International Journal of Current Pharmaceutical Research

ISSN- 0975-7066 Vol 16, Issue 1, 2024

Original Article

A COMPARATIVE STUDY ON THE EFFECT OF GENERAL ANAESTHESIA ON BLOOD GLUCOSE LEVELS IN NON-DIABETIC AND CONTROLLED DIABETIC PATIENTS: AN OBSERVATIONAL STUDY AT S. M. S. MEDICAL COLLEGE, JAIPUR

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Received: 23 Oct 2023, Revised and Accepted: 02 Dec 2023

ABSTRACT

Objective: Diabetes, a complex metabolic disorder, poses significant challenges during surgery due to its association with chronic hyperglycemia. Surgical stress triggers hormonal changes, impacting glucose homeostasis. With an increasing global prevalence of diabetes, understanding the interplay between surgery, stress, and diabetes becomes crucial for perioperative management.

Methods: This hospital-based cross-sectional observational study included 222 patients (111 non-diabetic and 111 controlled diabetic) undergoing elective surgery. Demographic data, hemodynamic parameters, and blood glucose levels were assessed at various intervals. Statistical analyses compared age, gender, blood glucose levels, and hemodynamic responses between the two groups.

Results: Demographic parameters were comparable between non-diabetic and controlled diabetic groups. Hemodynamic responses, including heart rate and blood pressure, showed no significant differences during the surgery. Blood glucose levels were similar preoperatively and up to 30 min post-intubation. However, a significant difference was observed after 5 min of extubation, with controlled diabetic patients exhibiting higher levels. Variations in blood glucose levels after extubation were statistically significant, emphasizing the importance of postoperative monitoring.

Conclusion: This study highlights the intricate relationship between surgery, stress, and diabetes, emphasizing the need for tailored perioperative management. Close monitoring, especially during critical moments, is essential to ensure optimal glucose control and mitigate complications. The findings align with existing literature, reinforcing the importance of individualized approaches for diabetic patients undergoing surgery.

Keywords: Diabetes, Surgery, Perioperative management, Hemodynamic responses, Blood glucose levels, Stress response, Individualized treatment

DOI: https://dx.doi.org/10.22159/ijcpr.2024v16i1.4013. Journal homepage: https://innovareacademics.in/journals/index.php/ijcpr

INTRODUCTION

Diabetes, a metabolic disorder with diverse etiologies, is characterized by chronic hyperglycemia affecting carbohydrate, fat, and protein metabolism due to defects in insulin secretion, insulin action, or both, according to the World Health Organization (WHO) definition [1]. Notably, 25% of diabetic patients may require surgery, and their mortality rate is up to five times greater than non-diabetic counterparts, often linked to end-organ damage. Approximately 66% of postoperative complications and 25% of perioperative deaths are associated with diabetes, implicating impaired leukocyte function, altered chemotaxis, and phagocytic activity. As the prevalence of diabetes rises globally and outpatient surgical procedures increase, anesthesiologists are encountering diabetic patients in ambulatory settings more frequently [2].

The metabolic and hormonal responses to anesthesia and surgery, particularly their impact on stress, have been extensively studied. Surgical stress induces biochemical and hormonal changes, with hormonal interplay playing a pivotal role in evaluating stress responses, such as hyperglycemic reactions and variations in catecholamines during different surgeries and anesthetic procedures. Individuals with diabetes undergo surgical procedures at higher rates than non-diabetic individuals, and major operations necessitate fasting periods during which oral antidiabetic medications cannot be administered [3].

Surgery-induced stress responses can lead to metabolic perturbations, disrupting glucose homeostasis and resulting in persistent hyperglycemia a risk factor for various complications, including endothelial dysfunction, postoperative sepsis, impaired wound healing, and cerebral ischemia [4]. Hyperglycemia in the perioperative period may trigger complications like dehydration, fluid shifts, electrolyte abnormalities, a predisposition to infection, impaired wound healing, ketoacidosis, and hyperosmolar states. Additionally, the stress response may precipitate diabetic crises, such as Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar Syndrome, with negative prognostic consequences [5].

Given the intricate relationship between surgery, stress, and diabetes, careful attention is paramount. This manuscript delves into the challenges faced by diabetic patients undergoing surgical procedures, emphasizing the need for individualized treatment based on diabetes classification, regimen, glycaemic control, nature and extent of the surgery, and available expertise [6, 7]. The liver's role in glucose production, hormonal responses, and the crucial role of insulin in maintaining glucose homeostasis are explored, providing a foundation for understanding the challenges and guiding perioperative treatment goals. In subsequent sections, this manuscript will further explore the classifications of diabetes, diagnostic criteria, and preoperative evaluations, shedding light on the critical factors that influence the perioperative management of diabetic patients undergoing surgery [8].

MATERIALS AND METHODS

Equipment and supplies

The study utilized standard anesthesia equipment, including an anesthesia machine, oxygen delivery system, various airway management tools (endotracheal tubes, connectors, vent masks, facemasks, Guedel airways, and laryngoscope with curved blades), suction apparatus, intravenous cannulas, monitors (N. I. B. P, E. C. G, SPO2), intravenous and blood transfusion sets, syringes, intravenous fluids (Ringer Lactate, Normal Saline, 6% Hydroxy Ethyl Starch), a glucometer with glucose oxidase strips, and sterilization materials.

Drugs required

The study involved the administration of specific drugs, including Metoclopramide, Glycopyrrolate, Midazolam, Fentanyl, Thiopentone, Propofol, Atracurium, Ondansetron, and Neostigmine.

Study area

The research was conducted in the Department of Anaesthesia and Operation Theatres at S. M. S. Medical College, Jaipur, with appropriate permissions from the institutional ethics committee and research review board.

Study design

This was a hospital-based cross-sectional observational study.

Study period

The study continued until the desired sample size was achieved after obtaining approval from the ethics committee.

Sample size

The target sample size was 111 cases in each group, determined with 95% confidence and 80% power.

Randomization

Participants were randomly allocated into two study groups.

Study universe

The study included cases requiring non-diabetic and controlled diabetic patients for surgery under general anesthesia.

Eligibility criteria

Inclusion criteria

1. Patients scheduled for surgery under general anesthesia.
2. Age: 25 to 70 y.
3. ASA Grade 1 and 2.
4. Duration of surgery ≤ 2 h.
5. Controlled diabetic patients (either on Insulin, Oral hypoglycemic drugs, or diet control).
6. Fasting plasma glucose<126 mg/dl.
7. HbA1C: 5% to 6.5%.

Exclusion criteria

1. ASA Grade 3 and 4.
2. Fasting blood glucose<60 mg/dl or HbA1C>6.5%.
3. Duration of surgery>2 h.
4. Patient refusal.

Study groups

1. Group A (n=111): Non-diabetic patients.
2. Group B (n=111): Controlled diabetic patients.

Pre-anaesthetic check-Up

Detailed pre-anesthetic check-up included a complete patient history, airway assessment, general physical and systemic examination, and routine and specific investigations.

Procedure

The study enrolled 222 patients aged 25-70 y, belonging to ASA Grade 1 and 2, scheduled for elective surgical procedures lasting 1-2 h under general anesthesia. A thorough pre-anesthetic check-up, including a detailed history, systemic examination, and relevant investigations, was conducted. After obtaining informed consent, patients were preloaded with normal saline. Specific drugs were administered, and general anesthesia was induced. Blood glucose readings were taken at different intervals during and after surgery.

Definition

- Hyperglycemia: Plasma blood glucose levels>200 mg/dl or HbA1c>6.5%.
- Hypoglycemia: Plasma blood glucose levels<70 mg/dl.
- Bradycardia: Pulse rate<60 beats/min or>20% decline from baseline.
- Nausea: Unpleasant feeling of needing to vomit.
- Vomiting: Forceful contraction of the stomach propelling content upward.

Outcome variables

1. Estimation of blood glucose levels at different time intervals during surgery under general anesthesia.
2. Variation in blood glucose levels at different time intervals during surgery under general anesthesia.
3. Mean hemodynamic parameters (HR, SBP, DBP, MAP).

Statistical analysis

Data was entered in an Excel sheet, computed using Microsoft Excel 2013, and analyzed using SPSS version 28.0. Results were presented as mean±SD for continuous variables and Frequency (percentage) for categorical variables. Chi-square and ANOVA tests were applied for comparisons, and a significance level of p<0.05 was considered.

RESULTS

Table 1 Shows that mean age of the study subject between the two study groups. It was observed that there was no statistically significant difference between the mean age of study subjects of two study groups (p>0.05)

Table 2 shows that gender of study subjects between two groups. It was observed that there was no statistically significant difference between the gender of study subjects among two groups (p>0.05)

Table 3 shows blood glucose levels at different time intervals (Preoperative, After 5 min of intubation, After 30 min of intubation, After 5 min of extubation) in study subjects of two study groups. It was observed that blood glucose levels in study subjects between the two study groups were statistically non-significant (comparable) (p>0.05) preoperatively, after 5 min of intubation, after 30 min of intubation, while statistically significant (Non-comparable) (p<0.05)

Table 4 shows variation in blood glucose levels at different time intervals (After 5 min of intubation, after 30 min of intubation, After 5 min of extubation) in study patients between the two study groups. It was observed that variation in blood glucose levels in study patients between the two study groups were statistically non-significant (Comparable) after 5 min of intubation (p=0.480), after 30 min of intubation (p=0.586), while statistically significant (Non-comparable) (p<0.01)

Table 5 shows mean heart rate in 1st h of surgery in study subjects between the two study groups. It was observed that there was no statistically significant difference between nean heart rate (in 1st h of surgery) in study subjects among the two study groups (p>0.05)

Table 1: Comparison of study subjects according to age distribution between the two study groups

Age group (years)	Non diabetic (Group A)		Controlled diabetic (Group B)		Total	
	N	%	N	%	N	%
20-39	50	45	40	36	90	40.5
40-59	35	31.5	47	42.4	82	37
60-79	26	23.5	24	21.6	50	22.5
Total	111	100	111	100	222	100
mean±SD	43.65±14.23		46.10±13.09		44.87±13.69	
Chi-square = 2.947 with 2 degrees of freedom; P = 0.229						

Test used: Chi-Square test data are expressed as mean±SD and in percentage, Data are expressed as = Percentage (Distribution of age in each group)

Table 2: Comparison of study subjects according to gender between two study groups

Gender	Controlled diabetic (Group B)		Non-diabetic (Group A)		Total	
	N	%	N	%	N	%
Female	55	49.5	50	45	105	47.3
Male	56	50.5	61	55	117	52.7
Total	111	100	111	100	222	100
Chi-square = 0.289 with 1 degree of freedom; P = 0.591						

Test used = Chi-square test Data are expressed as percentage

Table 3: Comparison of blood glucose levels between the subjects of two study groups

Time	Non-diabetic (Group A)	Controlled diabetic (Group B)	P value
Preop	89.62±6.42	89.90±6.05	0.739
After 5 min of intubation	86.36±6.08	87.63±5.85	0.114
After 30 min of intubation	103.43±7.33	104.62±7.57	0.235
After 5 min of extubation	114.58±8.45	127.26±8.27	<0.001 (S)

Test Used–ANOVA test data are expressed as mean±SD

Table 4: Comparison of variation (change) in blood glucose level in study patients between the two study groups

Time	Non-diabetic (Group A)	Controlled diabetic (Group B)	P value
After 5 min of intubation	-3.04±10.82	-2.07±9.50	0.480
After 30 min of intubation	16.04±12.05	16.9±11.57	0.588
After 5 min of extubation	28.46±12.93	42.21±13.36	<0.001 (S)

Test Used–ANOVA test data are expressed in mean±SD

Table 5: Comparison of mean heart rate (beats/min) in 1st h of surgery in study subjects between the two study groups

Time	Non diabetic (Group A)	Controlled diabetic (Group B)	P value
Baseline	89.71±12.2	91.02±12.11	0.424
5 min	90.5±12.33	91.81±12.12	0.468
10 min	91.53±12.5	92.57±12.52	0.538
15 min	92.42±13	93.31±12.7	0.609
20 min	92.14±13.08	93.72±13.63	0.380
25 min	93.04±12.61	94.88±13.38	0.291
30 min	94.93±12.74	95.95±13.14	0.559
35 min	95.58±14.32	95.71±12.83	0.941
40 min	95.84±16.99	94.32±15.08	0.481
45 min	93.58±16.47	96.21±15.9	0.227
50 min	94.64±13.59	97.36±13	0.129
55 min	95.42±15.96	96.69±14.61	0.537
60 min	95.74±15.16	98.61±15.31	0.161

Test used-ANOVA test data are expressed as mean±SD

DISCUSSION

Diabetes, a complex metabolic disorder, involves chronic hyperglycemia and disruptions in carbohydrate, fat, and protein metabolism. Surgical stress induces a range of biochemical and hormonal changes, affecting glucose homeostasis. The stress response, marked by increased catecholamines, cortisol, and growth hormone secretion, can lead to insulin resistance, decreased insulin secretion, and elevated blood glucose levels. The perioperative period poses significant challenges for diabetic patients, including stress-induced hormonal changes, interruptions in food intake, altered consciousness, and circulatory disturbances. Careful management is crucial to avoid harmful hypoglycemia. The study's demographic data, including age, weight, gender, and ASA grade, were comparable between non-diabetic and controlled diabetic groups [9].

Hemodynamic parameters, specifically heart rate and blood pressure, were monitored during surgery. The study findings align with previous research, showing comparable values between non-diabetic and controlled diabetic groups. Other studies, including Rao A Ramakrishna and Indira P (2015) and Gotluru Priyanka and Kumari Pratibha *et al.* (2018), reported similar hemodynamic responses under general anesthesia. Blood pressure changes during surgery were statistically non-significant between the two groups, consistent with previous studies. The findings correspond with Rao A Ramakrishna and Indira P (2015) and Gotluru Priyanka and Kumari Pratibha *et al.* (2018), reinforcing the similarity in hemodynamic responses in both non-diabetic and controlled diabetic patients [10].

Blood glucose levels were assessed at various points, revealing comparable values preoperatively and postoperatively up to 30 min after intubation. However, there was a significant difference after 5 min of extubation, with controlled diabetic patients showing higher levels. This aligns with the stress response and the impact of surgery on blood glucose levels. The study's results are consistent with findings from Rao A Ramakrishna and Indira P (2015), demonstrating that controlled diabetic patients exhibit slightly higher blood glucose levels postoperatively. This is a critical consideration for perioperative care [11].

Variations in blood glucose levels between non-diabetic and controlled diabetic groups were statistically non-significant after 5 and 30 min of intubation but significant after 5 min of extubation. This emphasizes the importance of postoperative monitoring, especially in diabetic patients. Comparisons with other studies, such as Widyana IMG and Senapathi TGA *et al.* (2017), highlight the potential impact of interventions, such as preoperative oral glucose administration, on mitigating the metabolic stress response in diabetic patients [12].

CONCLUSION

In conclusion, this study contributes valuable insights into the perioperative management of diabetic patients. It underscores the importance of close monitoring, especially during critical perioperative moments, to ensure optimal glucose control and mitigate the risk of complications. The findings align with existing literature, emphasizing the need for tailored approaches in diabetic patients undergoing surgery.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All authors have contributed equally.

CONFLICT OF INTERESTS

Declared none

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