International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 3, March 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.3.2025.241

ORIGINAL RESEARCH

Comparative Analysis of Intraoperative Blood Glucose Levels in Non-Diabetic Patients Undergoing Elective Surgeries: Subarachnoid Block versus General Anaesthesia

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Received: 27 January, 2025 Accepted: 21 February, 2025 Published: 19 March, 2025

ABSTRACT

Background: The hyperglycaemia that arises from surgical stress is due to a reduction in glucose uptake and glycogen synthesis in skeletal muscle, an increase in gluconeogenesis and glycogenolysis in the liver, and activation of the sympathetic nervous system. The present study was conducted to assess the effect of subarachnoid block vs general anaesthesia on intraoperative blood glucose levels in non- diabetic patients undergoing elective surgeries. **Materials & Methods:** 80 non diabetic adult patients of either sex, aged 35- 65 years, with American Society of Anaesthesiologists (ASA) grading of I or II scheduled for elective surgical procedures lasting 1-3 hours were divided into 2 groups of 40 each. Group I patients were undergoing surgery under GA and group II patients were undergoing surgery under SAB. Average capillary blood glucose (CBG) levels were compared in both groups. **Results:** Group I comprised of 22 males and 18 females and group II 17 males and 23 females. The mean CBG 30 min before anaesthesia was 104.2±13.8 mg/dl and 100.6±11.3 mg/dl. At 30 minutes after anaesthesia was 126.4±12.2 mg/dl and 105.3±14.3 mg/dl. At 60 minutes after anaesthesia was 157.8±17.0 mg/dl and 98.4±11.8 mg/dl and 30 minutes after shifting to PACU was 142.7±23.5 mg/dl and 93.2±28.5 mg/dl in group I and II respectively. The difference was significant (P< 0.05). **Conclusion:** CBG levels increased considerably in those who were given GA for surgery. This suggests that the hormonal stress response is more pronounced during GA than during SAB.

Keywords: Diabetes, General anaesthesia, Subarachnoid block

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INTRODUCTION

The American Diabetes Association and the American Association of Clinical Endocrinologists agree that stress hyperglycaemia is characterized by any blood glucose level exceeding 7.8 mmol/L (140 mg/dL) in individuals without a history of diabetes.[1]

The hyperglycaemia that arises from surgical stress is due to a reduction in glucose uptake and glycogen synthesis in skeletal muscle, an increase in gluconeogenesis and glycogenolysis in the liver, and activation of the sympathetic nervous system. This activation results in the release of catabolic hormones and hormones from the pituitary gland.

Acute insulin resistance is regarded as a primary

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DOI: 10.69605/ijlbpr_14.3.2025.241

contributor to intraoperative hyperglycaemia owing to the increased production of catecholamines and cortisol during surgery.[2]

A variety of factors, such as genetics, race, and ethnicity, significantly influence perioperative blood glucose levels. These factors also impact pain threshold, insulin sensitivity, and the response of the Hypothalamic-Pituitary-Adrenal (HPA) axis to stress. There are several adverse effects associated with perioperative hyperglycaemia, including immune system compromise, increased postoperative infection risk, acute kidney damage, protracted wound recovery, occurrence of delirium after surgery, and cognitive dysfunction. Moreover, it is associated with an increased risk of immunological and vascular dysfunction, anastomotic leaks, and intra-abdominal abscess formation, all of which can lead to prolonged hospitalizations and adverse surgical outcomes.[3]

A key facet of anaesthetic management is to stress the importance of reducing fluctuations in blood glucose during the intraoperative and postoperative phases. It is essential to choose an anaesthetic technique that can reduce surgical stress and the resultant hyperglycaemic response during the intraoperative and postoperative periods, whenever feasible.[4] Suppressing the pain pathways originating from the injured site adequately can reduce the stress response. GA and Subarachnoid Block (SAB) can aid in preventing hyperglycaemia and stress reactions after surgery through different mechanisms. While GA inhibits the brain's signals at the HPA axis, regional anaesthesia blocks the afferent neural pathway that transmits impulses from the spinal cord to the brain.[5]

AIM AND OBJECTIVES

Aim

To evaluate and compare the effects of Subarachnoid Block (SAB) and General Anaesthesia (GA) on intraoperative and immediate postoperative capillary blood glucose (CBG) levels in non-diabetic patients undergoing elective surgeries.

Objectives

1. **Baseline Assessment**: Measure and compare pre-anaesthesia CBG levels in patients receiving GA and SAB.
2. **Intraoperative Monitoring**: Assess and compare CBG levels at 30 and 60 minutes post-anaesthesia induction between the two groups.
3. **Postoperative Evaluation**: Evaluate and compare CBG levels 30 minutes after transferring patients to the Post Anaesthesia Care Unit (PACU) in both groups.
4. **Statistical Analysis**: Determine the significance of differences in CBG levels between GA and SAB groups at each time point.

MATERIALS AND METHODS

Study Design

This was a prospective, comparative observational study designed to assess the effect of subarachnoid block (SAB) and general anaesthesia (GA) on intraoperative blood glucose levels in non-diabetic patients undergoing elective surgeries.

Study Population

A total of 80 adult non-diabetic patients of either sex, aged between 35 and 65 years, and classified as American Society of Anaesthesiologists (ASA) Physical Status I or II, were recruited for the study. Written informed consent was obtained from all participants.

Study place

The study was conducted in the Department of Anaesthesia, Himalaya Medical College, Hospital, Patna, Bihar, India.

Study Duration

The study was conducted over a period of 11 months from January 2024 to November 2024.

Inclusion Criteria

- Adults aged between 35 and 65 years
- Non-diabetic (confirmed by history and fasting blood glucose)
- ASA Physical Status I or II
- Undergoing elective surgeries lasting 1–3 hours
- Provided informed written consent

Exclusion Criteria

- Known cases of diabetes mellitus
- Patients on corticosteroids or other glucose-altering medications
- Patients with endocrine disorders affecting glucose metabolism
- Emergency surgeries
- Patients with anticipated surgical duration of less than 1 hour or more than 3 hours
- ASA grade III and above
- Refusal to consent

Ethical Considerations

Approval for the study was obtained from the Institutional Ethics Committee (IEC). The study adhered to the ethical principles laid down in the Declaration of Helsinki. All participants provided written informed consent after a

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thorough explanation of the study protocol, potential risks, and benefits.

Study Procedure

The patients were randomly allocated into two groups (n = 40 each) using a computer-generated random number table:

- Group I (GA Group): Underwent surgery under general anaesthesia
- Group II (SAB Group): Underwent surgery under subarachnoid block (spinal anaesthesia)

Baseline demographic data including age, sex, weight, and preoperative fasting blood sugar levels were recorded. Standard preoperative fasting protocols were followed.

Surgical Technique

- Surgeries performed included a mix of general, orthopaedic, and gynaecological procedures. The specific type of surgery was recorded but not limited to any particular specialty.
- The anaesthetic technique used followed standard protocols:
  - GA: Induction with IV agents (e.g., propofol), maintenance with volatile agents (e.g., isoflurane/sevoflurane), muscle relaxants and airway control with endotracheal intubation.
  - SAB: Performed using 0.5% hyperbaric bupivacaine at L3-L4 or L4-L5 interspace under aseptic conditions, with patients in sitting or lateral decubitus position.

Outcome Measures

The primary outcome was the capillary blood glucose (CBG) level measured intraoperatively at:

- Baseline (before induction or spinal injection)
- 30 minutes after start of surgery
- At the end of surgery

CBG was measured using a calibrated glucometer with appropriate infection control measures.

Statistical Analysis

- Data were entered in Microsoft Excel and analysed using SPSS (version 25.0).
- Quantitative variables (CBG levels) were expressed as mean ± standard deviation (SD).
- Student's t-test (unpaired) was used to compare mean CBG levels between the two groups.
- Chi-square test was used for categorical variables.
- A P-value of < 0.05 was considered statistically significant.

RESULTS

Table 1: Distribution of Patients

Groups	Group I	Group II
Method	GA	SAB
M:F	22:18	17:23

Table 1, figure I shows that group I comprised of 22 males and 18 females and group II 17 males and 23 females.

Figure I: Gender wise distribution of the patients

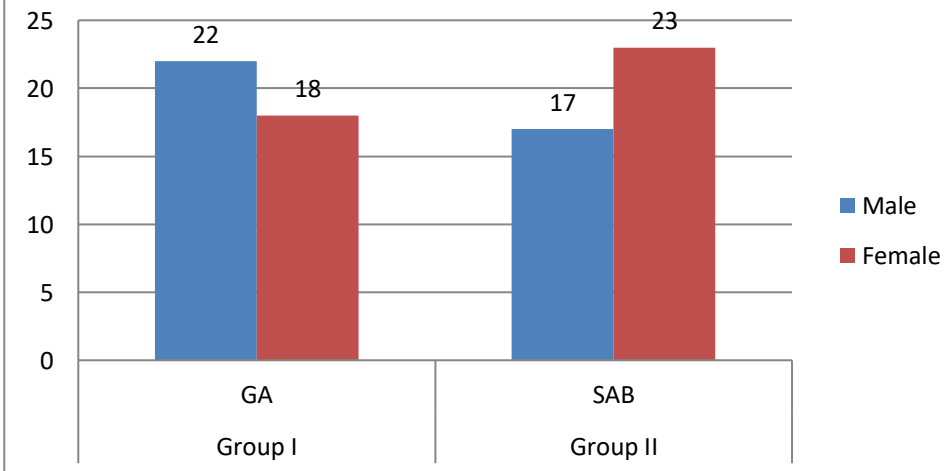

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Table 2: Comparison of Average Capillary Blood Glucose (CBG) Levels

Variables blood sugar	Group I	Group II	P value
30 min before anaesthesia	104.2±13.8	100.6±11.3	0.72
30 min after anaesthesia	126.4±12.2	105.3±14.3	0.01
60 min after anaesthesia	157.8±17.0	98.4±11.8	0.01
30 min after shifting to PACU	142.7±23.5	93.2±28.5	0.01

Table 2 shows that mean CBG 30 min before anaesthesia was 104.2±13.8 mg/dl and 100.6±11.3 mg/dl. At 30 minutes after anaesthesia was 126.4±12.2 mg/dl and 105.3±14.3 mg/dl. At 60 minutes after anaesthesia was 157.8±17.0 mg/dl and 98.4±11.8 mg/dl and 30 minutes after shifting to PACU was 142.7±23.5 mg/dl and 93.2±28.5 mg/dl in group I and II respectively. The difference was significant (P< 0.05).

DISCUSSION

Worldwide, diabetes mellitus is the most common metabolic disorder and is a key contributor to adverse postoperative outcomes.[6] During the perioperative period, pain and anxiety lead to increased blood glucose levels. This process activates the sympathetic nervous system and causes hormones like cortisol, norepinephrine, and adrenaline to be released.[7,8] There are significant alterations in the haemodynamic, endocrine, metabolic, and immunological systems, leading to hyperglycaemia and insulin resistance that are directly related to the extent of surgical stress. The main hormones responsible for hyperglycaemia are cortisol, glucagon, epinephrine, and growth hormone.[9] The present study was conducted to assess the effect of subarachnoid block vs general anaesthesia on intraoperative blood glucose levels in non-diabetic patients undergoing elective surgeries.

We found that group I comprised of 22 males and 18 females and group II 17 males and 23 females. Ganar et al.[10] examined the effects of Subarachnoid Block (SAB) and General Anaesthesia (GA) on perioperative Capillary Blood Glucose (CBG) levels in individuals undergoing surgery lasting 1-3 hours. The mean CBG levels measured 30 minutes before anaesthesia in the GA group were 105.50±21.13 mg/dL, while in the SAB group they were 99.67±19.04 mg/dL, with a p-value of 0.330. However, CBG levels measured 30 minutes after anaesthesia in the GA group were 125.69±22.95 mg/dL, compared to 104.67±20.94 mg/dL in the SAB group, with a p-value of 0.001. At 60 minutes after anaesthesia, CBG levels in the GA group were 152.41±28.97 mg/dL, while in the SAB group they were 99.65±22.69 mg/dL, with a p-value of 0.003. Finally, 30 minutes after shifting to PACU, CBG levels in the GA group were 147.49±27.20 mg/dL, compared to 92.86±24.35 mg/dL in the SAB group, with a p-value of 0.002.

We found that mean CBG 30 min before anaesthesia was 104.2±13.8 mg/dl and 100.6±11.3 mg/dl. At 30 minutes after anaesthesia was 126.4±12.2 mg/dl and 105.3±14.3 mg/dl. At 60 minutes after anaesthesia was 157.8±17.0 mg/dl and 98.4±11.8 mg/dl and 30 minutes after shifting to PACU was 142.7±23.5 mg/dl and 93.2±28.5 mg/dl in group I and II respectively. Bajracharya A et al.[11] compared intra operative blood glucose level in Spinal and General Anesthesia. Sixty non diabetic patients (30 in each group) aged between 20 – 60 years belonging to ASA I and ASA II status. Capillary blood glucose was measured preoperatively and thereafter at 15 minutes interval after incision in Spinal Anesthesia and after induction of General Anesthesia till one hour of surgery. Blood sugar level was well controlled in patients receiving spinal anesthesia. General anesthesia produced more increase in blood sugar level compared to base line value which was statistically significant (P<0.05). Similarly, Glycaemia was significantly higher in the General anesthesia group (p < 0.05) when compared with Spinal Anesthesia group suggesting poor control of stress response during general anesthesia.

Samuel H et al.[12] enrolled 70 adult patients who underwent lower abdominal and pelvic surgery under general and spinal anaesthesia; 35 in each group. No statistically significant difference was observed in mean blood glucose levels at baseline and 5 minutes after induction of general anaesthesia and complete blocks of spinal anaesthesia. But at the end of surgery and 60 minutes after the end of surgery the mean blood glucose levels were statistically significantly higher in the general anaesthesia group compared with the spinal anaesthesia group (P<0.05). And the blood glucose level was significantly

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DOI: 10.69605/ijlbpr_14.3.2025.241

increased from baseline compared with the different time intervals in the general anaesthesia group.

LIMITATIONS OF THE STUDY

- Small sample size (n = 80) limits the generalizability of results to a broader population.
- Single-centre study may not reflect variations across different clinical settings or geographic locations.
- Heterogeneous surgical procedures: Different types of surgeries with variable stress responses may influence blood glucose levels.
- Short duration of glucose monitoring: Only intraoperative CBG levels were recorded; postoperative trends were not assessed.
- No hormonal analysis: Stress hormone levels (like cortisol or catecholamines) were not measured, which could have provided mechanistic insights.
- Glucometer variability: Capillary blood glucose may vary from venous blood glucose, and operator error in glucometer readings could affect accuracy.

CONCLUSION

Authors found that CBG levels increased considerably in those who were given GA for surgery. This suggests that the hormonal stress response is more pronounced during GA than during SAB. The study findings indicate that non-diabetic patients undergoing elective surgeries under General Anaesthesia experience a significant rise in intraoperative and immediate postoperative blood glucose levels compared to those receiving Subarachnoid Block. This suggests that GA is associated with a greater hormonal stress response, leading to elevated CBG levels. Conversely, SAB appears to provide better glycemic stability during the perioperative period. Therefore, when feasible, SAB may be the preferred anaesthetic technique to minimize perioperative hyperglycemia in non-diabetic patients.

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