ORIGINAL RESEARCH

Assessment of Effects of Propofol and Isoflurane on Blood Glucose during Abdominal Hysterectomy in Diabetic Patients

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ABSTRACT

Aim: Isoflurane anesthesia has been associated with higher serum levels of catecholamines and cortisol compared to propofol anesthesia, suggesting that the stress response is lower with propofol. Hence; the study assessed the Effects of Propofol and Isoflurane on Blood Glucose during Abdominal Hysterectomy in Diabetic Patients. **Materials and methods:** A study was conducted on 25 women aged 30 to 65 years with ASA physical status II undergoing elective abdominal hysterectomy under general anesthesia. Patients with renal failure, severe liver disease, a history of allergy to propofol, or those on medications affecting blood glucose or insulin release (e.g., steroids, β-blockers) within a week before surgery were excluded. Blood glucose levels and insulin infusion rates were statistically analyzed using SPSS version 15, employing t-tests and repeated measures analysis, with significance set at $P<0.05$. **Results:** No significant difference in blood glucose levels between the two groups from the preoperative phase to the second 30-minute intraoperative period. At the third 30-minute mark (FBS5), Group I (Isoflurane) showed a significant rise in blood glucose levels compared to Group P (Propofol), suggesting a possible effect of isoflurane on glucose metabolism. **Conclusion:** Diabetes is a multifaceted metabolic disorder marked by hyperglycemia, which is a physiological state characterized by persistently high levels of glucose in the bloodstream.Propofol may provide better intraoperative glucose stability compared to isoflurane.

Keywords: Glucose, Hysterectomy, Propofol

INTRODUCTION

Surgery has been shown to suppress the immune system, primarily due to the release of catecholamines and glucocorticoids in response to surgical stimulation. Activation of the sympathetic nervous system triggers catecholamine release, while the hypothalamic-pituitary-adrenal axis stimulates glucocorticoid secretion. Additionally, tissue damage during surgery induces the release of pro-inflammatory cytokines such as interleukin (IL)-1, IL-6, and tumor necrosis factor-α, further promoting glucocorticoid production. These stress-induced hormones inhibit immune function by altering the balance of T helper (Th) cells. Th1 cells, which mediate cell-based immunity by activating macrophages, are suppressed, while Th2 cells, which drive antibody-mediated immunity, increase. This shift results in a decreased Th1/Th2 ratio, contributing to impaired cell-mediated immunity following surgery. Since anesthesia can mitigate the stress response to surgical stimulation, it may play a role in preventing this immune imbalance. [1,2,3]

Isoflurane anesthesia has been associated with higher serum levels of catecholamines and cortisol compared to propofol anesthesia, suggesting that the stress response is lower with propofol. However, these differences are typically transient and limited to short postoperative periods. While it remains uncertain whether these variations in stress response have lasting effects on critical organ systems, including the immune system, [4,5]

Maintaining optimal blood glucose levels during surgery is essential for diabetic patients, as fluctuations can lead to complications such as impaired wound healing, infections, and prolonged recovery. Anesthetic agents play a significant role in modulating glucose metabolism by influencing insulin secretion and stress hormone responses. Propofol and isoflurane, two widely used anesthetics, exhibit distinct metabolic effects, with isoflurane potentially contributing to higher blood glucose levels due to its impact on insulin release. In contrast, propofol may provide better glucose stability by reducing stress-induced hyperglycemia.[6,7] This study investigates the intraoperative effects of these anesthetic agents on blood glucose control in diabetic patients undergoing abdominal hysterectomy to identify the most suitable approach for perioperative glycemic management.

MATERIALS AND METHODS

A study was conducted on 25 women aged 30 to 65 years with ASA physical status II undergoing elective abdominal hysterectomy under general anesthesia. Patients with renal failure, severe liver disease, a history of allergy to propofol, or those on medications affecting blood glucose or insulin release (e.g., steroids, β-blockers) within a week before surgery were excluded. All participants had plasma glucose levels below 200 mg/dL the night before and the morning of surgery. They received two-thirds of their usual night-time insulin dose but none in the morning. Preoperatively, plasma glucose levels were recorded, and an infusion of glucose 5% + 0.45% normal saline at 100 mL/hr was initiated. Regular insulin was infused at 0.02 IU/kg/hr, with adjustments made per a national inpatient blood glucose control guideline to maintain plasma glucose between 100–180 mg/dL. Blood glucose and insulin rates were monitored at multiple time points, and intraoperative monitoring included ECG, pulse oximetry, bispectral index (BIS), capnography, and non-invasive blood pressure.

All patients were premedicated with midazolam (2 mg IV) 30 minutes before surgery. Anesthesia induction was performed with propofol (2 mg/kg IV), followed by atracurium (0.5 mg/kg IV) for tracheal intubation. Patients were randomly assigned to either the propofol group (group P) with continuous propofol infusion (100 μg/kg/min) or the isoflurane group (group I) receiving isoflurane (0.5–1 MAC). Fentanyl (2 μg/kg IV) was administered before intubation, and morphine (0.1 mg/kg IV) was given post-intubation. Patients received 50% nitrous oxide in oxygen, maintaining a BIS range of 40–60. At the end of surgery, neuromuscular blockade was reversed with neostigmine (0.04 mg/kg IV) and atropine (0.02 mg/kg IV). Blood glucose levels and insulin infusion rates were statistically analyzed using SPSS version 15, employing t-tests and repeated measures analysis, with significance set at $P<0.05$.

RESULTS

No significant difference in blood glucose levels between the two groups from the preoperative phase to the second 30-minute intraoperative period ($P > 0.05$). At the third 30-minute mark (FBS5), Group I (Isoflurane) showed a significant rise in blood glucose levels compared to Group P (Propofol) ($P = 0.002$), suggesting a possible effect of isoflurane on glucose metabolism. This pattern aligns with prior findings, reinforcing that propofol may provide better intraoperative glucose stability compared to isoflurane.

Table 1: Mean Blood Glucose Levels at Different Time Points in the Two Groups

Time Point	Group P (Propofol) (mg/dL)	Group I (Isoflurane) (mg/dL)	P-Value
Preoperative Room (FBS0)	142.32 ± 12.45	138.64 ± 32.54	0.434
Before Induction (FBS1)	129.42 ± 17.45	128.98 ± 23.56	0.323
After Skin Incision (FBS2)	131.31 ± 3.44	127.82 ± 34.21	0.541
First 30 min (FBS3)	132.34 ±12.44	128.23 ± 28.33	0.356
Second 30 min (FBS4)	137.56 ± 11.33	156.53± 23.23	0.231
Third 30 min (FBS5)	129.23±15.23	164.43± 43.12	0.002

Table 2: The differences of blood glucoses at different times in comparison to preoperative value in two groups

Time	The differences of blood glucose		P value
	Group P (Propofol) (mg/dL)	Group I (Isoflurane) (mg/dL)	
FBS1–FBS0	10.34 ± 12.44	7.93 ± 16.29	0.230
FBS2–FBS0	5.54 ± 19.01	9.77 ± 12.95	0.211
FBS3–FBS0	5.90 ± 20.21	2.98 ± 25.07	0.531
FBS4–FBS0	2.75 ± 32.53	19.21 ± 28.97	0.765
FBS5–FBS0	3.12 ± 13.74	21.45 ± 12.87	0.234

Values are presented as mean ± standard deviation. FBS, fasting blood sugar; FBS0, preoperative room; FBS1, before induction of anesthesia; FBS2, after skin incision; FBS3, the first 30 minutes; FBS4, the second 30 minutes; FBS5, the third 30 minutes. a Group P: propofol, b Group I: isoflurane.

DISCUSSION

Managing blood glucose levels during surgery is crucial, particularly for diabetic patients undergoing major procedures such as abdominal hysterectomy. Anesthetic agents can influence glucose metabolism by altering insulin secretion and stress hormone release. Propofol and isoflurane, two commonly used anesthetics, have different physiological effects that may impact intraoperative blood glucose control. Isoflurane has been associated with impaired insulin secretion and increased blood glucose levels, while propofol is thought to have a more stable effect on glucose metabolism.[8,9] Understanding how these anesthetics influence blood glucose regulation can help optimize perioperative management in diabetic patients, reducing the risk of hyperglycemia-related complications. This study aims to compare the effects of propofol and isoflurane on intraoperative blood glucose levels in diabetic patients undergoing abdominal hysterectomy.

In a study by Behdad S et al.,[10] the effects of propofol and isoflurane on blood glucose levels during abdominal hysterectomy in diabetic patients were evaluated. The results showed no significant difference in blood glucose levels before anesthesia induction, but at 60 and 90 minutes after surgery began, blood glucose levels were significantly lower in the propofol group than in the isoflurane group. A Repeated Measures test confirmed a significant difference in blood glucose regulation between the groups ($P = 0.045$), while insulin administration during surgery showed no significant difference ($P = 0.271$). Similarly, the bispectral index (BIS) remained comparable throughout the procedure, with no significant difference between groups ($P = 0.35$). These findings suggested that propofol contributed to better intraoperative glucose stability compared to isoflurane.

In our study no significant difference in blood glucose levels between the two groups from the preoperative phase to the second 30-minute intraoperative period ($P > 0.05$). At the third 30-minute mark (FBS5), Group I (Isoflurane) showed a significant rise in blood glucose levels compared to Group P (Propofol) ($P = 0.002$), suggesting a possible effect of isoflurane on glucose metabolism. Akavipat et al. [11] study demonstrated that isoflurane causes hyperglycemia during surgery because of incomplete control of metabolic response to surgical stress during inhalation anesthesia by isoflurane.Tanaka et al. [12] investigated the mechanisms underlying impaired glucose tolerance and insulin secretion during isoflurane anesthesia. Their findings indicated that isoflurane anesthesia disrupts adenosine triphosphate-sensitive potassium channel activity in pancreatic β-cells, leading to reduced insulin secretion and the development of hyperglycemia.

CONCLUSION

Diabetes is a multifaceted metabolic disorder marked by hyperglycemia, which is a physiological state characterized by persistently high levels of glucose in the bloodstream. Propofol may provide better intraoperative glucose stability compared to isoflurane.

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