Comparison of Changes in Blood Glucose Levels in Spinal versus General Anaesthesia in Patients Undergoing Infraumbilical Surgeries

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Abstract: ***The aim of the study was to carry out the comparative study of variations in blood glucose levels intra operatively in patients undergoing infraumbilical surgeries under Spinal Anaesthesia and General Anaesthesia by capillary blood glucose level. Objective: To compare intra operative blood glucose level in Spinal and General Anaesthesia. Methodology: Seventy two non diabetic patients (36 in each group) aged between 18 – 60 years belonging to ASA I and ASA II status were enrolled for this prospective comparative study. Capillary blood glucose was measured preoperatively, at 30 minutes post induction, at the end of surgery and 60 minutes post operatively in Spinal Anaesthesia and General Anaesthesia. For statistical analysis paired sample t – test was used for comparing mean of quantitative data. Difference was considered statistically significant if p < 0.05. Results: Blood sugar level was well controlled in patients receiving spinal anaesthesia. General anaesthesia produced more increase in blood sugar level compared to base line value which was statistically significant (P< 0.05) when compared with Spinal Anaesthesia group suggesting poor control of stress response during general anaesthesia. Conclusion: Based on capillary blood glucose level, spinal anaesthesia proved more effective in suppressing stress response as compared to general anaesthesia in elective surgical patients.***

Keywords: Capillary blood glucose; general anaesthesia; spinal anaesthesia; stress response

1. Introduction

Surgery is associated with increased stress response which results in sympathetic activations and the release of pituitary hormones that accelerate glycogenolysis and gluconeogenesis and result in stress hyperglycaemia[1]. Stress hyperglycaemia is defined as any blood glucose concentration >7.8 mmol/l (140 mg/dl) without evidence of previous diabetes by the American Diabetes Association and American Association of Clinical Endocrinologists consensus[2].

Stress-induced hyperglycaemia is common and more than 50% occurs in previously non-diabetic patients[3-4]. Perioperative stress-induced hyperglycaemia is reported in 20–40% of patients undergoing general surgical procedures[5-7].

The magnitude of stress hyperglycaemia relates to the extent of surgical procedures, the technique of anaesthesia, the anatomic location of the surgery, and the types of intraoperative fluids[8,9].

The associated factors for the incidence of stress hyperglycaemia include age, body mass index, duration of surgery, baseline blood glucose level, and intraoperative blood transfusion[3,10,11].

Perioperative stress hyperglycaemia is associated with an increased risk of postoperative complications; including infection, and vascular and immune dysfunction both in diabetic and non-diabetic patients[12,13]. Studies also show patients with stress-induced hyperglycaemia had a higher risk of developing postoperative complications than known diabetic patients with the same blood glucose levels[14,15]. In patients undergoing abdominal surgery, it is associated with a higher incidence of anastomotic leak and intra-abdominal abscess[16]. All of these complications result in long hospital stays and poor surgical outcomes.

On the other hand, treating intraoperative hyperglycaemia may cause hypoglycaemia and which has its consequence and complication. Hypoglycaemia is the most common complication secondary to insulin administration and is associated with poor clinical outcomes[2]. This may indicate that preventing hyperglycaemia is more important than treating hyperglycaemia.

The stress response can be reduced by adequate suppression of the pain pathways that arise from the site of injury[17]. Both general anaesthesia and spinal anaesthesia blocks stress responses to surgery and hyperglycemic responses through different mechanisms. General anaesthesia blocks the brain's signal at the hypothalamic pituitary adrenal Axis (HPA axis) whereas regional anaesthesia blocks the afferent neuronal pathway that transmits the impulse from the spinal cord to the brain[8]. Lower abdominal surgeries can be performed by both techniques.

2. Aims and Objectives

To compare the perioperative blood glucose levels in patients undergoing spinal anaesthesia and general anesthesia for infraumbilical surgeries.

Sample size calculation

Sample size is calculated using the formula

$$(n)=[2(Z1-\alpha/2+Z1-\beta)2 \times (\sigma)2]/ d2$$

- $Z\alpha/2$ = 1.96 standard normal variable
- $Z\beta$ = 0.84 power of the test
- σ (combined standard deviation) =64.20[9]
- $\bar{x}1$ = 115.57
- $\bar{x}2$= 104.83
- d= $\bar{x}1$ - $\bar{x}2$ which is 10.74
- $\sigma 1$ = 16.6
- $\sigma 2$ = 14.06
- $n=2(1.96+0.84)^2(16.29)^2/10.74$
- So, n= 36.09
- Calculated sample size is 36 in each group and we have taken sample size as 36 in each group.

3. Methodology

Methods of collection of data

After obtaining ethical committee clearance, patients aged 18-60 years belonging to ASA class I and II undergoing elective infraumbilical surgeries under either spinal anaesthesia or general anaesthesia fulfilling the predetermined inclusion and exclusion criteria were enrolled in the study. The data was recorded using a semi structured proforma.

1) The first part contains the details regarding socio-demographic characteristics like name, age, sex and baseline values of Pulse rate, Systolic and Diastolic Blood pressure, Mean Arterial Pressure and SpO_2 will be recorded.
2) The second part contains the details of time of induction of spinal anaesthesia/general anaesthesia and the capillary blood glucose levels just before induction.

GA group: Patients undergoing infraumbilical surgeries under general anaesthesia as follows: pre-oxygenation with 100% oxygen, induction with 2mg/kg of propofol, 2mcg/kg of Fentanyl, and 2mg/kg suxamethonium for tracheal intubation, maintaining anaesthesia with oxygen, nitrous oxide, sevoflurane, and vecuronium. At the end of the surgery, patients were reversed with glycopyrrolate and neostigmine followed by tracheal extubation.

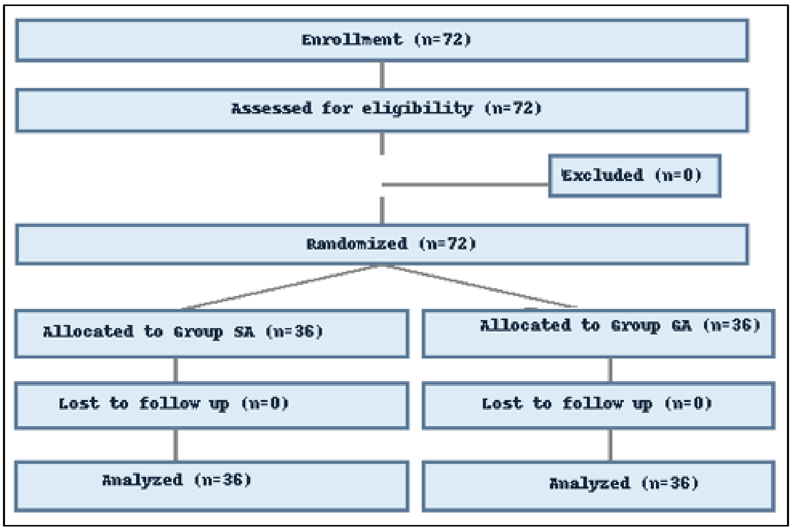
SA group: Patients undergoing infraumbilical surgeries under spinal anaesthesia receiving 0.5% heavy bupivacaine 15mg in L3-L4 interspace using 25G Quincke's needle and in whom sensory block was achieved to T6 dermatomal level.

Patients were administered with adequate intravenous crystalloid fluids like normal saline as a part of routine intraoperative management.

Capillary blood glucose levels (CBG) were noted four times throughout the perioperative period.
Time 1 (T1): preoperatively 5 mins before induction of anaesthesia as a baseline value
Time 2 (T2): intraoperatively 5 mins after induction of anaesthesia.
Time 3 (T3): immediately at the end of surgery in both the groups.

Time 4 (T4): postoperatively 60 mins after the end of surgery in the recovery room. During each time sample taking, the tips of fingers of the nondominant hand were disinfected with an alcohol swab before pricking with a lancet to measure capillary blood glucose levels.

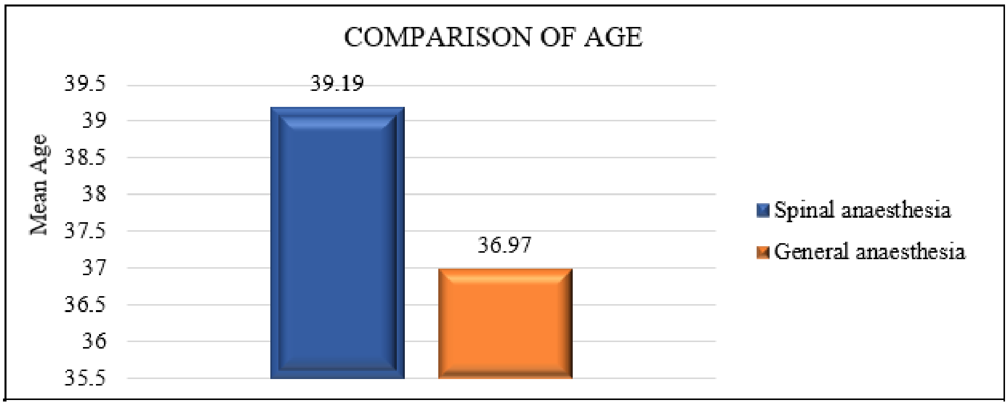
4. Consort Flow Diagram

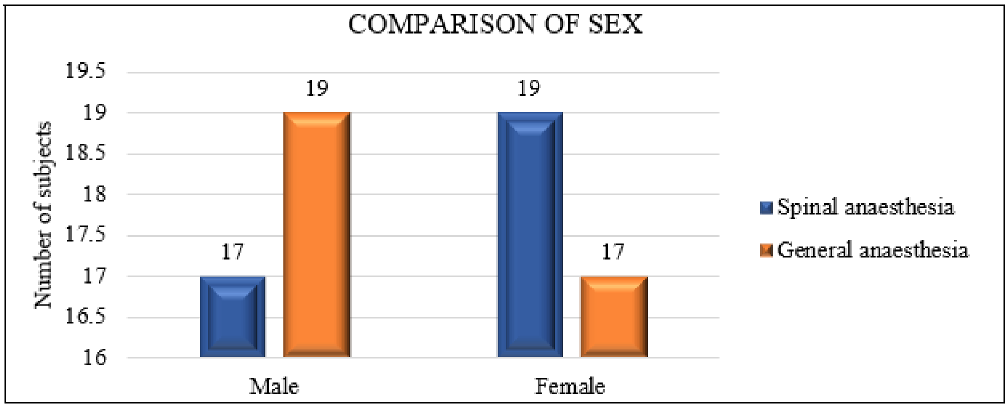


5. Results & Graphs

Table: Comparison of Baseline Characteristics between the Groups

Variables		Spinal anaesthesia	General anaesthesia	P value
Age (Yrs)		39.19 (± 10.474)	36.97 (± 10.363)	0.369
Sex	Male	17 (47.2%)	19 (52.8%)	0.389
	Female	19 (52.8%)	17 (47.2%)	
ASA	I	22 (61.1%)	22 (61.1%)	1.000
	II	14 (38.9%)	14 (38.9%)	





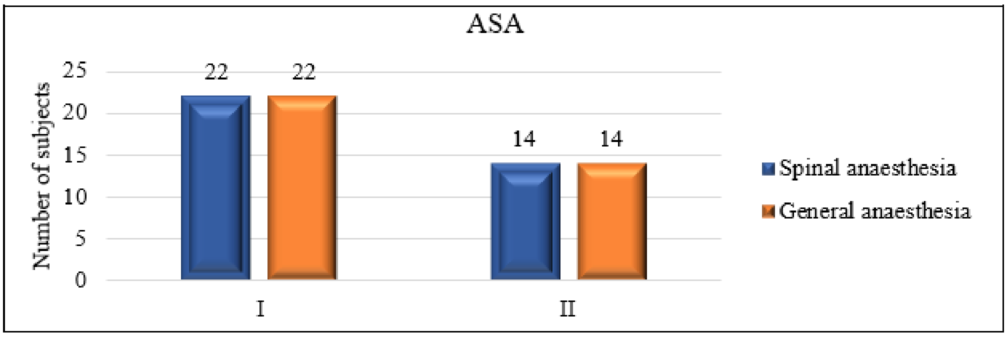


Table: Comparison of Blood Glucose Levels in Spinal Anaesthesia

Time	Baseline BGL	BGL at different time	P value
Intra-op 30 min after induction	92.08 (± 10.69)	91.86 (± 16.17)	0.915
Immediately at the end of surgery	92.08 (± 10.69)	90.78 (± 11.27)	0.391
Post-op 60 min after the end of surgery	92.08 (± 10.69)	93.36 (± 12.23)	0.307

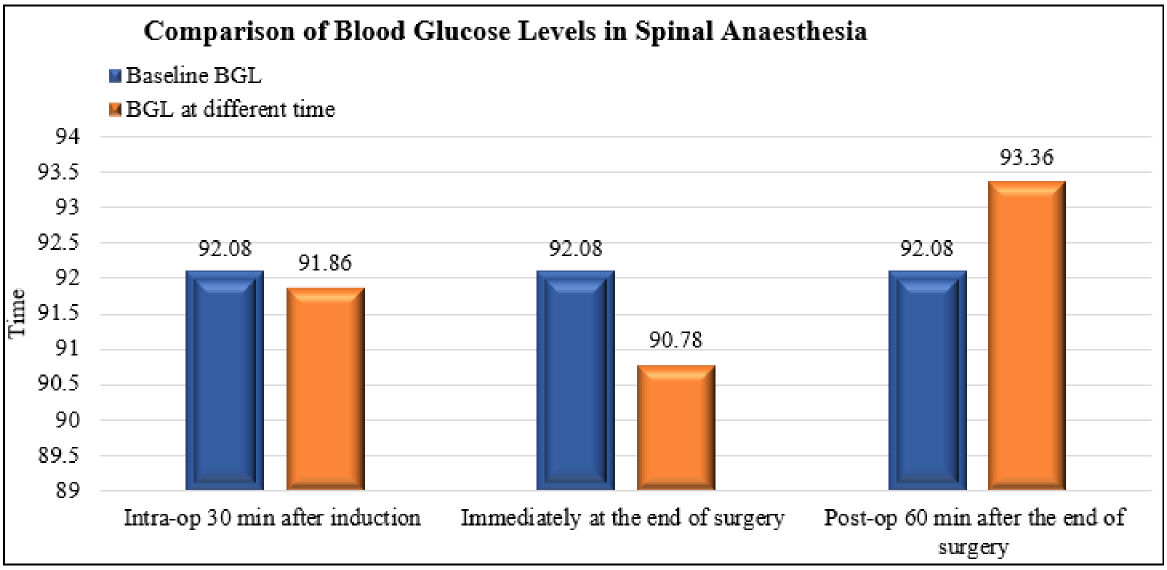


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Table: Comparison of Blood Glucose Levels in General Anaesthesia

Time	Baseline BGL	BGL at different time	P value
Intra-op 30 min after induction	82.72 (± 9.7)	102.06 (± 8.78)	<0.001
Immediately at the end of surgery	82.72 (± 9.7)	99.69 (± 8.45)	<0.001
Post-op 60 min after the end of surgery	82.72 (± 9.7)	102.39 (± 8.17)	<0.001

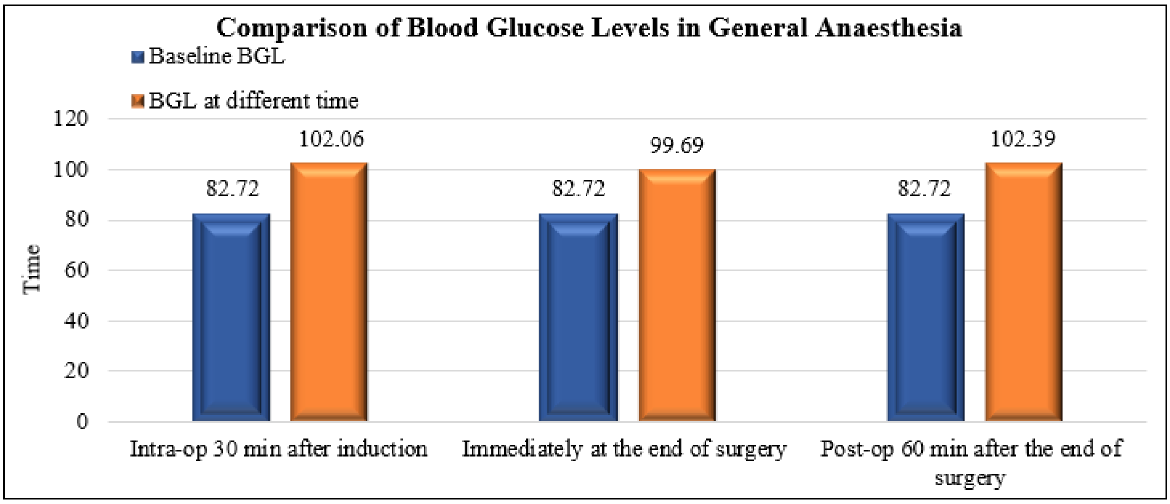
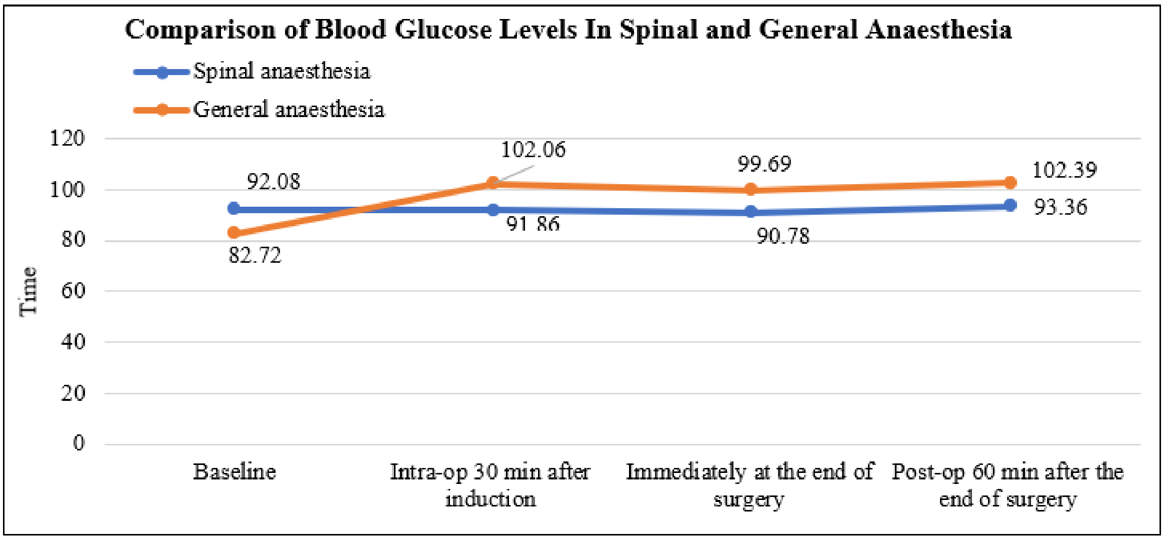


Table: Comparison of Blood Glucose Levels in Spinal and General Anaesthesia

Time	Spinal anaesthesia	General anaesthesia	P value
Baseline	92.08 (± 10.69)	82.72 (± 9.7)	<0.001
Intra-op 30 min after induction	91.86 (± 16.17)	102.06 (± 8.78)	0.001
Immediately at the end of surgery	90.78 (± 11.27)	99.69 (± 8.45)	<0.001
Post-op 60 min after the end of surgery	93.36 (± 12.23)	102.39 (± 8.17)	<0.001



There was no much variation in capillary blood glucose levels in patients for whom spinal anaesthesia was given. General anaesthesia resulted in more increase in capillary blood glucose levels from the baseline and was statistically significant ($p < 0.05$) suggesting poor control of stress response during general anaesthesia.

6. Discussion

In this study, we compared perioperative blood glucose responses between patients undergoing surgery under spinal anaesthesia and those receiving general anaesthesia. The two groups were comparable in terms of baseline demographic and clinical characteristics, including age distribution, sex ratio, and ASA physical status. The lack of significant differences in these baseline variables strengthens the validity of the subsequent comparisons in blood glucose trends, as it minimizes the likelihood that group differences were due to confounding factors [1,4].

Among patients receiving **spinal anaesthesia**, blood glucose levels remained remarkably stable throughout the perioperative period. There were no significant changes from baseline at 30 minutes intraoperatively ($p = 0.915$), immediately at the end of surgery ($p = 0.391$), or 60 minutes postoperatively ($p = 0.307$). These findings indicate minimal activation of the surgical stress response in patients under spinal anaesthesia[4,12]. This aligns with existing literature suggesting that regional anaesthesia techniques attenuate sympathetic activation, catecholamine release, and cortisol-

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mediated gluconeogenesis [5]. As a result, spinal anaesthesia appears to blunt the metabolic stress response and maintain glucose homeostasis more effectively [3,12].

In contrast, patients receiving **general anaesthesia** demonstrated a consistent and statistically significant rise in blood glucose levels at all measured time points. Compared to baseline, glucose levels increased markedly at 30 minutes after induction ($p < 0.001$), at the end of surgery ($p < 0.001$), and at 60 minutes postoperatively ($p < 0.001$). These results reflect the well-known hyperglycaemic effect of general anaesthesia, likely attributable to stress-induced hormonal surges involving cortisol, epinephrine, and glucagon [5,11]. The magnitude and persistence of this increase highlight general anaesthesia's less favourable impact on metabolic stability during the perioperative period[15,16].

Direct comparisons between the two groups further underscore these differences. While the spinal anaesthesia group exhibited higher baseline glucose levels, their glucose profile remained stable throughout the perioperative timeline. Conversely, the general anaesthesia group demonstrated significantly higher glucose values at all postoperative time points despite starting with lower baseline levels. The statistically significant differences at 30 minutes intraoperatively ($p = 0.001$), at the end of surgery ($p < 0.001$), and 60 minutes postoperatively ($p < 0.001$) suggest a pronounced stress response induced by general anaesthesia [1,7,8].

These findings are consistent with the physiologic understanding that regional techniques reduce nociceptive input and sympathetic outflow, thereby attenuating stress-mediated metabolic changes [3,5]. Clinically, the hyperglycaemic response in general anaesthesia may have implications for perioperative glycaemic management, particularly in patients with diabetes, impaired glucose tolerance, or in surgeries where tight glycaemic control is critical to reducing complications [9,10].

Overall, this study demonstrates that **spinal anaesthesia provides superior perioperative glucose stability compared to general anaesthesia**, supporting its use in patients where modulation of the surgical stress response is desired [12,14]. Future studies with larger sample sizes and inclusion of high-risk patient populations may help clarify how these findings translate into clinical outcomes such as infection rates, recovery profiles, and postoperative morbidity [3,15].

7. Conclusion

This study demonstrates that spinal anaesthesia provides significantly better perioperative glucose stability compared to general anaesthesia. While blood glucose levels remained stable at all time points in patients receiving spinal anaesthesia, general anaesthesia was associated with a marked and persistent rise in blood glucose from induction through the postoperative period. These findings highlight the attenuating effect of spinal anaesthesia on the surgical stress response, likely due to reduced sympathetic activation and hormonal surges. Clinically, spinal anaesthesia may be preferable in patients where glycaemic control is critical, particularly those at risk for metabolic or infectious complications. Further research involving larger and diverse patient populations is warranted to confirm these results and explore their implications for postoperative outcomes.

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Conflict of Interest
None

Financial Disclosure
None

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