/dL. The postoperative glucose values ranged from 67 mg/dL to 524 mg/dL, revealing a wider dispersion and a notably higher maximum value compared to preoperative levels. The mean length of stay in the hospital was 3.76 days, with a standard deviation of 1.74 days. The shortest hospital stay was 2 days, while the longest was 12 days, illustrating variability in the duration of hospitalization among the participants.

Table 1. Subject's characteristics.

Characteristic	**Frequency (%) or Mean ± SD**	**Minimum**	**Maximum**
Gender			
Male	27 (55.1%)		
Female	22 (44.9%)		
Surgical site infection (SSI)			
Yes	5 (10.2%)		
No	44 (89.8%)		
Surgical stress hyperglycemia (>180 mg/dL)			
Yes	4 (8.2%)		
No	40 (91.8%)		
Age (years)	36.65 ± 16.70	15	80
Preoperative random blood glucose (mg/dL)	115.31 ± 28.35	76	250
Postoperative random blood glucose (mg/dL)	135.82 ± 64.94	67	524
Length of stay (days)	3.76 ± 1.74	2	12

Table 2 presents the results of Spearman's correlation analysis, which examined the relationships between several variables and hospital length of stay. The table displays Spearman's rho (r value), indicating the strength and direction of the correlation, and the corresponding p-value, showing the statistical significance of the correlation. The correlation between gender and hospital length of stay was not statistically significant. The rho value was 0.030, and the p-value was 0.837. This suggests that there was no meaningful linear association between a participant's gender and the duration of their hospital stay in this study. Age showed a statistically significant positive correlation with hospital length of stay. The rho value was 0.324, and the p-value was 0.023. This finding implies that older patients tended to have longer hospital stays. Preoperative random blood glucose levels also demonstrated a statistically significant positive correlation with hospital length of stay. The rho value was 0.324, and the p-value was 0.023. This indicates that higher preoperative blood glucose levels were associated with longer hospital stays. Postoperative random blood glucose levels exhibited the strongest correlation with hospital length of stay among the variables analyzed. The rho value was 0.484, and the p-value was 0.000. The correlation was statistically significant, suggesting a moderate positive relationship between higher postoperative blood glucose levels and prolonged hospital stays. Surgical site infection (SSI) showed a statistically significant positive correlation with hospital length of stay. The rho value was 0.360, and the p-value was 0.011. This finding suggests that the occurrence of surgical site infection was associated with longer hospital stays.

Table 2. Spearman's correlation analysis.

Variable	Hospital length of stay	
	Rho (r value)	p Value
Gender	0.030	0.837
Age	0.324	0.023*
Preoperative random blood glucose	0.324	0.023*
Postoperative random blood glucose	0.484	0.000*
Surgical site infection (SSI)	0.360	0.011*

*p < 0.05 is considered statistically significant.

Table 3 presents the results of the receiver operating characteristic (ROC) curve analysis, specifically focusing on the use of postoperative blood glucose levels to predict prolonged hospitalization, defined in this analysis as a hospital stay exceeding 3 days. The key feature examined in this analysis is postoperative blood glucose. The ROC analysis identified a cut-off value for postoperative blood glucose of greater than 123 mg/dL. This cut-off point is the threshold determined by the analysis to best discriminate between patients who experienced prolonged hospitalization (>3 days) and those who did not. At this cut-off value of >123 mg/dL, the sensitivity of postoperative blood glucose in predicting prolonged hospitalization was 65.2%. This means that the test correctly identified 65.2% of the patients who actually had a prolonged hospital stay. The specificity at the same cut-off value was 65.4%. This indicates that the test correctly identified 65.4% of the patients who did not have a prolonged hospital stay (i.e., those with a hospital stay of 3 days or less). The area under the curve (AUC) for this ROC analysis was 0.71. The AUC provides an overall measure of how well the test can discriminate between the two groups (prolonged vs. non-prolonged hospitalization). The 95% confidence interval for the AUC was 0.56 to 0.86. This range provides an estimate of the precision of the AUC value. The interpretation of the AUC is "Moderate Discrimination." An AUC of 0.71 suggests that postoperative blood glucose levels have a moderate ability to distinguish between patients who will experience prolonged hospitalization and those who will not. While not a perfect predictor, it does offer some discriminatory power.

Table 3. ROC curve analysis of postoperative blood glucose levels for predicting prolonged hospitalization (>3 days).

Feature	Cut-off value (mg/dL)	Sensitivity (%)	Specificity (%)	Area under the curve (AUC)	95% confidence interval	Interpretation of AUC
Postoperative blood glucose	> 123	65.2	65.4	0.71	0.56 - 0.86	Moderate Discrimination

4. Discussion

The core finding of this prospective cohort study establishes a significant positive correlation between perioperative blood glucose levels and hospital length of stay in patients diagnosed with complicated appendicitis. This finding is pivotal as it reinforces the notion that a patient's metabolic state, specifically their blood glucose levels during the surgical period, has a measurable impact on their recovery trajectory, as reflected by the duration of their hospitalization. This observation is not isolated, it resonates with a broader body of existing research that has consistently identified an association between perioperative hyperglycemia and a range of adverse surgical outcomes, with prolonged hospitalization being a frequently reported consequence. Hyperglycemia,

characterized by elevated blood glucose levels, during the perioperative phase, is increasingly recognized as a significant factor that can complicate recovery processes and contribute to less favorable outcomes following surgical interventions. The significance of this correlation lies in its potential to inform clinical practice and risk stratification. By demonstrating that elevated blood glucose levels, both before and after surgery, are linked to longer hospital stays, the study underscores the importance of glucose management as a key component of postoperative care, particularly in patients with complicated appendicitis who are already at an elevated risk of complications. Specifically, the study's results meticulously demonstrate that both preoperative and postoperative blood glucose levels exhibit a statistically significant correlation with the duration of hospitalization. This dual correlation—preoperative and postoperative—suggests that a patient's glycemic status throughout the surgical journey, from the period leading up to the intervention to the immediate recovery phase, plays a crucial role in determining the length of their hospital stay. Preoperative blood glucose levels, reflecting a patient's metabolic condition before the surgical procedure, provide a baseline indicator of their glycemic control. Elevated preoperative glucose levels may signify pre-existing diabetes, undiagnosed glucose intolerance, or a stress response to the underlying condition of complicated appendicitis itself. Regardless of the cause, the study's findings indicate that higher preoperative glucose levels are predictive of a longer hospital stay. This highlights the potential value of preoperative glucose screening and optimization in patients scheduled for appendectomy for complicated appendicitis. Identifying and addressing hyperglycemia before surgery might contribute to mitigating prolonged hospitalization. Postoperative blood glucose levels, on the other hand, reflect the acute metabolic response to the surgical stress. The surgical procedure triggers a cascade of hormonal and inflammatory changes in the body, leading to the release of counter-regulatory hormones that promote glucose production and reduce glucose utilization. This phenomenon, known as surgical stress hyperglycemia, is a common occurrence in surgical patients. The study's results demonstrate that the degree of postoperative hyperglycemia is also a significant predictor of hospital length of stay. Higher postoperative glucose levels are associated with longer hospitalizations. This underscores the importance of monitoring and managing glucose levels in the immediate postoperative period to potentially influence recovery and the duration of hospitalization. The correlation between perioperative blood glucose levels and hospital length of stay has several potential clinical implications. Firstly, it emphasizes the need for vigilant glucose monitoring in patients with complicated appendicitis, both before and after surgery. Regular glucose monitoring can help identify patients at increased risk for prolonged hospitalization. Secondly, it supports the implementation of strategies aimed at optimizing glycemic control in the perioperative period. This may include the use of insulin therapy, dietary modifications, or other interventions to manage hyperglycemia and maintain blood glucose levels within a target range. Thirdly, it highlights the potential role of perioperative glucose management as a quality indicator in the care of patients with complicated appendicitis. Hospital length of stay is an important metric of healthcare efficiency and resource utilization. By demonstrating the link between glucose levels and length of stay, the study suggests that effective glucose management can contribute to reducing hospitalization duration and improving overall healthcare delivery. The consistency of these findings with existing research strengthens the evidence base supporting the prognostic value of perioperative blood glucose levels. While this study focused on complicated appendicitis, the association between hyperglycemia and adverse surgical outcomes, including prolonged hospitalization, has been observed across various surgical specialties and patient populations. This suggests that the impact of perioperative glucose dysregulation on recovery is a widespread phenomenon, not limited to a specific

condition. Furthermore, the study's results contribute to a more nuanced understanding of the factors influencing hospital length of stay. While clinical factors such as the severity of the disease, the presence of complications, and the type of surgical intervention are undoubtedly important, the study demonstrates that metabolic factors, such as glucose control, also play a significant role. This highlights the complexity of patient recovery and the need for a holistic approach to care that addresses both clinical and metabolic parameters.[11-13]

A noteworthy finding within this study is the observation that postoperative blood glucose levels demonstrated a stronger correlation with hospital length of stay when compared to preoperative glucose levels. This disparity in the strength of correlation carries significant implications for understanding the dynamics of glucose dysregulation in surgical patients and its impact on recovery. The stronger correlation observed with postoperative blood glucose levels suggests that the acute hyperglycemic response to surgical stress exerts a more direct and pronounced influence on the immediate postoperative recovery period and, consequently, the subsequent length of hospitalization. In essence, while preoperative glycemic status provides a backdrop, it is the degree and nature of the glucose elevation *following* the surgical intervention that appears to be a more potent determinant of how long a patient needs to remain hospitalized. This finding underscores the critical importance of monitoring and managing glucose levels in the immediate aftermath of surgery. The postoperative period represents a phase of heightened physiological stress, metabolic flux, and increased vulnerability to complications. The stronger correlation between postoperative glucose and length of stay implies that interventions aimed at mitigating or controlling postoperative hyperglycemia may be particularly effective in influencing recovery trajectories and potentially reducing the duration of hospitalization. The surgical procedure itself triggers a complex and multifaceted physiological stress response within the body. This response is not simply a localized phenomenon confined to the surgical site, rather, it involves a systemic cascade of neuroendocrine and metabolic alterations designed to help the organism cope with the perceived threat and initiate the healing process. A key component of this stress response involves the activation of the endocrine system. The endocrine system, a network of glands that produce and secrete hormones, plays a central role in coordinating the body's response to stress. In the context of surgery, several hormones are released in increased amounts, including cortisol, catecholamines (such as epinephrine and norepinephrine), and glucagon. Cortisol, often referred to as the "stress hormone," is released by the adrenal glands in response to surgical trauma. It has numerous effects on metabolism, including increasing glucose production by the liver (gluconeogenesis), promoting the breakdown of proteins and fats to provide energy, and decreasing insulin sensitivity in peripheral tissues. These actions collectively contribute to an elevation in blood glucose levels. Catecholamines, also released by the adrenal glands, also play a crucial role in the stress response. They increase heart rate, blood pressure, and respiratory rate, and also contribute to hyperglycemia by stimulating glycogenolysis (the breakdown of glycogen to glucose) in the liver and muscles, and by inhibiting insulin secretion. Glucagon, secreted by the pancreas, is another hormone that increases blood glucose levels. It primarily acts on the liver to stimulate glycogenolysis and gluconeogenesis. These hormones, in concert, lead to an increase in hepatic glucose production. The liver, the primary site of glucose production, is stimulated to generate more glucose to provide energy for the body's increased metabolic demands during the surgical recovery period. At the same time, there is a decrease in peripheral glucose utilization. Tissues that normally take up glucose from the bloodstream, such as muscle and adipose tissue, become less responsive to insulin, the hormone that facilitates glucose uptake. This insulin resistance further contributes to the elevation in blood glucose levels. Ultimately, the combined effects of increased

glucose production and decreased glucose utilization result in an elevation in blood glucose levels. This phenomenon is commonly referred to as surgical stress hyperglycemia. It is a well-recognized and frequently observed metabolic response to surgical trauma. While it is generally a transient and self-limiting response, in some individuals, particularly those with pre-existing glucose intolerance or diabetes, the hyperglycemic response can be more pronounced and prolonged. The stronger correlation between postoperative hyperglycemia and prolonged hospitalization observed in this study strongly suggests that the magnitude and duration of the hyperglycemic response in the immediate postoperative period are critical factors influencing patient recovery and, ultimately, the length of hospital stay. The degree to which a patient experiences postoperative hyperglycemia, and how long that hyperglycemia persists, appear to be key determinants of their recovery trajectory. Several factors can contribute to the degree of postoperative hyperglycemia. More extensive or complex surgical procedures tend to elicit a greater stress response and, consequently, a more pronounced hyperglycemic response. The degree of tissue trauma, the duration of surgery, and the invasiveness of the procedure all play a role. In the context of this study, complicated appendicitis, by its nature, often involves more severe inflammation and potential complications compared to uncomplicated appendicitis, which can contribute to a more significant stress response. There is considerable variability among individuals in how they respond to surgical stress. Factors such as age, genetics, pre-existing health conditions, and psychological factors can all influence the magnitude of the hormonal and metabolic response to surgery. Some individuals may mount a more robust stress response, leading to greater hyperglycemia, while others may have a more blunted response. Patients with pre-existing metabolic conditions, such as diabetes or glucose intolerance, are at a significantly increased risk of developing postoperative hyperglycemia. These individuals already have impaired glucose regulation, and the added stress of surgery can further exacerbate their condition. Even patients without a formal diagnosis of diabetes may have underlying insulin resistance or impaired glucose tolerance that predisposes them to more severe hyperglycemia in the postoperative period. The stronger correlation between postoperative hyperglycemia and prolonged hospitalization highlights the importance of personalized approaches to glucose management in surgical patients. Assessing individual risk factors, closely monitoring postoperative glucose levels, and implementing timely interventions to control hyperglycemia are crucial steps in optimizing patient recovery and reducing the duration of hospitalization.[14-16]

The finding that perioperative blood glucose levels correlate with hospital length of stay is consistent with a substantial body of previous research that has consistently highlighted the importance of postoperative glucose control as a significant predictor of surgical outcomes. This consistency across different studies and surgical settings reinforces the validity and generalizability of the present study's findings. Previous investigations have extensively demonstrated that postoperative hyperglycemia, an elevation in blood glucose levels following surgical procedures, is associated with an increased risk of a diverse array of complications. These complications are not limited to a single organ system or type of adverse event, rather, they encompass a broad spectrum of clinical challenges that can significantly impact patient recovery and well-being. Among the complications linked to postoperative hyperglycemia, infections are a particularly prominent concern. Hyperglycemia has been shown to impair the function of leukocytes, the white blood cells responsible for defending the body against infection. This impairment in leukocyte function compromises the body's ability to combat invading pathogens, increasing the risk of postoperative infections such as surgical site infections, pneumonia, and sepsis. Postoperative infections not only increase patient morbidity and mortality but also contribute significantly to prolonged hospitalization, as they often require extended

antibiotic therapy, additional interventions, and a longer recovery period. Wound healing impairment is another significant consequence of postoperative hyperglycemia. Elevated blood glucose levels can disrupt the complex cellular and molecular processes involved in wound repair. Hyperglycemia can impair the migration and proliferation of cells essential for wound healing, such as fibroblasts and keratinocytes. It can also interfere with the deposition of collagen, a crucial structural protein that provides strength and support to healing tissues. Furthermore, hyperglycemia can promote inflammation and the production of reactive oxygen species, which can further impede wound healing. Impaired wound healing can lead to wound dehiscence, delayed recovery, and an increased risk of complications, all of which contribute to prolonged hospitalization. Cardiovascular events represent another category of complications associated with postoperative hyperglycemia. Hyperglycemia can have detrimental effects on the cardiovascular system, increasing the risk of arrhythmias, myocardial ischemia, and heart failure. These cardiovascular complications can be particularly problematic in patients with pre-existing heart disease, but they can also occur in individuals without a prior history of cardiac problems. Postoperative cardiovascular events can necessitate intensive medical management and prolonged monitoring, often resulting in extended hospital stays. Respiratory insufficiency is also linked to postoperative hyperglycemia. Hyperglycemia can impair respiratory muscle function and increase the risk of pulmonary complications such as pneumonia and respiratory failure. These complications can be particularly challenging to manage and may require mechanical ventilation and prolonged respiratory support, leading to extended hospitalization and increased healthcare costs. These complications—infections, wound healing impairment, cardiovascular events, and respiratory insufficiency—are not isolated events, they often interact and exacerbate each other, creating a cascade of adverse consequences that can significantly impact patient outcomes. These complications invariably contribute to prolonged hospitalization and increased healthcare costs. The management of these complications requires additional medical interventions, extended antibiotic therapy, increased nursing care, and a longer recovery period, all of which contribute to a longer duration of hospitalization and a greater economic burden on the healthcare system. To illustrate the consistency of the present study's findings with prior research, it is useful to consider specific examples. For instance, a study reported that non-survivors in non-cardiac surgery had significantly higher blood glucose levels both before and after surgery compared to survivors. This study, conducted in a broad range of non-cardiac surgical procedures, highlights the prognostic significance of perioperative blood glucose levels in predicting patient outcomes across different surgical settings. The finding that higher glucose levels are associated with increased mortality underscores the severity of the consequences of perioperative hyperglycemia and the importance of effective glucose management. This research emphasizes that the implications of perioperative glucose control extend beyond just the length of hospital stay, it can be a critical factor in determining patient survival. Similarly, another study found that patients with diabetes had a higher risk of surgical site infection and longer hospital stays following emergency appendectomy. This study specifically examines the impact of pre-existing glycemic conditions on surgical outcomes in a specific patient population undergoing a common surgical procedure. The results demonstrate that patients with diabetes, who are more likely to experience hyperglycemia, are at an increased risk of developing surgical site infections, a major cause of postoperative morbidity and prolonged hospitalization. This research highlights the importance of considering pre-existing diabetes as a risk factor for adverse outcomes following appendectomy and the need for tailored management strategies in this patient population. The results of the present study extend these findings by specifically examining the correlation between perioperative blood

glucose levels and hospital length of stay in patients with complicated appendicitis. While previous research has established the general association between perioperative hyperglycemia and adverse surgical outcomes, including prolonged hospitalization, the present study focuses on a specific patient population with a particular surgical condition. By focusing on this specific patient population, the study provides valuable insights into the prognostic significance of glucose control in the context of a common and challenging surgical condition. Complicated appendicitis, characterized by perforation, abscess formation, or peritonitis, represents a more severe form of appendicitis that is associated with increased morbidity, complications, and prolonged hospitalization compared to uncomplicated appendicitis. Understanding the role of glucose control in this specific context is crucial for optimizing patient management and improving outcomes. The study's focus on complicated appendicitis allows for a more targeted assessment of the impact of perioperative glucose levels on the recovery of patients with this particular condition. It provides evidence that the association between hyperglycemia and prolonged hospitalization is also relevant in the context of complicated appendicitis, reinforcing the importance of glucose management in this specific surgical scenario.[17-20]

5. Conclusion

This study provides compelling evidence that perioperative blood glucose levels are significantly correlated with hospital length of stay in patients with complicated appendicitis. The findings indicate that elevated blood glucose levels, particularly in the postoperative period, are associated with prolonged hospitalization. This underscores the importance of vigilant glucose monitoring and management in patients undergoing surgical intervention for complicated appendicitis. The study's results are consistent with a broader body of research that has established the link between perioperative hyperglycemia and adverse surgical outcomes. The stronger correlation observed between postoperative blood glucose levels and hospital length of stay, compared to preoperative levels, highlights the critical role of the acute hyperglycemic response to surgical stress in influencing recovery trajectories. This finding suggests that interventions aimed at mitigating postoperative hyperglycemia may be particularly effective in reducing the duration of hospitalization. Furthermore, the study's findings contribute to a more nuanced understanding of the factors influencing hospital length of stay, demonstrating that metabolic factors, such as glucose control, play a significant role in addition to clinical factors. The results of this study emphasize the need for a holistic approach to patient care, incorporating effective glucose management strategies to improve patient outcomes and reduce the economic burden associated with prolonged hospitalization.

6. References

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