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Relationship Between Type of Surgery and Postoperative Random Blood Sugar

Assist. Prof. Dr. Zaid Ali majeed[1*], Haider yahya Naief [2] and Safa Haider yahya
Al-Muthanna University, College of Medicine (General surgery)[1]
Al-Hussein Teaching Hospital, Samawah, Al-Muthanna, Iraq (FRCS Specialist surgeon)[2]
Corresponding author: Zaid-a28@mu.edu.iq* dr.zaid.ali.36@gmail.com*

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Abstract

Background*: - -Hyperglycemia is associated with poor outcome in critically ill hospitalized patients and causes impaired wound healing. Patients after surgery may develop hyperglycemia and is related to the hyper-metabolic stress response, in which the rate of glucose production increases and insulin resistance due to increase the level of counter regulatory hormones such as cortisol, epinephrine. The degree of these changes affected by the type and duration of surgery, anesthesia, and patients' factors like age gender whether they are diabetic or not.*

Method: - *200 samples were collected from patients 168 female and 32 male were aged between {< 1 year- 80 years} underwent various types of operations and received either general anesthesia or spinal anesthesia ,the samples were taken from capillary blood and tested by HMG method at time of admission for surgery and postoperatively day zero .*

Results: *The study included 200 participants with a mean age of 31.51 years, predominantly female (84.0%), and non-diabetic (96.5%). Cesarean section was the most common surgery (68.0%), and spinal anesthesia was the preferred choice (72.5%). There was no statistically significant difference in postoperative glucose levels based on the type or duration of surgery or the type of anesthesia used ($p > 0.05$). The mean postoperative glucose level was 123.28 mg/dL (SD = 30.765), with minor variations observed across different surgical and anesthesia categories.*

Conclusion: *This study provides insights into the impact of surgery on postoperative glucose levels and highlights the importance of monitoring glucose metabolism in surgical patients. While factors such as surgery type, duration, and anesthesia did not significantly affect postoperative glucose levels in this study, further research with larger sample sizes and comprehensive perioperative glucose management protocols is warranted to optimize surgical outcomes and patient care.*

Key words: *Non-Diabetic, Postoperative, Surgery*

INTRODUCTION

Surgery is a procedure in which the anesthesia, medications, tissue damage , blood loss, and changes in body temperature all these things enhance metabolic changes and causing postoperative stress response.[1]Surgery stimulate the production of counter regulatory hormones (catecholamines, glucagon and cortisol) .[2]

Metabolic response to surgery occurs at the level of endocrine, metabolic and immunology .The severity of these changes is related to the amount of exposed stress. The stimulation of central nervous system and hormonal responses against injury, the direct effect of mediators like TNF-α and IL 1, which are released from traumatic tissue, on the hypothalamus has been wellknown. However, many new studies refer to nuclear factor kappa B (NF-kB) in this regard.[3]

The endocrine response is activated via afferent neuronal impulses from the site of injury. These travel along sensory nerve roots through the dorsal root of the spinal cord, up the spinal cord to the medulla to activate the hypothalamus.[4]

The greater the stress, the more reactions and catabolic impact it causes. The main effect of these reactions and subsequent metabolic status is impairment of the normal anabolic action of insulin, i.e., lead to development of insulin resistance.[5]

Insulin is mainly an anabolic hormone which is usually stimulated by high level of blood sugar and elicit its action which is glucose utilization by the body tissue and glycogen synthesis. Lipolysis is inhibited and muscle protein loss reduced. The failure insulin secretion as a response to surgery is somehow caused by the inhibition of the β-cells in the pancreas by the α2adrenergic inhibitory effects of catecholamines. 'Insulin resistance' by target cells occurs later because of a defect in the insulin receptor/intracellular signalling pathway. Thus, the perioperative period is characterized by a state of functional insulin deficiency. In contrast to insulin, glucagon release promotes hepatic glycogenolysis and gluconeogenesis, but insulin effects predominate. Glucagon secretion increases briefly during surgery but it is not thought to make a major contribution to the hyperglycaemia. [6,7,8]

The degree of insulin resistance is reflected by the circulating level of cortisol as post-operative tress response .[4] The high level of cortisol , resulting in hyperglycaemia which have a significant efect on the healing process and lead to increase morbidity and mortality in patients undergoing surgery .[2]

The major feature of this response is hyperglycemia which results from an increase in glucose production, at the same time as a reduction in glucose utilization ,and is facilitated by counter regulatory hormones such as catecholamines and cortisol, which promote process of glycogenolysis and gluconeogenesis.[7]

Cortisol is a glucocorticoid steroid hormone secreted from zone fasciculate of the adrenal gland in response to adrenocorticotropic Hormone (ACTH). This hormone acts by increasing blood sugar levels by gluconeogenesis, suppression of the immune system, and increases the metabolism of fat, protein and carbohydrates .[3]

The reason why hyperglycemia links with poor post operative outcome is explained by some mechanisms (In addition to undiagnosed illness causing physiologic stress) there's also derangements in leukocyte function, glycosylation and inactivation of immunoglobulins (leading to immune impairment), and collagen glycosylation (leading to poor wound healing and organ damage). [9,10,11,12]

Undetected pre-operative hyperglycemia is due to either undiagnosed diabetes, physiologic process, or both, and might be a sign of poor outcomes or a primary pathologic process. [13,14,15,16]

One of the most significant bodily reactions to any trauma or during critical illness is to supply enough substrate to organs and cells when mitochondrial respiration is not possible. Leukocytes, macrophages, and vulnerable organs are unable to execute mitochondrial respiration. As a result, endogenous glucose synthesis in trauma patients should increase by 150% compared to the control. In this aspect, glucose is a vital substrate since oxygen is not required during some stages of glycolysis and energy supply is maintained. [17] The surgical response is affected by many factors that might be related to the patient or to the surgical procedure, so the severity of these changes is not the same among people, and these factors are:-

1-Age: metabolic responses are often different in children than in adults[18]. Differences have been also discovered between term and preterm neonates. This postoperative response period lasts longer as age increases [19].

2-Nutrition and diet:the general nutritional status affect the metabolic response to surgery. [20] It is worth mentioning that even the type of fluid given intraoperatively affects the surgical response directly or indirectly.

3-Anesthesia: Both general and local/regional anesthesia have been used to reduce the inflammatory response to surgery and affect the surgical response. Some epidural block with local anesthetic agents particularly alters the metabolic response to surgical stress by significantly decreases protein degradation without affecting whole body protein synthesis in adults, within the first 24 hours after surgery. [20] So epidural block alters postoperative response rather than directly affecting the metabolism . [21]

4-Type and technique of surgery :like Inflation of the abdominal cavity with CO_2 or other gases during laparoscopic surgery elicit both local and systemic reactions which affect metabolic response to surgery. [22]

5-Operative stress:The degree of Surgical damage may also affects the magnitude of inflammatory and metabolic response to surgery. [23]

Objectives of study

1-This study aims to evaluate the random blood sugar before and after surgery.

2-To assess the effect of surgery as a stressful condition on the metabolic and endocrine function of the body according to the type and duration of surgery,type of anesthesia .

Methodology

This study was done in Iraq ,Al-Muthanna government,Al-Hussein teaching hospital .

From the period of 18th of October , 2023 to 10th of march, 2024.

Samples of blood for estimation of Random blood sugar were taken from the patients at time of admission to the hospital for surgery and on day zero postoperatively. Total 200samples that is 32 males and 168 females were collected.

Each sample was then tested for Random blood sugar level by HMG (Hansa Medical Germany)method . 5patients have diabetes mellitus 4 on insulin and one on metformin .

Results Demographic Distribution

The study included a total of 200 participants with a mean age of 31.51 years (SD = 10.971). The majority of participants were female, comprising 81.0% of the sample. Regarding diabetic status, 93% of participants were not diabetic, while only 7% reported having diabetes (Table 1, Fig. 1 and 2).

Table 1 presents the demographic distribution of participants, including age, gender, and diabetic status.

Table 1: Demographic Distribution

Demographic Characteristic	Category	Frequency	Percent
Age	Mean ± Sd (Years)	31.51 ± 10.971	
Gender	Female	162	81.0
	Male	38	19.0
Diabetic Status	Not	186	93
	Yes	14	7

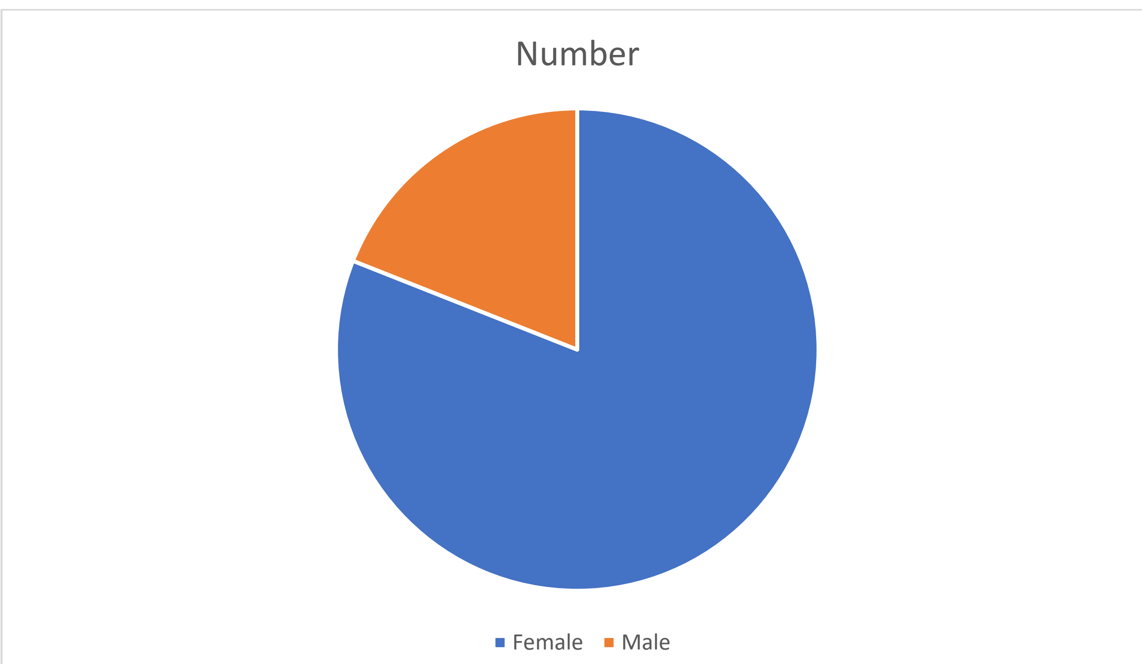

Figure 1. Number of patients according to gender

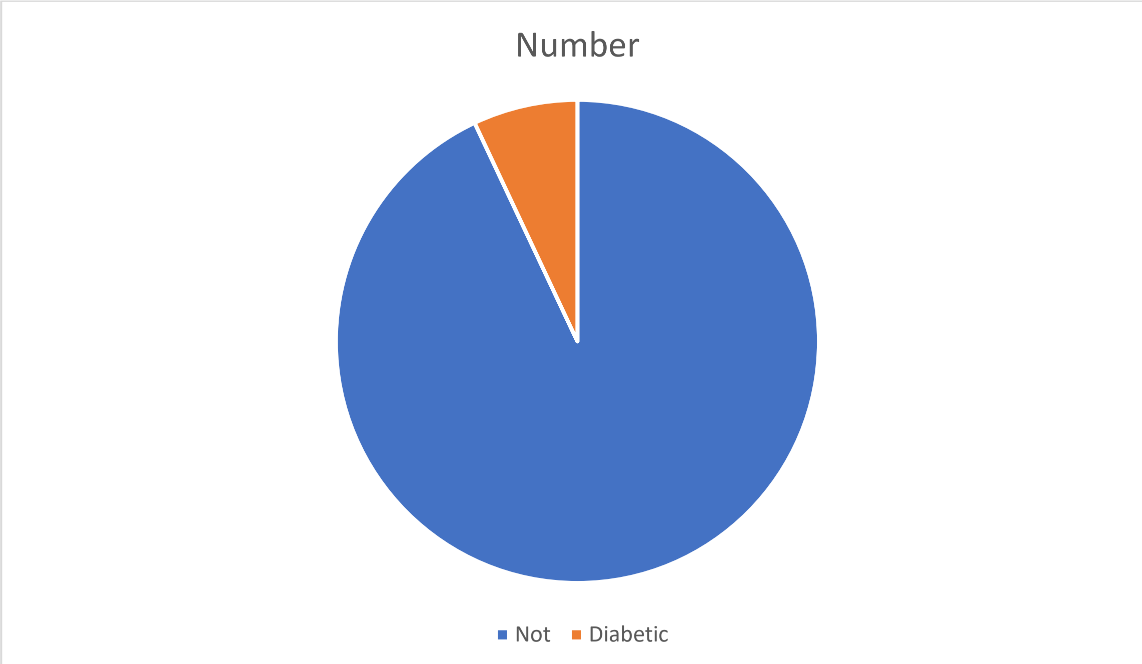

Figure 2. Number of patients according to diabetic status

Type of Operation and Anesthesia

Table 2 illustrates the distribution of types of surgeries and anesthesia utilized in the study. Among the surgical procedures, Cesarean section was the most common (69%), followed by Laparoscopic cholecystectomy (5.5%). The majority of participants received spinal anesthesia (74%), while 23.5% underwent general anesthesia and 2.5% received local anesthesia (Table 2, Fig. 3,4).

Table 2: Type of Operation and Anesthesia

Variable	Category	Frequency	Percent
Type of Surgery			
	Cesarean section	138	69
	Laparoscopic cholecystectomy	11	5.5
	Other surgical procedures	51	25.5
Type of Anesthesia	Spinal anesthesia	148	74
	General anesthesia	47	23.5

	Local anesthesia	**5**	**2.5**

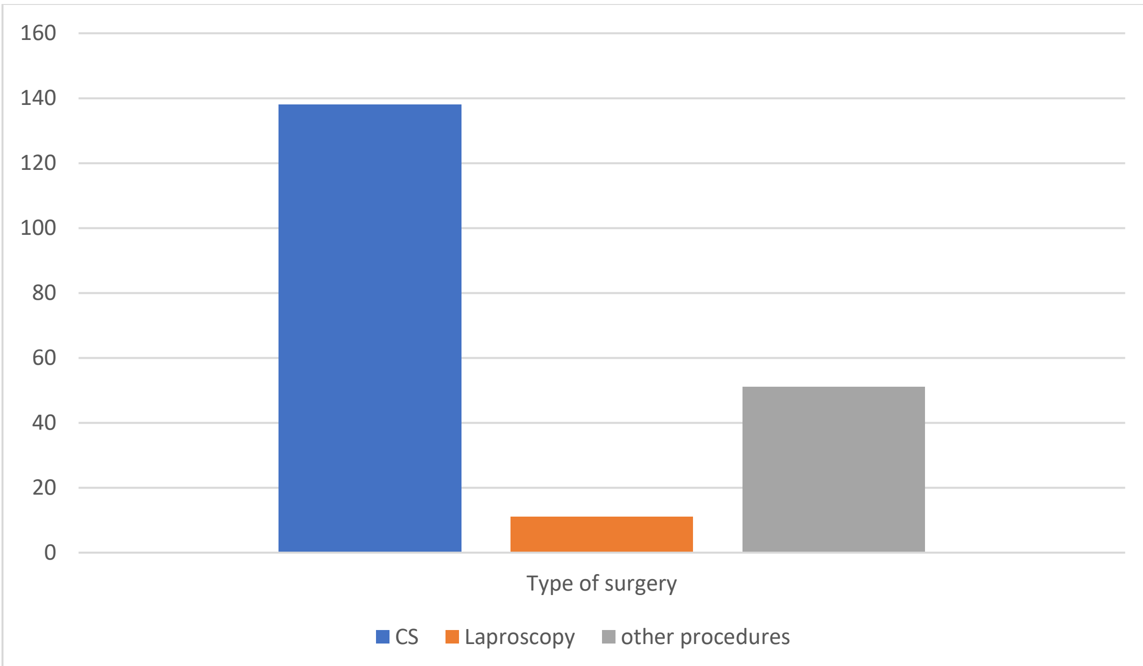

Figure 3. Types of operations

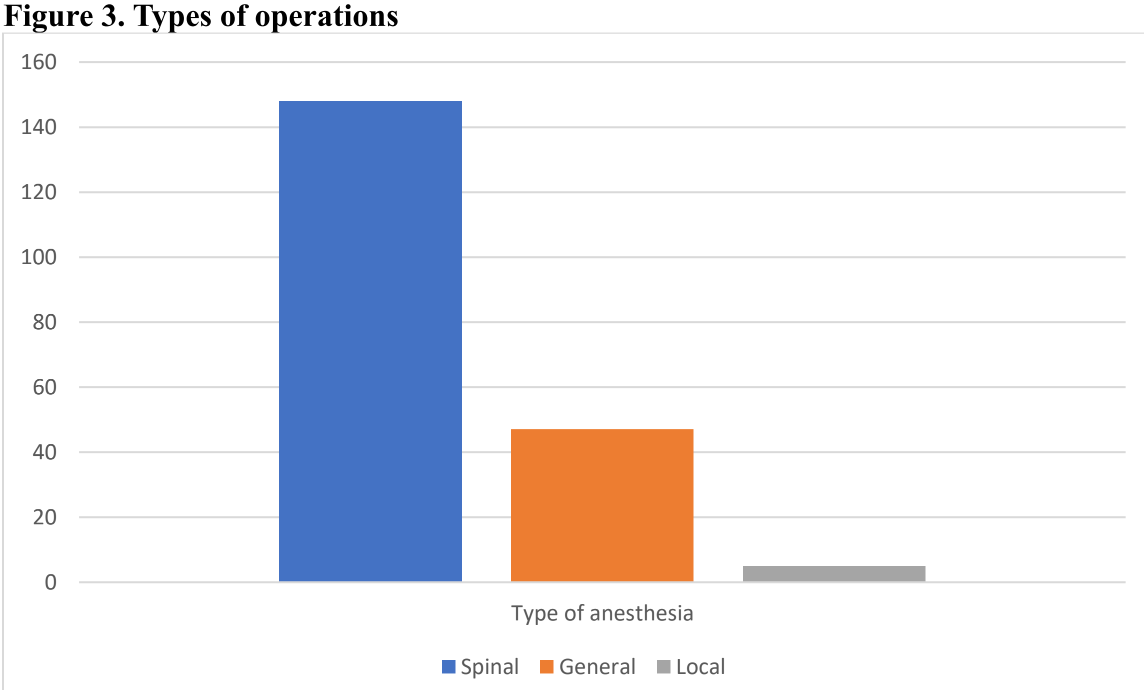

Figure 4. Types of anesthesia

Glucose Levels

Descriptive statistics for pre-operative and post-operative glucose levels are presented in Table 3. The mean pre-operative glucose level was 109.33 mg/dL (SD = 28.380), while the mean post-operative glucose level was 123.28 mg/dL (SD = 30.765).

Table 3: Glucose Levels

Variable	Minimum	Maximum	Mean	Std. Deviation
Pre-op Glucose	70	333	109.33	28.380
Post-op Glucose	15	279	123.28	30.765

Difference of Post-op Glucose based on Surgery Type

Table 4 presents the mean post-operative glucose levels categorized by different types of surgeries. The mean post-operative glucose levels varied across different operation types, with minor surgeries having a mean glucose level of 114.00 mg/dL (SD = 41.154), above major surgeries with a mean of 128.84 mg/dL (SD = 46.560), major surgeries with a mean of 121.92 mg/dL (SD = 23.503), and intermediate surgeries with a mean of 126.40 mg/dL (SD = 30.419). Overall, the mean post-operative glucose level for all surgeries was 123.28 mg/dL (SD = 30.765). However p value was 0.495, this means that the difference in mean was not statistically significant.

Table 4: Difference of Post-op Glucose based on Surgery Type

Operation Type	Mean Post-op Glucose (mg/dL)	Count	Std. Deviation
Minor	**114.00**	**7**	**41.154**
Above major	**128.84**	**44**	**46.560**
Major	**121.92**	**144**	**23.503**
Intermediate	**126.40**	**5**	**30.419**
ANOVA *p* value	**0.495**		
Association	**Not statistically significant**		

Mean Difference in Post-op Glucose Based on Duration of Operation Table 5 displays the mean difference in post-operative glucose levels based on the duration of the operation. The mean post-operative glucose levels varied across different durations of surgery, ranging from 110.00 mg/dL (SD = 28.284) for surgeries lasting 15 minutes to 155.56 mg/dL (SD = 59.534) for surgeries lasting 2 hours. The analysis of variance (ANOVA) indicated that there was no statistically significant difference in post-operative glucose levels based on the duration of surgery (F = 1.888, p = 0.064).

Table 5: Mean Difference in Post-op Glucose Based on Duration of Operation

Duration	Mean Post-op Glucose (mg/dL)	Count	Std. Deviation
1 hour	126.00	31	36.489
1:30 hours	144.00	3	64.506
15 min	110.00	2	28.284
2 hours	138.50	2	44.548
20 min	119.35	26	24.456
25 min	116.81	16	20.821
2hour	155.56	9	59.534
30 min	122.11	93	23.570
40 min	116.22	18	36.444
ANOVA *p* value	0.064		
Association	Not Statistically Significant		

Mean Difference in Post-op Glucose Based on Type of Anesthesia

Table 6 presents the mean difference in post-operative glucose levels based on the type of anesthesia used. The mean post-operative glucose levels were 127.08 mg/dL (SD = 36.979) for general anesthesia, 109.00 mg/dL (SD =
46.422) for local anesthesia, and 122.46 mg/dL (SD = 27.750) for spinal anesthesia. The analysis of variance (ANOVA) indicated that there was no statistically significant difference in post-operative glucose levels based on the type of anesthesia used (F = 0.972, p = 0.380).

Table 6: Mean Difference in Post-op Glucose Based on Type of Anesthesia

Type of Anesthesia	Mean Post-op Glucose (mg/dL)	Count	Std. Deviation
GA	127.08	50	36.979
Local	109.00	5	46.422

Spinal	**122.46**	**145**	**27.750**
ANOVA *p* value	**0.972**		
Association	**Not Statistically Significant**		

Discussion

This study investigated the demographic distribution, types of surgeries and anesthesia, and the impact of various factors on post-operative glucose levels in 200 participants. The findings shed light on important aspects of surgical care and metabolic outcomes, contributing to the existing body of literature in this field.

The demographic profile of the participants revealed a predominance of females (81.0%) and a relatively young mean age of 31.51 years. This distribution contradicts with previous stud y conducted by [24] highlighting the higher prevalence of males undergoing surgical intervention, in which 68% of those presenting to the general surgery were males, and women had significantly higher odds of non-operative management when compared to men [25]. Additionally, the overwhelming majority of participants were not diabetic (93%), consistent with the general population's prevalence of diabetes.

Cesarean section emerged as the most frequent surgical procedure (69%), reflecting the significant demand for obstetric surgeries in healthcare settings.

The preference for spinal anesthesia (74%) over general and local anesthesia corresponds to established trends in surgical practice, emphasizing its safety and efficacy, particularly in lower abdominal and lower extremity surgeries [26]. This finding aligns with findings of previous study conducted by [27], in which 54% of participants had chosen spinal anesthesia, 22% had chosen general anesthesia [27].

The analysis of post-operative glucose levels based on surgery type revealed no statistically significant differences. While minor variations were observed, they did not reach significance levels. This finding contrasts with some previous studies suggesting an association between the invasiveness or duration of surgery and post-operative glucose dysregulation [28]. The discrepancy may stem from sample size differences, variations in patient populations, or differences in surgical techniques and perioperative care protocols.

Similarly, the duration of surgery did not exert a significant influence on postoperative glucose levels. Although longer surgeries tended to exhibit slightly higher glucose levels, the differences were not statistically significant. This finding contradicts some literature suggesting a positive correlation between prolonged surgical duration and increased post-operative glucose levels [29].However, methodological differences, such as the inclusion criteria and surgical complexity, may contribute to these disparities.

The type of anesthesia administered also failed to demonstrate a significant impact on post-operative glucose levels. Despite variations in mean glucose levels across different anesthesia types, the differences did not reach statistical significance. This finding is contradicts with several studies indicating different metabolic outcomes between general and regional anesthesia techniques, for instance a study conducted by [30] found that Glycemia was significantly higher in the general anesthesia group. However, the influence of anesthesia depth, intraoperative glucose management strategies, and patient-specific factors warrants further exploration.

Conclusions and Recommendations

Conclusions:

1. **Demographic and Surgical Trends**: The study reveals a notable demographic profile with a majority of female participants and a prevalence of cesarean sections. This contrasts with previous findings, indicating shifting patterns in surgical demographics. Understanding these trends is crucial for tailoring healthcare services to meet evolving patient needs.
2. **Anesthesia Preferences and Glucose Levels**: Despite established trends favoring spinal anesthesia and its perceived safety, no significant impact on post-operative glucose levels was observed across different anesthesia types. This challenges previous research suggesting metabolic differences between anesthesia techniques, highlighting the need for nuanced exploration of intraoperative glucose management strategies.
3. **Post-operative Glucose Regulation**: The absence of significant associations between surgery type, duration, and post-operative glucose levels underscores the complexity of metabolic responses to surgical interventions. Further investigations incorporating larger sample sizes and standardized perioperative care protocols are warranted to elucidate the underlying mechanisms and optimize metabolic outcomes in surgical patients.

Recommendations:

1. **Further Research**: Future studies should explore the interplay between anesthesia depth, intraoperative glucose management strategies, and patientspecific factors to better understand their collective impact on post-operative glucose regulation. This will facilitate the development of tailored perioperative care protocols to optimize metabolic outcomes in diverse patient populations.
2. **Clinical Practice Guidelines**: Healthcare providers should consider the evolving demographic trends and anesthesia preferences highlighted in this study when developing clinical practice guidelines for surgical care. Emphasizing individualized approaches to anesthesia selection and perioperative glucose management may help mitigate potential metabolic complications and enhance patient outcomes.
3. **Education and Training**: Given the variability in surgical practices and patient populations, ongoing education and training programs for healthcare professionals are essential. Clinicians should stay abreast of emerging research findings and best practices in perioperative glucose management to deliver optimal care and improve patient safety and satisfaction.

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