COMPARISON OF PERIOPERATIVE BLOOD GLUCOSE CONCENTRATION IN SPINAL VERSUS GENERAL ANESTHESIA IN PATIENTS UNDERGOING ELECTIVE LOWER ABDOMINAL AND PELVIC SURGERY AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA,2020/21: A PROSPECTIVE COHORT STUDY.

INVESTIGATOR: MESTAWET NEGASH (BSC IN ANESTHESIA)

ADVISORS: BETELIHEM GIRMA (BSC. MSC. LECTURER IN ANESTHESIA)

HIRBO SAMUEL (BSC. MSC. LECTURER IN ANESTHESIA)

A THESIS SUBMITTED TO THE DEPARTMENT OF ANESTHESIA, COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY, FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENT OF A MASTER DEGREE IN ANESTHESIA.

Name of Investigator	Mestawet Negash (BSC in Anesthesia) Gmail. Mestawetnegash2 @gmail.com
Name of Advisors	1. Betelihem Girma (B.Sc. M.Sc. lecturer in anesthesia) Email. betigirma17@gmail.com 2. Hirbo Samuel (B.Sc. M.Sc. lecturer in anesthesia) Email. samuelhirbo1@gmail.com
Full Title of the Research Paper	Comparison of Perioperative Blood Glucose Concentration in Spinal versus General Anesthesia in a Patient Undergoing Elective Lower Abdominal and pelvic Surgery
Duration of project	January 30, to June 05, 2021.G.C.
Study Area	Tikur Anbessa Specialized Hospital
Total Cost of the project	25,150.00 Ethiopian Birr
Address of investigator	Tel: +251-912-840-335 E-mail mestawetnegash2@gmail.com

Declaration

I, the undersigned, declare that the research entitled comparison of perioperative blood glucose concentration in spinal versus general anesthesia in patients undergoing elective lower abdominal and pelvic surgery at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia, a prospective cohort study is my original work in partial fulfillment of the requirements of Master of Science degree in Anesthesia. I understand that plagiarism is not tolerated and all directly cited literature has been appropriately referenced.

Investigator

Name **Mestawet Negash** Signature ______________ Date ______________

Approval of the Board of Examiners

1. **Advisor**

Name ________________________ Signature ______________ Date ______________

2. **Internal Examiner**

Name _________________________ Signature ______________ Date ______________

3. **External Examiner**

Name __________________________ Signature ______________ Date ______________

Date of Submission: ________________________________

Acknowledgement

First, I would praise God who helped me walk through this thesis. Next, I would like to express my genuine appreciation to my advisors Ms. Betelihem Girma and Mr. Hirbo Samuel for their continuous guidance, support, valuable comments in each and every step of this thesis work. Also, I would like to thanks my sponsoring organization Addis Ababa University for giving me this chance to develop this project and also the department of anesthesia for continuous support throughout this work. Finally want to express my great thanks to the authors and researchers of the articles I used in this work. My gratitude also goes to my data collectors and study participants.

Table of Contents

List of Tables and Figures

List of abbreviations

GA – General anesthesia

SA- Spinal anesthesia

SIH-Stress Induced hyperglycemia

CBG- Capillary blood glucose

ASA – American Society of Anesthesiologists

BGL – Blood glucose levels

TASH- Tikur Anbessa Specialized Hospital

DM- Diabetic Mellitus

Hr.-Hours

Min.-Minutes

N/S- Normal saline

R/L-Ringer lactate

DNS-Dextrose in normal saline

NSAID -Nonsteroidal anti-inflammatory drugs

ACTH- Adrenocorticotrophic Hormone

HPA-Axis- Hypothalamic Pituitary Adrenal Axis

Abstract

Introduction: Surgery is linked with fear and stress that disrupt metabolic and neuroendocrine activities which impair normal maintained glucose metabolism that leads in stress hyperglycemia. Anesthesia inhibits the stress responses and hyperglycemia but the mechanism at which they reduce surgical induced hyperglycemia is different.

Objective: This study compares the effect of GA and SA on perioperative blood glucose levels in patients that undergo lower abdominal and pelvic surgery at Tikur Anbessa Specialized Hospital.

Method: An institutional-based prospective cohort study was done on 70 individual patients; 35 in each group that undergo lower abdominal and pelvic surgery under GA and SA by using a systematic random sampling technique. Capillary blood glucose was measured 4 times: T1; 5 minutes before induction in GA and giving SA, T2; after 5 minutes of induction in GA and complete block in SA, T3; immediately at the end of surgery in both groups and T4; 60 minutes after the end of the surgery in both groups. Collected data were entered into SPSS version 24 and the normality was checked by the Shapiro Wilk test. For statistical analysis unpaired t-test and paired t-test were used to compare the mean of normally distributed data between the two groups and within the group respectively, presented by mean and standard deviation. Manny Whitney U test was used for asymmetric data and presented by median and interquartile range. Categorical data were presented by percentage and analyzed by chi-square test. P values <0.05 were considered statistically significant.

Result: No statistically significant difference was observed in mean blood glucose levels at T1 and T2 between the two groups. But at T3 (GA:115.57 ± 16.60 vs. SA:104.34 ± 14.06, p= 0.005) and T4 (GA;117.34 ± 16.79 vs. SA;106.00 ± 14.57, p=0.004) the mean blood glucose levels were statistically significantly higher in the GA group than SA group and when compared to the baseline. The incidence of stress hyperglycemia under GA was 34.3% compared to 8.6% under SA.

Conclusion and Recommendation: SA reduces the incidence of stress-induced hyperglycemia as compared to GA in patients undergoing lower abdominal and pelvic surgery. We recommend SA over GA whenever possible for patients undergoing lower abdominal and pelvic surgery.
Key Words: General anesthesia, Spinal anesthesia, Stress-induced hyperglycemia

1. Introduction

1.1. Background

Surgery is associated with increased stress response which results in sympathetic activations and release of pituitary hormones (1). This is due to the combination of different factors that includes tissue trauma, fasting, bleeding as well as administration of different drugs. Stimulation of the sympathetic nervous system increases the release of hormones from the adrenal medulla. Stimulation of the hypothalamic-pituitary axis increases the secretion of adrenocorticotrophic hormone (ACTH) and cortisol from the adrenal cortex which can be detected within minutes of the start of the surgical injury (2). These hormones accelerate glycogenolysis and gluconeogenesis and result in stress hyperglycemia (1) which 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(3).

The stress response can be reduced by adequate suppression of the pain pathways that arise from the site of injury (4). Both general anesthesia and spinal anesthesia blocks stress responses to surgery and hyperglycemic responses through different mechanisms. General anesthesia blocks brains signal at the HPA axis whereas regional anesthesia blocks the afferent neuronal pathway that transmits the impulse from the spinal cord to the brain (5). Most of lower abdominal and pelvic surgeries can be performed by both techniques. Spinal anesthesia remains a preferred technique for surgery to the lower abdomen, pelvis, and lower extremities due to its minimal complications and good postoperative analgesia compared to general anesthesia (6).

The magnitude of stress hyperglycemia relates to the extent and anatomical location of surgery, the technique of anesthesia, and types of intraoperative fluids(5,7). Thoracoabdominal procedures are associates with more stress responses than lower body procedures this may due to an increase in cytokine release from the site of injuries (8). The associated factors for the incidence of stress hyperglycemia include age, BMI, duration of surgery, baseline blood glucose level, and intraoperative blood transfusion(9–11).

1.2. Statement of the problem

Surgical stress hyperglycemia is common and more than 50% occur in previously non-diabetic patients (11,12). Perioperative stress-induced hyperglycemia is reported in 20-40% of patients undergoing general surgical procedures (13–15).

Perioperative stress hyperglycemia is associated with an increased risk of postoperative complications in both DM and NDM patients. But studies show patients SIH had a higher risk of developing postoperative complications than known diabetic patients with the same blood glucose level(16,17).

Amy M. et al. observed that intraoperative hyperglycemia is an independent predictor of infectious complications among both DM and NDM patients(18). These may due to hyperglycemia leads to, impair neutrophil function, activate reactive oxygen species, free fatty acids, and inflammatory mediators which contribute to direct cellular damage, vascular and immune dysfunction(19). Supporting the above finding, other studies observed intraoperative hyperglycemia as an independent risk factor for postoperative infection complications, including death in patients who underwent cardiac surgeries and higher incidence of anastomotic leak and intraabdominal abscess in patients with abdominal surgery(20,21). All of these complications result in long hospital stays and poor surgical outcomes.

On the other hand, treating intraoperative hyperglycemia may cause hypoglycemia and which has its consequence and complication. Hypoglycemia is the most common complication secondary to insulin administration and associated with poor clinical outcomes(22). This may indicate that preventing hyperglycemia is more important than treating hyperglycemia.

There are contradicting studies on the effect of types of anesthesia on blood glucose levels. In studies conducted in elective surgical patients, they observed a significant reduction of perioperative blood glucose level in SA than GA(22–25). On the other hand, a significant reduction of blood sugar levels was observed in GA than SA right after surgeries in patients undergoing cesarean section(26). Another study found an absence of significant difference in blood glucose levels between the two groups (27).

1.3. Justification of the study

Choosing the appropriate technique of anesthesia with minimum side effects and the minimum cost is the standard of care for patients in anesthesia practice. To avoid the side effects of acute intraoperative hyperglycemia it is important to know the types of anesthetic techniques that influence blood glucose levels.

In addition to contradictory findings on the effect of spinal and general anesthesia on blood glucose levels, as far as my knowledge there is no published previous literature that compares blood glucose levels between the two groups in Africa and also in Ethiopia. Ethnicity, race, and genetic affect pain threshold to noxious stimuli, insulin sensitivity, and insulin response to maintain the normal blood glucose levels and also on HPA axis response to stress(28–31). Also, it was reported that ethnicity may affect the anesthesia requirement and hyperglycemic response during surgery under general anesthesia(32,33).

Hence, this study is conducted to compare the effect of spinal and general anesthesia in blunting stress-induced hyperglycemia for non-diabetic patients undergoing elective lower abdominal and pelvic surgery in this study area. In addition, the results of this study will be needed as a scientific source of choosing appropriate types of anesthesia for high-risk patients, to modify the intraoperative monitoring depending on the types of anesthesia, and also it will be a source of literature review for the future researchers.

2. Literature review

The stress response is a metabolic, neuronal, and endocrine response that follows injury or trauma(2). In surgical patients, combination anxiety, tissue trauma, fasting, and blood loss contribute to increased release of hypothalamic pituitary hormones and stimulation of the sympathetic nervous system which in turn promotes glucose production, reduces glucose utilization, and results in elevated blood glucose concentrations. (1,34).

Anesthesia blunts these stress responses but different studies shows that the degree at which different anesthetic technique reduces stress responses and consequently hyperglycemia varies (5,35).

Opioids have been known to reduce stress responses to surgery by suppression of hypothalamic and pituitary hormone secretion(5,36). On the other hand, volatile anesthetics impair insulin secretion and glucose utilization by inhibiting ATP-sensitive $K+$ channel activity in pancreatic beta cells which may increase the plasma glucose concentration(37–39). Studies showed that propofol anesthesia inhibits the metabolic endocrine stress reaction when compared to isoflurane anesthesia during an abdominal hysterectomy(40). Central neuraxial blockade by either spinal or epidural anesthesia reduces the hyperglycemic response to different types of surgery(2,35).

In 2010 Hanss R. et al. conducted a prospective controlled randomized trial on evaluation of surgical stress test between GA and SA in patients who underwent elective urology and orthopedic surgery. They observed a higher surgical stress index in SA compared with the GA group and baseline $P< 0.001$(41).

In Iran,2014, Amiri. et al. in their randomized clinical trial on 50 patients that undergo curettage surgeries, observed that the absence of significant change in the stress response to surgery by measuring blood glucose level and hemodynamic changes between general and spinal anesthesia(27).

There are contradictory findings to the above studies that show a significant difference in stress-induced metabolic, hormonal, and hemodynamic responses in between spinal and general anesthesia.

According to a clinical prospective study done in Serbia in 2014, they found that serum cortisol levels and glycemia were significantly higher in the GA group compared to the SA group.

Supporting the above studies in 2018, Bajracharya A. et al. on prospective cohort studies found that significantly high blood glucose level in the GA group throughout the procedure and also when compared with the SA group with a p-value of less than 0.05. Their studies were on 60 patients (30 in each group) that underwent an elective surgical procedure and the blood glucose level was measured in a 15-minute interval for 1 hr.(24).

In 2018, according to a single-blinded clinical trial study that compared blood glucose level between spinal and general anesthesia on 60 non-diabetic patients that underwent cesarean section, there observed absence of significant difference in intraoperative blood glucose concentrations until the end of the surgery ($P< 0.05$)(26).

In 2019 another comparative prospective study was conducted on elective cesarean section and they measure blood glucose levels preoperatively, 5 min after induction, 5 minutes before the end of the surgery, and 30 minutes after the end of surgery. They found that the absence of statistically significant difference in the mean BGL between the two groups in T1 and T2 ($p> 0.05$) but there was statistically significantly higher in the GA group in comparison to a SA group at T3 and T4 ($p< 0.05$)(25)

The incidence of stress hyperglycemia varies depends upon the types of surgery, types of anesthesia, ethnicity, types of perioperative fluid, and the cut point of blood glucose level the researcher used for hyperglycemia(7,30,31,42). There are scarce data on the incidence of intraoperative stress hyperglycemia, most researchers focused on postoperative hyperglycemia which is common in the first 24 hrs. (15).

In 2009, Pili-Floury et al. in patients undergo knee and hip surgery under general anesthesia the incidence of perioperative stress hyperglycemia (>126mg/dl) was found to be 75%. (43) In 2015, on the same study population under spinal anesthesia, even though they include diabetic patients only 40% of them developed postoperative hyperglycemia(>140mg/dl)(10).

In 2013 in Boston, according to a retrospective cohort study on non-diabetic patients who underwent cardiac surgery 39.7% had post-operative stress hyperglycemia(44). In 2019 in Asia, on prospective cohort study on the same study population, 56% of patients developed post-operative stress hyperglycemia (9). The reason for the difference in the incidence of hyperglycemia in between these studies was thought to be genetic factors.

The hypothesis of the study

Ho: There is no significant difference in blunting stress-induced hyperglycemia between the spinal anesthesia and general anesthesia groups.

H1: There is a significant difference in blunting stress-induced hyperglycemia between the spinal anesthesia and general anesthesia groups.

3. Objective of the study

3.1. General Objective

To compare the effect of general and spinal anesthesia on perioperative blood glucose level in patients undergoing lower abdominal and pelvic surgeries at TASH from January 30, 2021, to May 20, 2021.G.C.

3.2. Specific Objective

- To compare perioperative blood glucose levels among spinal and general anesthesia groups.
- To assess the incidence of stress-induced hyperglycemia in spinal and general anesthesia groups.

4. Methods and Materials

4.1. Study Area

This study was conducted at Tikur Anbessa specialized Hospital, which is the main teaching hospital found in Ethiopia. It is also an institution that provides specialized clinical services to the whole nation. TASH is a very large referral hospital and approximately 370,000-400,000 patients are served a year. It was established in 1972 and, in 1998 it became a university teaching hospital. It has 800 beds, 12 operation theatres, annually 6000-8000 operation done, and more than 900 health professionals. It has eight major operating theater rooms and from that one is for gynecological surgery, two are for general surgery and one is for urological surgery.

4.2. Study Design and Period

An institutional-based prospective cohort study was employed from January 30, 2021, to May 20, 2021.G.C.

4.3. Population

4.3.1 Source population

All adult patients who underwent elective lower abdominal and pelvic surgery under general or spinal anesthesia at TASH, Addis Ababa, Ethiopia

4.3.2 Study Population

All adult patients who underwent elective lower abdominal and pelvic surgery under general or spinal anesthesia at TASH, Addis Ababa, Ethiopia during the study period from January 30, 2021, to May 20, 2021.G.C.

Study Variables

4.4 Study variable

4.4.1 Dependent Variables

- Blood glucose levels

4.4.2 Independent Variables

- Patient factors;
  - ✓ Preexisting patient condition and coexisting diseases
  - ✓ Patients' medication history
  - ✓ NPO time
- Demographic factor; Sex, Age, BMI
- Anesthesia-related factors; anesthetic drugs
  - ✓ Types of anesthesia
  - ✓ Induction drugs - ketamine, propofol, thiopental
  - ✓ Type maintenance agents
  - ✓ Intraoperative analgesia used – opioid, NAIDS
  - ✓ Types of perioperative fluids-N/S, R/L, DNS
  - ✓ Level of spinal sensory block
  - ✓ Adjuvant and types of local anesthetics
- Surgical factor;
  - ✓ Types of surgery
  - ✓ Duration of surgery
  - ✓ Intraoperative blood loss
  - ✓ Intraoperative blood transfusion

- **Conceptual framework**

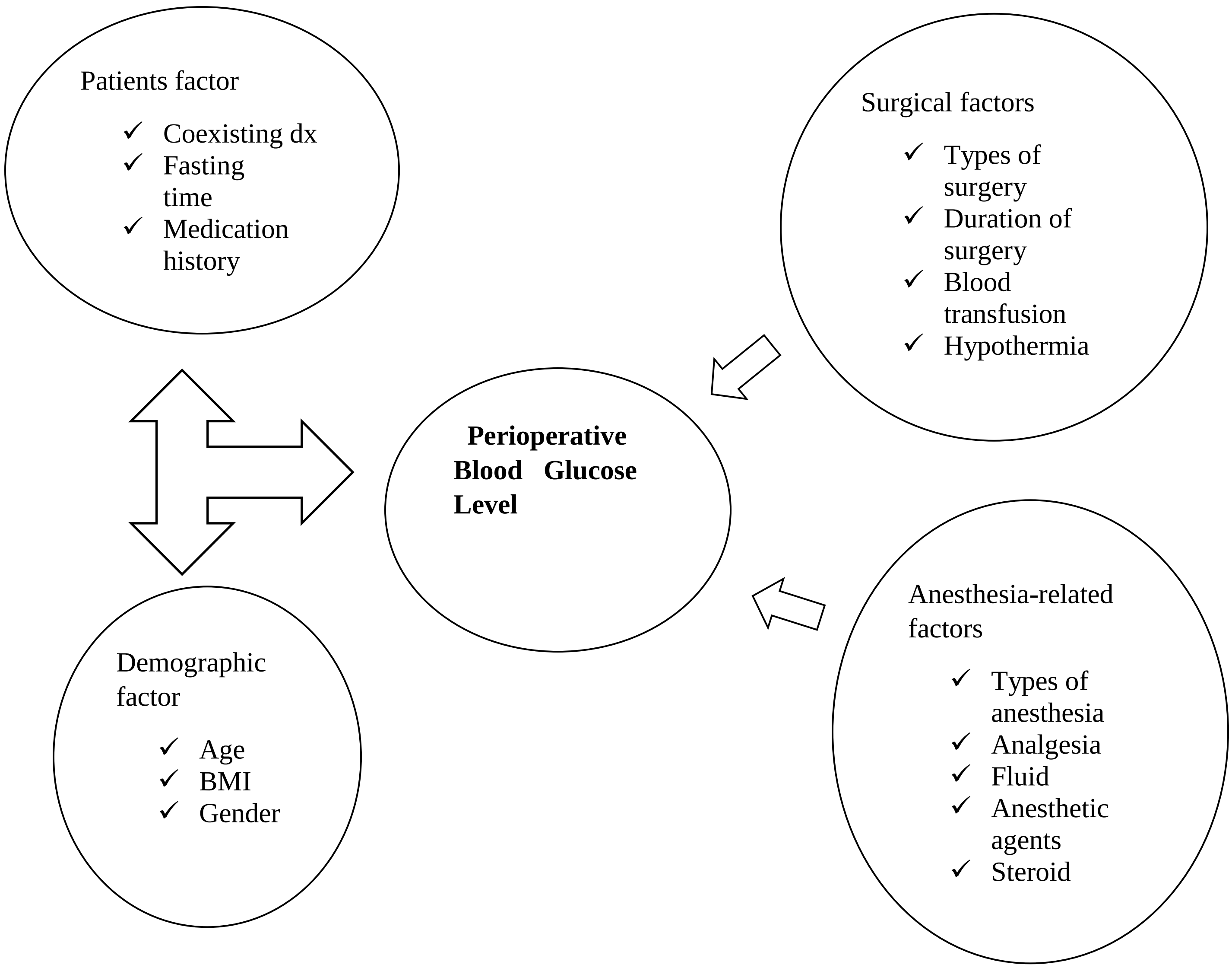


Figure 1: Conceptual framework based on factors that affect perioperative blood glucose level

4.5. Operational Definition

Surgical stress: is a systemic response to surgical injury(36)

Stress-induced hyperglycemia- any blood glucose concentration > 7.8 mmol/l (140 mg/dl) without evidence of previous diabetes(3)

Incidence of stress hyperglycemia- at least one measurement of intraoperative and postoperative stress hyperglycemia

Capillary blood glucose levels: the concentration of glucose found in blood

Difficult airway: Difficult to facemask ventilation or tracheal intubation which requires multiple attempts (45).

4.6. Inclusion and Exclusive Criteria

4.6.1. Inclusion Criteria

Non-diabetic adult patients with ASA grading of I or II without difficult airway undergoing elective lower abdominal and pelvic procedures.

4.6.2. Exclusive Criteria

Exclusion criteria include; Failed SA changed to GA, patients with cardiovascular, respiratory, endocrine, renal disease and patients taking beta-blockers, statins or steroids, patients undergoing cesarean section, chronic alcohol consumers or drug abusers, anemic patients, NPO time greater than 12 hours, patient receive perioperative nerve block and vasoactive drugs, intraoperative blood transfusion, patients with fasting blood glucose level >126; intraoperative administration of insulin or glucose will be excluded from the study.

4.7. Sample size and sampling procedure

To determine sample size(n), we used the formula for sample sizes calculation for two independent samples, continuous outcomes and we required equal sample size in both groups. According to the result from a recent study in Nepal (24), the mean blood glucose in general anesthesia is (86.32 ±12.3) and spinal anesthesia is (95.36 ±14.14) with $\mu_{1=}$ 86.32, $\sigma_{1=}$12.3 and $\mu_{2=}$95.36, $\sigma_{2=}$14.1 with an alpha error of 0.05 at a power of 80%.

$$n=\frac{(\sigma 1^{2}+\sigma 2^{2})(\mathbf{Z1}+\mathbf{Z2})^{2}}{(\mu\mathbf{1}-\mu\mathbf{2})^{2}}$$

By substituting to the formula;

$$n=\frac{(\mathbf{12.3^{2}+14.15^{2}})(\mathbf{1.96+0.84})^{2}}{(\mathbf{95.36-86.32})^{2}}$$

n =34

both groups n= 34x 2 = 68 and adding 10% contingency the final total sample size requires became 76.

Study participants were selected by using a systematic random sampling technique. According to the average number of case in our study period which is N=260 and sample size(n=76), the sampling interval was calculated as Kth = N/n= 260/76=3.4

Since the sampling interval was three, after random selection of the first study participant by lottery method, data were collected in every 3rd case from the daily schedule of elective lower abdominal and pelvic surgery based upon the planned types of anesthesia until the required sample size was fulfilled.

4.8. Data collection technique and patients

Depending on the types of anesthesia chosen, all patients scheduled for elective lower abdominal and pelvic surgery that met our inclusive criteria were included by using a systematic random sampling technique after taking their informed consent. Patients were grouped to GA or SA, based on their selected types of anesthesia.

In the GA group; following preoxygenation with oxygen, patients were induced with 5mg/kg of thiopentone, 0.1mg/kg of morphine, and 2mg/kg suxamethonium for tracheal intubation. Anesthesia was maintained with oxygen, isoflurane, and vecuronium. At the end of the surgery patients were reversed with atropine and neostigmine followed by endotracheal extubation.

In the SA group, 0.5% heavy bupivacaine was used after infiltrating the skin with lidocaine. Needle puncture was performed at L2-3or L3-4 or L4-5 interspace and the sensory block was below T6 dermatome level.

CBG was measured 4 times throughout the perioperative period. T1 preoperatively 5 minutes before induction in GA group and 5 minutes before giving spinal anesthesia as a baseline value, T2; intraoperatively after 5 minutes of induction in GA and after 5 minutes of complete block in SA, T3; immediately at the end of surgery in both groups and T4; postoperatively 60 minutes after the end of the surgery in the recovery room or ward in both groups.

During each time sample taking, the tips of the fingers of the non-dominant hand were disinfected with an alcohol swap before pricking with a lancet tip to measure the blood glucose levels.

4.9. Data Quality Control Issues

To assure the quality of data, before data collection; data collectors were trained on the objective, the significance of the study, and how and when to use measurement tools.

Before actual data collection pretest was done at Empress Zewditu Memorial Hospital on 10% of the total sample size and the result was used to check and correct for the effectiveness of the data collecting tool and questioner. Collected data were checked for completeness of the information and uncompleted data was discarded. Before and during data processing the information was rechecked for completeness, accuracy, and validity. Regular supervision and follow-up with further cross-checking of data were done.

4.10. Data processing and analysis

For analysis purposes and interpretation collected data were checked for completeness before transported to SPSS version 24 for analysis. Distributions of data were tested by the Shapiro Wilk normality test whereas, homogeneity of variance was assessed by using Levine's test for equality of variance before the data were analyzed.

Categorical data were presented by percentage and analyzed by chi-square test. Normally distributed data were presented by mean and standard deviation whereas non-normally distributed data were presented by median and interquartile range. For statistical analysis independent t-test was used to compare the mean of normally distributed data between the two groups and paired t-test was used to compare each measurement to the baseline value. Manny Whitney U test was used to compare the mean of non-normally distributed continuous data. P *v*alues <0.05 were considered statistically significant.

4.11. Ethical consideration

Before starting the study, ethical clearance and permission were obtained from the Addis Ababa University, Department of Anesthesia, and ethical clearance committee. The importance of the study was explained and verbal and written informed consent was obtained from each participant by the data collectors. There was no coercion from the data collectors to participants in the study and confidentiality of the participant's information that had been obtained in the course of the investigation was secured.

4.12. Dissemination plan

The results of the study will be presented to the department of anesthesia as part of an M.Sc. in anesthesia thesis. It may be presented at seminars, research conferences, and the annual National Conference of the Ethiopian Anesthetists Association (EAA) and may be published in journals for publishing purposes.

5. Result and Discussion

5.1. Results

A total of seventy-six patients met the eligibility criteria (thirty-eight in each group). From these, six data were excluded; three data from the GA group due to perioperative nerve block and three data from SA (one data due to intraoperative blood transfusion and two data due to intraoperative vasoactive used). Data from seventy respondents (which is of 92% respondent rate) were analyzed.

5.1.1 Socio-demographic patients characteristics

There was no statically significant difference between the two groups based on socio-demographic data like gender, age, ASA, and BMI with p> 0.05. (Table 1)

Table 1: *Sociodemographic characteristics of patients who underwent lower abdominal and pelvic surgery under general and spinal anesthesia at TASH, Addis Ababa, 2021*

Variable	GA	SA	P-Value
Age(years)	38.6± 9.67	42.74 ± 12.46	0.125[r]
BMI	21.7± 1.7	22.1 ± 1.52	0.294[r]
ASA			
I (n, %)	16(45.7%)	17(48.6%)	0.811[€]
II (n, %)	19(54.3%)	18(51.4%)	
Sex			
M (n, %)	20 (57%)	15(45%)	0.810[€]
F (n, %)	15 (43%)	16(46%)	

Hint: n (%) = number (proportion), [r] = unpaired t test, [€] = chi-square test

5.1.2. Peri-Operative patient characteristics

Perioperative characteristics on NPO time, types of surgery, duration of surgery, types of fluid, estimated blood loss and postoperative analgesia were also comparable in both SA and GA the study groups (all P > 0.05) as shown in Table 2.

Table 2: *perioperative values on NPO time, types of surgery, of surgery, types of fluid, estimated blood loss, and postoperative analgesia of patients who underwent lower abdominal and pelvic surgery under GA and SA at TASH,2021*

Variables		**GA(n=35)**	**SA(n=35)**	**p-value**
NPO#	Fasting time (hr.)	9(2)	10(2)	**0.588[a]**
Types of surgery (n, %)	General/Pelvic	9(25.7%)	7(20%)	
	Gynecological	11(31.4%)	8(22.9%)	0.487[€]
	Urological	15(42.9%)	20(57%)	
Types of fluid (n, %)	N/S	21(60%)	24(68.6%)	
	R/L	3(8.7%)	2(5.7%)	0.741[€]
	Both N/S and R/L	11(31.4%)	9(25.7%)	
Estimated blood loss#	EBL (ml)	600(200)	550(200)	**0.307[a]**
Duration of surgery	(minute)#	110(35)	110(25)	**0.621[a]**
Postoperative analgesia	NO	8(22.9%)	14(40%)	0.154[€]
	Tramadol	5(14.3%)	7(20%)	
	NSAIDS	22(62.9%)	14(40%)	

Hint: #=median (interquartile range), n (%) = number (proportion), [a] *Manny Whitney U test,* [€] *chi-square test,* ml=*milliliter, hr.=hour, N/S=normal saline, R/L= ringer lactate*

5.1.3. Comparison of blood glucose level within GA group

Comparison of blood glucose level at each time interval to the baseline value(T1) in the general anesthesia group is presented as shown in table 3.

Table 3*: Comparison of perioperative mean blood glucose in general anesthesia to baseline*

Baseline measurement (T1)	Measurement at each time	p-value
107.06 ± 11.81	109.97 ±13.46 (T2)	0.000***[b]*
107.06 ± 11.81	115.57 ± 16.6 (T3)	0.000***[b]*
107.06 ± 11.81	117.34 ± 16.79 (T4)	0.000***[b]*
	,	

*Hint: **= highly statistically significant, b = paired t - test*

5.1.4. Comparison of blood glucose level within SA group

Comparison of blood glucose level at each time interval to the baseline value(T1) in the spinal anesthesia group is presented as shown in table 4.

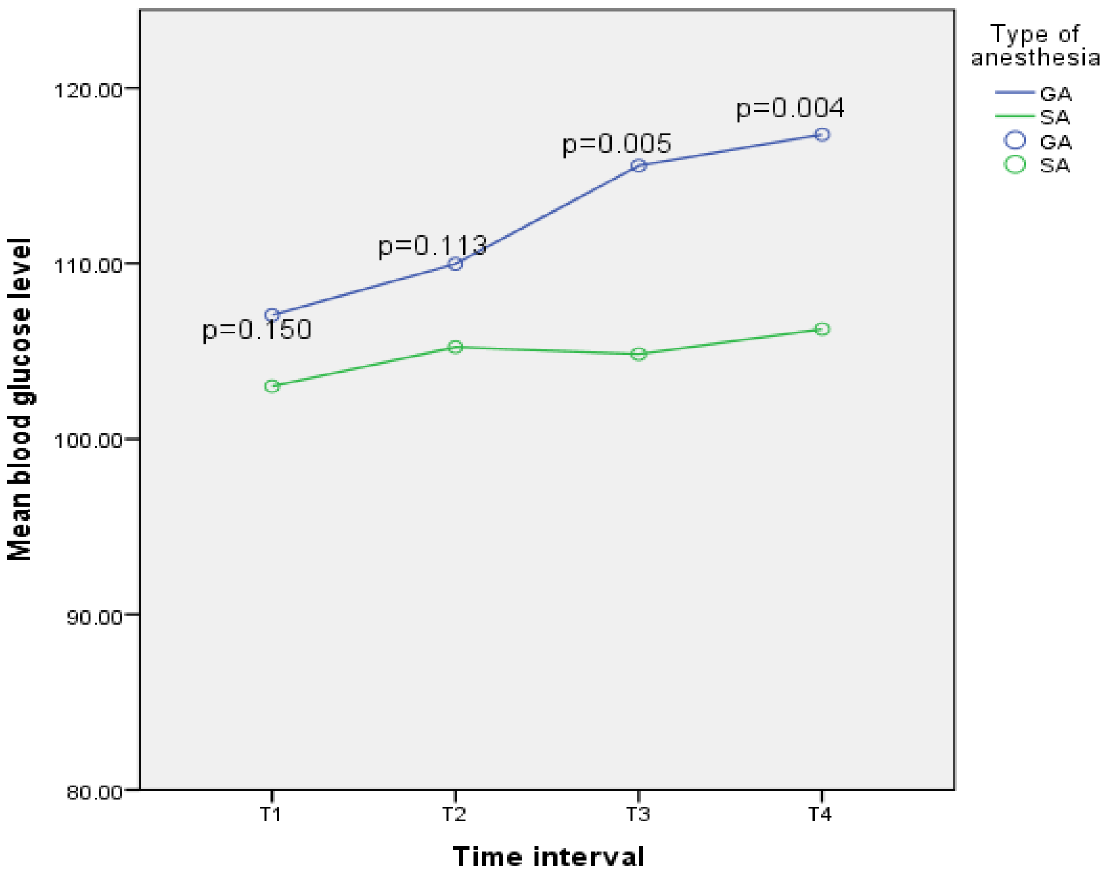
Table 4: Comparison of perioperative mean blood glucose level in spinal anesthesia to baseline *at TASH, Addis Ababa, 2021*

Baseline measurement (T1)	Measurement at each time	p-value
103.00 ± 11.48	105.23 ± 12.66 (T2)	0.046*[b]
103.00 ± 11.48	104.83 ± 14.06 (T3)	0.281[b]
103.00 ± 11.48	106.26 ± 14.57 (T4)	0.058[b]

*Hint: * = statistically significant, [b] = paired t - test*

5.1.5. Comparison of mean blood glucose level between the GA and SA groups

A comparison of mean blood glucose levels between the GA and SA groups at different time intervals is presented as shown below in figure 2.



Hint: All p values are analyzed by an independent t-test.

Figure 2: Comparison of perioperative mean blood glucose level in general and spinal anesthesia at TASH, Addis Ababa, 2021

5.1.6. The incidence of stress-induced hyperglycemia in general and spinal anesthesia

The incidence of SIH in 70 patients who underwent lower abdominal and pelvic surgery under both SA and GA was 21.4%. As Figure 3 below shows, the proportion of patients who develop SIH under GA was 34.3% compared to 8.6% under SA which was statically significant with a p-value of 0.009.

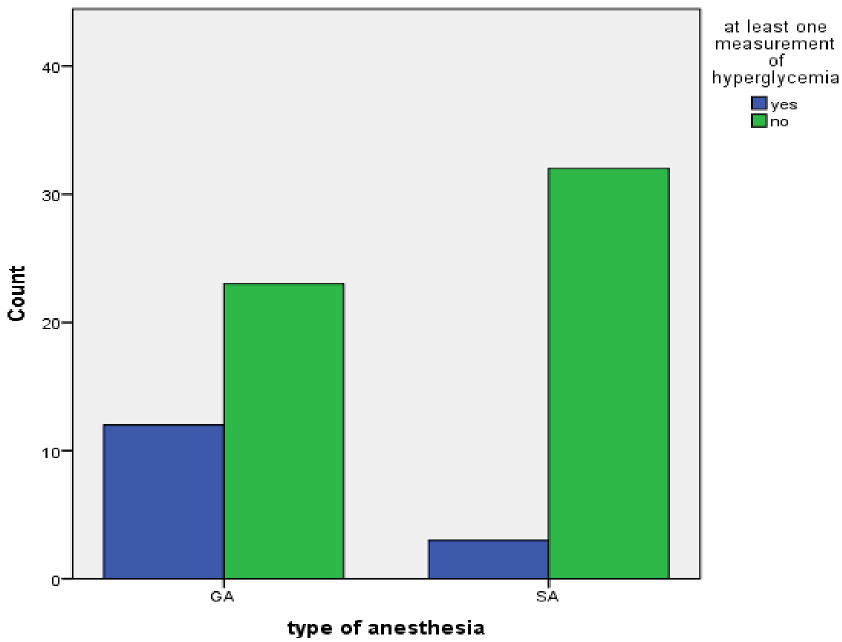


Figure 3: Incidence of stress hyperglycemia between GA and SA groups at TASH,2021

5.2. Discussion

This study compared GA with SA on a mean blood glucose level in patients undergoing lower abdominal and pelvic surgery and observed more increase in blood glucose level in patients under GA compared to SA. A significant difference was observed at the end of the surgery (T3) and one hour after the end of the surgery(T4) ($p < 0.05$). The mean blood glucose concentration at each measurement within both groups was higher than the baseline value with a statistically significant difference observed in GA groups. The incidence of SIH under GA was 34.3% compared to 8.6% under SA.

In our study, the mean blood glucose level during GA was significantly increased at each interval of time compared to baseline level(T1) with p <0. 001. The effect of types of anesthesia on blood glucose levels in patients undergoing different types of surgery has been investigated.

The result of our study is in line with a study conducted by Geisser. W et al. in patients who lower abdominal surgery under GA showed that significant increase in BGL compared to the baseline. They found a significant increase of blood glucose concentrations after 5 minutes of induction to the postoperative period with P<0. 001. They observed a 30% increment of glucose production after surgery (37). The reason for similarity could be due to the same anesthetic agent used in both studies; like in our study, they used thiopentone and isoflurane for induction and maintenance anesthesia respectively. And again, the types of surgery are almost similar.

A similar pattern of the result was obtained in a study conducted by Behdad.S et al. in 30 diabetic patients undergoing abdominal hysterectomy under GA, the BGL was significantly increased from a baseline value. Unlike our finding, a significant difference was observed after 60 minutes of the start of the surgery ($p<0.05$) (40)**.** The difference in time interval could be explained due to the difference in induction agent used for anesthesia.

In another study conducted in 2014 in Serbia, by Milosavljevic. S et al. on patients who underwent general surgery the BGL was significantly higher at 30 minutes of induction($p<0.01$). But unlike our study, the changes were not persisted and they started to decrease below baseline value without significant difference ($p>0.05$) (46).

The difference between this study and our result could be due to the difference in the types of anesthetic agents used for the maintenance of anesthesia. Unlike our study and the previous studies in which isoflurane was a maintenance agent, they used propofol as it may have less effect on glucose metabolism than inhalational anesthetics (40).

In our study on the effect of spinal anesthesia on BGL, we observed that the mean blood glucose level at each time interval was increased from the baseline value with a significant difference observed at T2(5 minutes of complete sensory anesthesia) $p=0.046$.

A similar pattern of the result was obtained in a study conducted in 2018 by Kouzegaran S.et al in patients undergoing cesarean section as they observed an increase of each measurement blood glucose level from the baseline levels (26). Unlike our study, a significant difference was observed at the immediate end of surgery with $p<0.05$. The similarity could be in both studies, the patients did not receive premedication. The time differences could be due to parturient has high risk of postoperative nausea and vomiting than surgical patients.

Contradicting our results in 2018 in a study conducted by Bajracharya A. et al. on a prospective cohort study in patients who underwent elective surgery under SA, each measurement of intraoperative blood glucose levels was slightly decreased from baseline without significant difference ($P>0.05$) (24). Supporting this finding on another study in randomized control trial on both DM and NDM patients undergoing hip surgery under SA they found an absence of significant change in blood glucose level from a baseline value (22). The possible explanation for the difference between the above-mentioned studies and our study could be due to the psychological stress response a patient can experience from fear of surgery and spinal needle prink that is pronounced in African American ethnic groups (29,47). Because unlike the other study groups in our study population, premedication was not used.

In comparing the mean BGL between the GA and SA groups, our study demonstrated that blood glucose level under GA is statically significantly higher than SA at T3 and T4 with $p<0.05$.

Contradicting our results, in a study conducted in Iran,2014, by Amiri. et al. found the absence of significant change in the mean blood glucose level between GA and SA with $p>0.05$. In this randomized clinical trial on 50 patients that undergo curettage surgeries, even though it was insignificant, they observed a decrease in blood glucose level in the GA group when compared to the SA group (27). The possible reason for this discrepancy to our result could be; one, in this study the patients were not intubated so that the laryngoscopic stimulation was absent since one cause of stress responses are laryngoscopic stimulation and endotracheal intubation (48). The other reason could be the level of spinal sensory block was limited to T10 dermatomes that could not completely abolish the neurohormonal stress response to surgery (2).

Our findings are in accordance with previous findings in 2014 by Gottschalk. A.et al. observed a significant increase in intraoperative and postoperative BGL in patients randomized to GA compared with SA(22). In this randomized control, they observed a statically significant difference at the immediate end of surgery and after 1 hr. of surgery. Although our study populations are different, we observed the same result at T3and T4.

Our findings are also directly in line with a recent comparative prospective study conducted by El-Radaideh K.et al. (in 2019) in elective cesarean section patients, as they observed a significant change in a perioperative mean blood glucose concentration between the GA and SA groups (25). The time interval used for measurement was also similar except T4. The blood glucose level at T1 and T2 was comparable, but there was a statistically significant higher mean blood glucose level in GA compared to SA at T3 and T4 (after 30-minute of end of surgery) ($P < 0.001$). Although we have different study populations, we found the same result as there were no statically significant differences in mean blood glucose level at T1and T2, $P>0.05$, and significant change at T3.

Even though the BGL could vary in both GA and SA from baseline level depending upon the anesthetic agent used and level of sensory block, when we compare the two groups, SA has less effect on stress-induced hyperglycemia. This can be explained by the fact that even if lower segment SA cannot prevent efferent adrenergic tone, it can prevent the neuroendocrine response to surgical stress (49).

Regarding the incidence of stress hyperglycemia according to our study finding the proportion of patients who develop stress hyperglycemia under GA was 34.3% compared to 8.6% under SA which was statically significant (with a p-value of 0.009). The relative risk of developing hyperglycemia under GA compared to SA was 4 (95% CI,1.235 to 12.955).

The result of our study is higher than the study conducted in 2013 by Maitra.S .et al in patients undergo major abdominal surgery under GA, the incidence of intraoperative stress-induced hyperglycemia was 29% (CBG ≥ 150 mg/dL) during surgery(14). Again, according to a study conducted in Saringcarinkul. A.et al. in patients undergo elective surgery under GA none of the patients had intraoperative hyperglycemia (>180ml/dl) (7). The differences could be due to the definition used for hyperglycemia.

In 2009, Pili-Floury et al. on a patient undergo knee and hip surgery under general anesthesia the incidence of postoperative stress hyperglycemia was found to be 75% (>126) (43). In 2015, on the same study population under spinal anesthesia, even though they include diabetic patients only 40% of them developed postoperative stress hyperglycemia (10). The difference between the two results was thought to be due to the types of anesthesia used which also confirms the difference we found between the SA and GA. Contradicting our results incidence of stress hyperglycemia was highly increased in both groups as their study only focused on the postoperative period.

The discrepancy in the incidence of stress hyperglycemia observed can be due to the invasiveness of the surgery, the cutoff point of hyperglycemia used, and also the genetic and ethnic differences between the study groups.

The associated factors of incidence SIH have been studied by researchers. According to a study conducted in patients undergoing general surgery the duration of surgery and previous history of DM were confirmed as independent risk factors for stress hyperglycemia (11). In a study conducted on NDM patients undergoing cardiac surgery, they demonstrated age, gender, BMI, comorbidities, and intraoperative blood transfusion as associated factors for postoperative hyperglycemia (9,44).

Types of fluids have also an effect on the incidence of SIH as indicated in a study in which 63% of patients received 0.45% of N/S with 5% dextrose compared to 29% of patients who received R/L developed hyperglycemia (14).

In our study, the confounding factor for the incidence of SIH was comparable between the groups as there were no significant differences in BMI, ASA, NPO time, duration and types of surgery, types of fluid, and postoperative analgesia used between the two groups.

From our results, we can accept the null hypothesis in that there is a significant difference in GA and SA in reducing the stress-induced hyperglycemia in a patient undergoing lower abdominal and pelvic procedures.

6. Strength and Limitation

6.1. Strength of our study

The two study groups were comparable in the sociodemographic and perioperative characteristics.

6.2. Limitation of the study

Because of lack of test and equipment's it was impossible to distinguish a patient with impaired glucose tolerance and stress hyperglycemia. Stress hyperglycemia is confirmed by testing glycosylated hemoglobin (HgbA1c) or the Impaired glucose tolerance test (IGT). Instead, we used preoperative hyperglycemia as exclusion criteria.

The other limitation of this study was the hemodynamic changes were not measured simultaneously with blood glucose level as surgical stress responses.

The interval of capillary blood glucose (CBG) measurement among the study populations was not constant, it can vary depending on the duration of surgery.

Our study is on elective patients undergoing lower abdominal and pelvic surgery, so the results could be different in emergency patients, in diabetic patients, patients undergoing other surgery including cesarean section.

7. Conclusion and Recommendation

7.1. Conclusion

Based on our result in patients undergoing lower abdominal and pelvic surgery, spinal anesthesia has less effect on stress-induced hyperglycemia when compared to general anesthesia.

7.2. Recommendation

From our observation, it's reasonable to recommend spinal anesthesia over general anesthesia whenever possible for patients undergoing lower abdominal and pelvic surgeries in reducing surgical stress-induced hyperglycemia. We also recommend monitoring intraoperative blood glucose levels in patients undergoing general anesthesia.

8. References

1. Burton D, Nicholson G, Hall G. Endocrine and metabolic response to surgery. Contin Educ Anaesthesia, Crit Care Pain. 2004;4(5):144–7.
2. Desborough J.The stress response to trauma and surgery. Br J Anaesth. 2000;85(1):109–17.
3. Etie S. Moghissi, Md, Facp, Face Mary T. Korytkowski. Statements ADA. American Association of Clinical Endocrinologists and American Diabetes control improve clinical outcomes for inpatients with. 2009;32(6).
4. Merila P, Huiku M, Uutela K, Gils M Van, Korhonen I, Kyma M, et al. Clinical Practice Assessment of surgical stress during general anaesthesia. 2007;98(4):447–55.
5. Desborough JP, Hall GM. Modification of the hormonal and metabolic response to surgery by narcotics and general anaesthesia. Baillieres Clin Anaesthesiol. 1989;3(2):317–34.
6. Frca JBW. Spinal anaesthesia : an update. 2005;5(2):37–40.
7. Saringcarinkul A, Kotrawera K. Plasma glucose level in elective surgical patients administered with 5% dextrose in 0.45% NaCl in comparison with those receiving lactated Ringer's solution. J Med Assoc Thail. 2009;92(9):1178–83.
8. Prete A, Yan Q, Al-Tarrah K, Akturk HK, Prokop LJ, Alahdab F, et al. The cortisol stress response induced by surgery: A systematic review and meta-analysis. Clin Endocrinol (Oxf). 2018;89(5):554–67.
9. Vikaesh Moorthy, Ming Ann Sim, et al. Risk factors and impact of postoperative hyperglycemia in nondiabetic patients after cardiac surgery. 2019;20894.
10. Jämsen E, Nevalainen PI, Eskelinen A, Kalliovalkama J, Moilanen T. Risk factors for perioperative hyperglycemia in primary hip and knee replacements A prospective observational study of 191 patients with osteoarthritis. 2015;86(2):175–82.
11. Knaak C, Wollersheim T, Mörgeli R, Spies C, Vorderwülbecke G. Risk Factors of Intraoperative Dysglycemia in Elderly Surgical Patients. 2019;16.
12. Dave JA, Engel ME, Freercks R, Peter J, May W, Badri M, et al. Abnormal glucose metabolism in non-diabetic patients presenting with an acute stroke: Prospective study and systematic review. Qjm. 2010;103(7):495–503.
13. Program OA. Importance of Perioperative Glycemic Control in General Surgery. 2013;257(1).
14. Maitra S, Pal S, Ray S, Bhattacharjee S, Kirtania J, Layek A. Intraoperative blood glucose

levels in nondiabetic patients undergoing elective major surgery under general anaesthesia receiving different crystalloid solutions for maintenance fluid. Anesth Essays Res. 2013;7(2):183.

15. Shi Z, Tang S, Chen Y, Yang J, Jiang B, Liu X, et al. Prevalence of stress hyperglycemia among hepatopancreatobiliary postoperative patients. Int J Clin Exp Med. 2013;6(9):799–803.

16. Anderson MJ. DigitalCommons @ UNMC Effects of Perioperative Hyperglycemia in Patients With Diabetes Compared to Patients Without Diabetes : A Retrospective Study of Treatment and Outcomes Effects of Perioperative Hyperglycemia in Patients With Diabetes Compared to Pat. 2019;

17. Kotagal M, Symons RG, Hirsch IB, Umpierrez GE. Perioperative Hyperglycemia and Risk of Adverse Events Among Patients With and Without Diabetes. 2015;261(1):97–103.

18. Shanks AM, Woodrum DT, Kumar SS, Jr DAC, Kheterpal S. Intraoperative hyperglycemia is independently associated with infectious complications after non-cardiac surgery. 2018;1–9.

19. Farrokhi F, Smiley D, Umpierrez GE. Glycemic control in non-diabetic critically ill patients. Best Pract Res Clin Endocrinol Metab. 2011;25(5):813–24.

20. Fiorillo C, Rosa F, Quero G, Menghi R, Battista G, Sergio D. Postoperative hyperglycemia in nondiabetic patients after gastric surgery for cancer : perioperative outcomes. Gastric Cancer. 2017;20(3):536–42.

21. Gandhi GY, Nuttall GA, Abel MD, Mullany CJ, Schaff H V., Williams BA, et al. Intraoperative hyperglycemia and perioperative outcomes in cardiac surgery patients. Mayo Clin Proc. 2005;80(7):862–6.

22. Gottschalk A, Anesthesiologist S, Rink B, Anesthesiologist S. Spinal anesthesia protects against perioperative hyperglycemia in patients undergoing. J Clin Anesth [Internet]. 2014;26(6):455–60. Available from: http://dx.doi.org/10.1016/j.jclinane.2014.02.001

23. Das W. Comparison between general anesthesia and spinal anesthesia in attenuation of stress response in laparoscopic cholecystectomy : A randomized prospective trial. 2015;9(2):184–9.

24. Bajracharya A, Sharma S, Bawa S, Rajbanshi.Comparative study of intra operative blood sugar level in spinal anesthesia and general anesthesia in. 2018;3(2):458–62.

25. El-radaideh K, Alhowary A, Alsawalmeh M, Abokmael A, Odat H, Sindiani A. Effect of Spinal Anesthesia versus General Anesthesia on Blood Glucose Concentration in Patients Undergoing Elective Cesarean Section Surgery : A Prospective Comparative Study. 2019;2019.
26. Kouzegaran S, Sarjughi H, Tanha AS. Comparing the effects of general anesthesia and spinal anesthesia on the serum level of blood sugar in patients undergoing cesarean. 2018;0(0):1–5.
27. Amiri F, Ghomeishi A, Mohammad S, Aslani M, Nesioonpour S, Adarvishi S. Comparison of Surgical Stress Responses During Spinal and General Anesthesia in Curettage Surgery. 2014;4(3):8–11.
28. Owery DAL. Ethnic Differences in Pain Tolerance : Clinical Implications in a Chronic Pain Population. 2001;323(24):316–23.
29. Price JL, Frazier IR, Lewis B, Walker R, Javors MA, Nixon J. Differences in Pituitary-Adrenal Reactivity in Black and White Men with and without Alcohol Use Disorder. 2014;140:20894.
30. Moorthy V, Sim MA, Liu W, Ti LK, Anaes M, Tsong S, et al. Association Between Ethnicity and Postoperative Hyperglycemia in a Southeast Asian Population Undergoing Cardiac Surgery. J Cardiothorac Vasc Anesth [Internet]. 2018;1–6. Available from: http://dx.doi.org/10.1053/j.jvca.2018.03.010
31. Keiichi K, Damon T, Satoru Y. et al. Ethnic differences in the relationship between insulin sensitivity and insulin response. A Systemic Review 2013
32. Cullingford DWJ. The blood sugar response to anaesthesia and surgery in. Br J Anaesth [Internet]. 1966;38(6):463–70. Available from: http://dx.doi.org/10.1093/bja/38.6.463
33. Jr SW. Ethnicity Can Affect Anesthetic Requirement. 2007;(1):4–5.
34. Reddy GVK, Rao MMM, Mahaboob S. The study of blood glucose level changes during general anesthesia in patients undergoing surgery. 2017;4(1):110–5.
35. Schricker T, Lattermann R, Schreiber M, Geisser W, Georgieff M, Radermacher P. The hyperglycaemic response to surgery : pathophysiology , clinical implications and modification by the anaesthetic technique. 1998;
36. Kehlet H. Surgical Stress : The Role Of Pain And Analgesia. Br J Anaesth [Internet]. 1989;63(2):189–95. Available from: http://dx.doi.org/10.1093/bja/63.2.189

37. Ulm U. Sevoflurane versus isoflurane — anaesthesia for lower abdominal surgery. Effects on perioperative glucose metabolism ¨. 2003;(5):174–9.
38. Tadashi Tanaka, Hideki Nabatame, and Yasumasa Tanifuji. Insulin secretion and glucose utilization are impaired under general anesthesia with sevoflurane as well as isoflurane in a concentration-. 2005;277–81.
39. Tanaka K, Kawano T, Tomino T, Kawano H, Okada T, Oshita S, et al. Mechanisms of Impaired Glucose Tolerance and Insulin Secretion during Isoflurane Anesthesia. 2009;(5):1044–51.
40. Behdad S, Mortazavizadeh A, Ayatollahi V, Khadiv Z, Khalilzadeh S. The Effects of Propofol and Isoflurane on Blood Glucose during Abdominal Hysterectomy in Diabetic Patients. 2014;311–6.
41. Hanss R, Steinfath M, Bein B, Ilies C, Gruenewald M, Ludwigs J, et al. Evaluation of the surgical stress index during spinal and general anaesthesia. 2010;105(August):533–7.
42. Clarke RSJMD, Ph D. The Hyperglycaemic Response To Different Types By. Br J Anaesth [Internet]. 1970;42(1):45–53. Available from: http://dx.doi.org/10.1093/bja/42.1.45
43. Pili-floury S, Mitifiot F, Penfornis A, Boichut N, Tripart M. Glycaemic dysregulation in nondiabetic patients after major lower limb prosthetic surgery. 2009;35:43–8.
44. Garg R, Grover A, Mcgurk S, Rawn JD. Predictors of hyperglycemia after cardiac surgery in nondiabetic patients. J Thorac Cardiovasc Surg [Internet]. 2013;145(4):1083–7. Available from: http://dx.doi.org/10.1016/j.jtcvs.2012.07.089
45. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, Nickinovich DG, et al. Practice Guidelines for Management of the Difficult Airway. Anesthesiology. 2013;118(2):251–70.
46. Sekulic AD. Influence of Spinal and General Anesthesia on the Metabolic , Hormonal , and Hemodynamic Response in Elective Surgical Patients. 2014;1833–40.
47. Wilcox S, Bopp M, Wilson DK, Fulk LJ, Hand GA. O Riginal R Eports : C Ardiovascular H Ealth. :17–24.
48. T. Pernerstorfer, P. Krafft .Stress response to tracheal intubation : direct laryngoscopy compared with blind oral intubation. 1995;50(May 1994):17–22.
49. Eugene .A, Jeffry .B et al. Effect Of Spinal anesthesia on adrenergic tone and the neuroendocrine responses to surgical stress in human. Anesthesiology 1981; 120-126.

9. Annexes

Annex I – Information Sheet

Information sheet to get permission for the research from the participants.

Title of the Research Project: Comparison of Perioperative Blood Glucose Concentration in Spinal versus General Anesthesia in a Patient Undergoing Elective Lower Abdominal and pelvic Surgery

Name of Principal investigator: Mestawet Negash (BSc in anesthesia)

Advisor's name: - Betelihem Girma (BSc, MSc lecturer in anesthesia) and

- Hirbo Samuel (BSc, MSc. lecturer in anesthesia)

Name of organization: Addis Ababa University, College of Health Science, Department of Anesthesia

Introduction:

Greetings! My name is Mestawet Negash. I am a student at Addis Ababa University Department of Anesthesia College of Health Sciences in Masters of Science (MSc) in clinical anesthesia. As part of this degree, I am undertaking a research project "Comparison of Perioperative Blood Glucose Concentration in Spinal versus General Anesthesia in a Patient Undergoing Elective Lower Abdominal and Pelvic Surgery"

Purpose of the Research Project: This study aims to identify the types of anesthetic techniques that reduce stress-induced hyperglycemia in a patient undergoing lower abdominal and pelvic surgeries in Tikur Anbessa specialized hospital. The information gained from this research will be used to make clinical recommendations that improve or avoids perioperative stress-induced hyperglycemia.

Procedure: The data collection will be conducted in Tikur Anbessa specialized hospital. The standard questioner is prepared to collect necessary information from the working anesthetist during data collection, from the monitoring device and anesthesia chart. To measure blood glucose the patient's middle finger will be prinked by a lancet (a very small needle that could not hurt) to obtain a small quantity of capillary blood for testing.

Benefits: There is no payment to be gained by taking part in this project. Participating in this research have some benefit for the patients. It gives a chance of monitoring perioperative blood glucose levels throughout the perioperative period that helps to improve anesthetic management.

Risk: No risk will face by participating in this research. The data will be collected from the card and also the sample will be taken perioperatively from the patients' fingers. It will not hurt at all; the patient just feels a small prink that will not injury or damage their finger.

Confidentiality: During data collection only, the patients' card number is registered that is only used for research purposes. Any personal information registered in the book will not be copied and transferred to other bodies. Every piece of information will be kept confidential. The thesis will be submitted to the Addis Ababa University Department of Anesthesia college of health science.

Thank you for reading the information.

Annex II - Consent form

Dear participant:

This is a study plan to assess the effect of spinal and general anesthesia on stress-induced blood glucose level by measuring capillary blood glucose level from the tip of the finger. By chance, you are selected to be a participant in this study. The purpose of this study is to identify types of anesthesia that blunt hyperglycemic response to stress which may harm the patient's outcome. To fulfill these objectives your participation in the study is crucial.

We kindly request you to participate in the study but you have a full right to accept or not. We need your consent willingly by understanding our objectives and without any external coercion. Your responses will be confidential and whenever you like you have a right to ask any question regarding the study and you have a right to quit or accept your participation.

Do you understand the advantage of the research and the roles you will have in the research?

- ☐ Yes
- ☐ No

If yes, are you willing to participate in the study?

- ☐ Yes
- ☐ No

Investigator: Mestawet Negash (BSc in anesthesia)

Tel: - +251-912-840-335

Email-Mestawetnegash2@gmail.com

Advisors:

- ❖ Betelihem Girma (B.Sc. M.Sc. lecturer in anesthesia)

  Email. Bitigirma17@gmail.com

- ❖ Hirbo Samuel (B.Sc. M.Sc. lecturer in anesthesia)

  Email. samuelhirbo1@gmail.com

Date of data collection__________

Name of data collector ___________ Signature___________

ውድ የዚህ ጥናት ተሳታፊዎች

ይህ ጥናት ታስቦ የተዘጋጀው ግማሽ እና ሙሉ አነስቴዝያ በጭንቀት በሚመጣው ከፍተኛ የደም የግሉኮስ መጠን (stress induced hyperglcemia) ላይ ያለውን ተፅእኖ ለማወቅ የታቀደ የጥናት ምርምር ነው ፡፡እርሶም እንደ እድል ሆኖ በዚህ ጥናት እንዲሳተፉ ተመርጠዋል ፡፡ውድ ተሳታፊ የዚህ ጥናት ዓላማ በታካሚው ውጤት ላይ አሉታዊ ተጽዕኖ ሊያሳድር የሚችል ከፍተኛ የደም የግሉኮስ መጠን የሚቀንስ የአንስተዚያ ዓይነቶችን ለመለየት ነው ፡፡

እነዚህን ዓላማዎች ለማሳካት በጥናቱ ውስጥ የእርስዎ ተሳትፎ ወሳኝ ነው፡፡ በጥናቱ እንዲሳተፉ በትህትና እንጠይቃለን ግን መሳተፍ አለመሳተፍ የራስዎ ምርጫ ብቻ ነዉ፡፡ ዓላማዎቻችንን በመረዳት እና ያለ ምንም ማስገደድ የእርስዎን ፈቃድ በአክብሮት እንጠይቃለን፡፡ የእርስዎ ምላሾች ምስጢራዊ ይሆናሉ እና በማንኛውም ጊዜ ጥናቱን በተመለከተ ማንኛውንም ጥያቄ የመጠየቅ መብት አለዎት እናም ተሳትፎዎን ለማቆም ወይም ለመቀበል መብት አለዎት ፡፡

ስለ ምርምሩ ጠቀሜታ እና በምርምር ውስጥ ስለሚኖራቸው ሚና ተገንዝበዋል?

☐ አዎ

☐ አይ

አዎ ከሆነ በጥናቱ ለመሳተፍ ፈቃደኛ ነዎት?

☐ አዎ   ፊርማ________________________

☐ አይደለሁም

እናመሰግናለን!

Annex III – Questionnaires

This questionnaire is prepared to compare perioperative blood glucose levels between spinal and general anesthesia in a patient undergoing elective lower abdominal and pelvic surgeries at Tikur Anbessa Specialized Hospital.

Instruction: For each of the following questions, please fill the blank space that corresponds to specific questions.

Preoperative Data

1. **Demographic Data**

   I. Card number_____________
   II. Age_____________
   III. Sex(M/F) ________
   IV. BMI _______
   V. ASA status(I/II) _____________
   VI. Fasting Time______________(hr.)

2. **Types of Planned surgery**
   I. General/ pelvic ☐
   II. Gynecological ☐
   III. Urological ☐
3. Is the patient have coexisting disease: Yes☐ No☐
   a. If yes specify____________
4. Is the patient chronic alcohol consumer; Yes☐ No ☐
5. Does the patient abuse drug Yes☐ No☐
   a. If yes specify____________
6. Does the patient have family history of DM Yes☐ No☐
7. Is a patient currently taking any medication? Yes☐ No☐
   I. Specify______
8. Premedication
   I. Benzodiazepine ☐

II. Opioid ☐

If used specify ______________

III. NSAID ☐

IV. Not used ☐

V. If other specify_____________

Intraoperative and Postoperative Data

9. Type of Anesthesia

A. GA ☐

I. Induction agent___________

II. Maintenance_____________

- ✓ Inhalation___________
- ✓ Muscle relaxant
  - o Intubation_____________
  - o Maintenance___________
- ✓ Difficult of mask ventilation
  - o Yes
  - o No
- ✓ Intubation attempt

Once☐ Twice☐ Three times☐ More than three☐

III. Analgesia

- ✓ Type______
- ✓ Dose______

B). SA

IV. Types of local anesthetics used intrathecally

1. Bupivacaine ☐

   Dose__________

2. Lidocaine ☐

   Dose_________

V. Adjuvant to LA

A. No☐

B. Yes☐ Type____________ Dose_________

VI. Level of sensory block

a. Up to T10___________

b. Up to T8_________

c. Up to T6___________

d. AboveT6__________

10. Additional drugs

No☐

Yes☐

- Type______
- Dose______
- Time ☐ preoperatively ☐ Intraoperatively ☐ postoperatively

11. Vasoactive drugs

✓ Yes☐

- Type__________
- Dose__________

✓ No☐

12. Nerve block

✓ Yes☐ Types_________

☐ preoperatively ☐ Intraoperatively ☐ postoperatively

✓ No☐

13. Types of perioperative fluid

1. R/L ☐
2. N/S ☐
3. DNS ☐

14. **Estimated Blood loss________**ml

15. Is blood transfused?

☐ Yes

☐ No

16. Is glucose administered?

☐ Yes

☐ No

17. Is insulin administered?

☐ Yes

☐ No

18. Is steroid administered?

☐ Yes

☐ No

19. Duration of surgery ____min

20. Postoperative analgesia

i. No☐

ii. Tramadol ☐

iii. NSAID ☐

iv. Opioids ☐

v. Others ☐

Perioperative (measurement)

Variables	Time(min)	Types of anesthesia	
		GA	SA
BGL (mg/dl)	Baseline T1(5 minutes before the start of anesthesia)		
	T2 (After 5 minutes of induction and complete block)		
	T3(immediately at the end of surgery)		
	T4 (60 minutes after the end of the surgery)		

THANK YOU!!