**ADDIS ABEBA UNIVERSITY**

**COLLEGE OF HEALTH SCIENCE**

# MAGNITUDE AND ASSOCIATED FACTORS OF POSTOPERATIVE HYPERGLYCEMIA AMONG ADULT PATIENTS WHO UNDERWENT ELECTIVE SURGERY AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABEBA, 2020.

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**A THESIS SUBMMITED TO DEPARTEMENT OF ANESTHESIA COLLEGE OF HEALTH SCIENCE, ADDIS ABEBA UNIVERSITY, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR MASTERS IN CLINICAL ANESTHESIA.**

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**ADDIS ABEBA, ETHIOPIA**

**ADDIS ABEBA UNIVERSITY**

**COLLEGE OF MEDICINE AND HEALTH SCIENCE**

**DEPARTMENT OF ANESTHESIA**

# MAGNITUDE AND ASSOCIATED FACTORS OF POSTOPERATIVE HYPERGLYCEMIA AMONG ADULT PATIENTS WHO UNDERWENT ELECTIVE SURGERY AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABEBA, 2020.

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**Examiner**

**Declaration**

I, the undersigned, declare that this thesis is my original work in partial fulfillment of the requirements for the Master of Science degree in Anesthesia. I understand that plagiarism will not be tolerated and all directly quoted material has been appropriately referenced

Name: Mitiku Desalegn_____

Signature; _____

Submitted to; MSc Tutor, Department of Anesthesia Addis Ababa University.

Date of Submission: _____

This thesis work has been submitted for examination with my/our approval as Advisors and Tutors on the Master of Science degree in Anesthesia

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2. _____ _____

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# Table of Contents

## List of tables

## List of figures

## Abstract

**Background:** Patients with post-operative hyperglycemia develop complications like surgical site infection, delayed wound healing and increased length of hospital stay. However, hyperglycemia in postoperative period remains high in surgical patients. This study assessed the magnitude and associated factors of hyperglycemia in postoperative period among adult patients who underwent elective surgery at Tikur Anbessa specialized hospital, Addis Abeba.

**Method:** Institutional based cross-sectional study was conducted among 282 adult patients that underwent elective surgery at Tikur Anbessa specialized hospital from January 1 to March 30, 2020. Systematic random sampling technique was used and quantitative data were collected by pre tested questionnaire through interview and data retrieval from chart. Both bivariate and multivariable logistic regression analysis were done to evaluate the association between independent and dependent variable. Level of statistical significance was declared at p-value less than 0.05.

**Result:** This study revealed that 126(44.7%) of patients developed postoperative hyperglycemia. Age group of 41-60 [AOR=11.2.; 95%CI :( 2-24.5)] and age group >60 [AOR=12.3; 95%CI :( 4.5-33.3)], ASA class III [AOR=6.3; 95%CI :( 1.4-27)], General anesthesia [AOR=5.6; 95%CI :( 1.3-24)], History of hypertension [AOR=8.4; 95%CI :( 1.26-47)] showed statistical association with post-operative hyperglycemia.

**Conclusion and recommendation:** Magnitude of hyperglycemia is higher in postoperative period. Age, ASA class, type of anesthesia and history of hypertension were identified predictive factors. Anesthesia and surgical staffs must develop local protocol or adopt protocol to treat post-operative hyperglycemia and factors associated with post-operative hyperglycemia should be identified a head of surgery.

**Key words:** Elective, Hyperglycemia, Tikur Anbessa specialized hospital.

## Abbreviations/Acronyms

**ASA:** American Society of Anesthesiologists

**AMI:** Acute myocardial infarction

**BMI:** Body mass index

**CBG:** Capillary blood glucose

**CI:** Confidence Interval

**DM:** Diabetes mellitus

**EC:** Ethiopian Calendar

**FBS:** Fasting blood sugar

**FMOH:** Federal ministry of health

**HgA1c:** Glycated hemoglobin

**ICU:** Intensive care unit

**LEB:** Lower extremity bypass

**PI:** Principal investigator

**PACU:** Post anesthesia care unit

**SPSS:** Statistical Packages for Social Science

**SD:** Standard deviation

**SBP:** Systolic blood pressure

**TASH:** Tikur Anbessa specialized hospital

**WHO:** World Health Organization

# 1. Introduction

## 1.1. Background

These days the practice of surgery in developing countries has increased relative to developed countries. From all performed major surgical procedures Cesarean section was widely practiced surgery in both low income and high income areas (1). In Ethiopia the most commonly performed procedures are emergency surgery usually related with trauma, late presentations and obstetric complications (2). A number of surgical procedures are performed annually in United States with the incidence of 30 days postoperative complications ranging from 5.8% to 43.2% in general surgical patients (3).

Hyperglycemia and glucose intolerance are common after acute trauma, injury and illness in both diabetic and non-diabetic patient(4). Surgical trauma result commonly in a postoperative insulin resistance and increase in a plasma level of corticosterone (5). Related to surgical stress, it has been well established that stress hormones are released into the circulation, which are associated with altered insulin and glucose metabolism. Glucogenic catecholamine exert effects by inhibiting insulin secretion and augmenting hepatic glucose output by stimulating gluconeogenesis and glycogen lysis (6).

Perioperative hyperglycemia is a common outcome with reported prevalence between 20-40% of patients undergoing general surgery (7, 8) and approximately 80% of patients after cardiac surgery(9, 10). The 7.8 mmol/L cut off point was based on the definition of hyperglycemia by the American Diabetes Association (2013). Glucose > 10 mmol/L (later referred to as “severe hyperglycemia”) is considered to be the threshold for treating hyperglycemia (American Diabetes Association 2013).

The American Association of Clinical Endocrinologists (AACE) and ADA have developed consensus statement on inpatient glycemic control that defines hyperglycemia as any BG value >140mg/dl without evidence of previous diabetes (11). Hospital related hyperglycemia, according to the ADA consensus definition is fasting glucose >6·9 mmol/L or random glucose >11·1 mmol/L without evidence of previous diabetes, and preexisting diabetes with deterioration of pre illness glycemic control (12).

Post-operative hyperglycemia is strongly associated with surgical site infection, mortality rate, hospital stay and cost. Continuous insulin infusion in post-operative period significantly reduced these adverse outcomes in cardiac surgical patients (13).

## 1.2. Statement of problem

The prevalence of hyperglycemia in general hospitalized patient is 35% with increased morbidity and mortality. Despite of high prevalence of hyperglycemia in inpatients there is clear lack of screening, treatment and long term follow up is observed specially in non-diabetic patients (14). Elevated blood glucose level have harmful effect on patients secondary to increased morbidity and mortality. Study in cardiac, general surgery and ICU patients have shown a clear association between inpatient hyperglycemia (>180 mg/dL, 10 mmol/l) and adverse clinical outcomes including surgical site infections, delayed wound healing and increased length of stay (7, 10, 15).

Study shows, perioperative hyperglycemia is associated with wound infection, skin infection, urinary tract infection, myocardial infarction, pneumonia and acute renal failure in non-cardiac surgery. Post-operative Mortality rate in perioperative hyperglycemic patient is higher in non-diabetic patient compared to diabetic patient during admission (7). In a patients who under took liver transplantation, hyperglycemia during the first week post transplantation is associated with mortality among patients without diabetes, this association not being found among those previously diagnosed with diabetes (16).

On procedure of exploratory laparotomy, open cholecystectomy and laparoscopic cholecystectomy, the prevalence of postoperative infection on hyperglycemic patient was significantly higher compared to norm glycemic patients on post-operative period (17). Retrospective study at Assela teaching referral hospital identified diabetes mellitus as one of the risk factor for surgical site infection among obstetric patients (18). Evidence from general and vascular surgery patients show post-operative hyperglycemia is one of the most important risk factor for postoperative surgical site infection (19).

Accumulation of brain cell metabolic by products may result in brain tissue acidosis. In severe hypoxia, hyperglycemia results in accumulation of lactic acid in brain cell through anaerobic glycolysis and this promote formation of free radicals and peroxides. In severe condition, results in neuronal injury and irreversible damage (20).

Study done on a colenectomy shows there is association between postoperative hyperglycemia and morbidity. Post-operative day 1 hyperglycemia was independently associated with 2 fold increase in risk of death, cardiac arrest and venous thrombo-embolism. This outcome was similar between diabetic and non-diabetic patients (21). Evidence from black lion specialized hospital shows the incidence of post-operative surgical site infection was 17.9% and identified perioperative hyperglycemia as one of the risk factor (22).

There are different protocols to control blood glucose level, but each are based on frequent blood glucose monitoring and insulin infusion. Insulin infusion in postoperative period for hyperglycemic patient showed less wound site infection on both diabetic and non-diabetic patients after lower extremity bypass surgery (23). A study showed, a bolus of subcutaneous insulin for a patient having post-operative hyperglycemia after knee and hip arthroplasty have showed improved outcome on both diabetic and non-diabetic patients. None of the patients have developed peri prosthetic joint infection and none of the patients have developed hypoglycemia as well (24).

A study done on gynecologic oncology surgical patient showed postoperative intensive glucose control in a patient with DM and hyperglycemia reduced the incidence rate of surgical site infection by 35%compared to patients receiving intermittent sliding scale insulin and to a rate equivalent to non-diabetics (25). Evidences show many factors are associated on incidence of post-operative hyperglycemia. History of hypertension, obesity, history of DM, age, prolonged procedure, and intraoperative infusion of catecholamine and intraoperative use of steroids are the main predictors of postoperative hyperglycemia (26-28).

### 1.3. Justification

Evidences show health professionals attitude to screen out and start therapy for hyperglycemia is low and neglected unless the patient is previously diagnosed with diabetes mellitus (29). Previously, it was considered transient hyperglycemia in critically ill patient is without consequence even considered as advantageous, but evidences show there is clear mortality and morbidity benefits from tight glycemic control of glucose level with insulin therapy in critically ill ICU patient irrespective of whether the patient is diabetic or non-diabetic (30).

Recent evidence shown non-diabetic patient with post-operative hyperglycemia are twice risk of surgical site infection (SSI), reoperation, increased cost, prolonged hospital stay and death

compared to previously diagnosed diabetic patients(31). One retrospective study shows, stress induced hyperglycemia in hospitalized critical patient has an incident with a development of type II diabetes mellitus following hospital discharge (32). Some institutions have developed protocols to treat post-operative hyperglycemia irrespective of patients are diabetic or non-diabetic(23, 24).

In Ethiopia, during my search there was no evidence that shows the magnitude and associated factors for postoperative hyperglycemia in general operated patients in immediate postoperative period. The available evidences on postoperative hyperglycemia were done in different set up and population which will possibly have an effect on the magnitude and associated factors. Results from this study may assist in identifying characteristics that place a patient at risk for high BG post-surgery, thus allowing targeted steps to be taken to improve the quality of care delivered to postsurgical patients. It will help responsible stake holders to develop protocol to manage postoperative hyperglycemia or adopt guidelines from other country and develop local protocol.

# 2. Literature review

## 2.1. Definition and mechanism of post-operative hyperglycemia

Hyperglycemia is a condition manifested by elevated glucose level in the circulation. It is not a disease entity by itself and may be caused by several factors including diabetes mellitus or pre-diabetic state, inflammation, tissue injury, acute illness and drugs (11, 12, 33). Hyperglycemia, often caused by surgery, is defined as fasting BG >140mg/dl without evidence of diabetes in preoperative period.

Moreover, surgery can induce profound hyperglycemia in patients with or without diabetes due to the disruption of glucose metabolism by activating the endocrine system, causing increased hepatic glucose production and inhibition of insulin secretion and action (34, 35). Post-operative hyperglycemia is characterized by the presence hyperinsulinemia, peripheral resistance to insulin and an over-production of glucose by various endogenous and exogenous mechanisms that result in incremented glycogen lysis and increased gluconeogenesis (36).

The endocrine system activation also causes an increased release of catecholamine (such as epinephrine and nor epinephrine) and cortisol, which further alter glucose metabolism, leading to hyperglycemia. Synthetic catecholamine such as epinephrine and norepinephrine might also elevate glucose levels and worsen the stress response, further increasing BG level (37).

## 2.2. Magnitude of postoperative hyperglycemia

On a study done to determine the relationship of perioperative hyperglycemia and insulin administration on outcomes in elective colon/rectal and bariatric operations in USA, university of Washington, postoperative day 1 and postoperative day 2 hyperglycemia incidence was 29.1% (38).

According to Esa jamsen et al, prospective observational study done, in Tampere university hospital, Finland between Dec.2009 and May 2011 on 191 patients who undergone hip and knee replacement surgery, they have found 46% of patients developed hyperglycemia and from those 25% had severe hyperglycemia in postoperative period (39).

Study done by V.R. Pereira et al. at university of Sao Paulo in 837 patients show the incidence of postoperative hyperglycemia was 26.4%.(28) Prospective study done by V. Moorthy et al on 1602

non diabetic patient who undergone cardiac surgery in Singapore general hospital, Singapore found out 56.1% developed postoperative hyperglycemia (40). Prospective observational study done by V.K. Singh1et al in India among 157 hip fractured patients, the incidence of stress hyperglycemia was 47.89% and among those patient the incidence of acute myocardial infarction was 62.67 % (41).

In another observational prospective study conducted in Iran Tabriz university on 282 non diabetic patients who undergone cardiac operation, the prevalence of at least one episode of severe hyperglycemia was 54.6%. Frequency of postoperative hyperglycemia was higher relative to intraoperative period (42). According J P Ghildiyal1 et al conducted prospective study in on 101 patients who undergone exploratory laparotomy, open cholecystectomy and laparoscopic cholecystectomy, the prevalence of perioperative hyperglycemic was 56.4% (17).

### 2.3. Associated factors of postoperative hyperglycemia

A case control study comparing the incidence of hyperglycemia after perioperative administration of 8mg of dexamethasone between diabetic and non-diabetic patient who underwent laparoscopic surgery, blood glucose level observed at 30min and 120min marks were statistically significant relative to the pre-induction blood glucose (26).

Randomized controlled study done by M. Tien et al, comparing the effect of anti-emetic doses of dexamethasone and ondasteron on postoperative blood glucose levels in non-diabetic and diabetic patients, predicted the maximum increase in 24-h postoperative blood glucose to be 1.9 mmol.l1 (95% CI: 1.0–2.9) higher in patients receiving dexamethasone compared with patients receiving Ondasteron (43).

Study comparing intraoperative blood glucose level changes between obese and non-obese non-diabetic patients undergoing general anesthesia for craniotomy surgeries, change in CBG increase gradually with the duration of surgery. At 120minutes CBG increase in non-obese population was 21.17% from baseline while in obese population was 32.63% from baseline and the results were statistically significant (27).

According to prospective cohort study done by Latham et al, on a patient who undergone cardiothoracic surgery, having diabetes (OR 2.76, $p<0.001$) and postoperative hyperglycemia (OR

2.02, p= 0.007) was independently associated with the development of surgical site infection, including mediastinitis, chest wound infections, saphenous vein harvest site infection, or combinations of the above (44). In a retrospective study conducted by Knapik et al, involving 814 patients undergoing first-time coronary artery surgery, difficult postoperative glycemic control was significantly associated with the female sex (OR 2.36) and history of diabetes (OR 2.22) (45).

In another study by Reyes et al, conducted a retrospective cohort study examining the relationship between BG level and length of stay in 398 comparing diabetic and non-diabetic cardiac surgery patients, they found that higher preoperative and post-operative BG levels were associated with an increased body mass index (BMI) ($p<0.001$ and $p= 0.001$) (46).

On a study conducted to investigate the effect of age on blood glucose, insulin and cortisol response after mild to moderate trauma, researchers have found increasing age may also contribute to hyperglycemia due to changes in carbohydrate metabolism (47).

Study done by V.R. Pereira et al. at university of Sao Paulo in 837 patients have found, age (OR=1, 95% CI 1.0-1.4); BMI (OR=1.052, 95% CI 1.0-1.1); duration of surgery (OR=1.011, 95% CI 1.0-1.7), history of hypertension (OR=1.6, 95% CI 1-2.1), and intraoperative use of corticosteroids (OR = 5.465, 95% CI 3.4-8.7) were independent risk factors for postoperative hyperglycemia (28).

Esa jamsen et al, done prospective observational study, higher ASA score (III and IV) in a patient preoperatively diagnosed with DM (32/38 vs. 7/15; adjusted OR = 6 (1.3–31)) and in patients with HbA1c ≥ 6.5% (24/25vs.3/7; adjusted OR=10 (1.3–82)) had strong association with postoperative hyperglycemia. HbA1c>6.5% and baseline glucose (>7mmol/l) have strong association with hyperglycemia in a patient preoperatively non-diabetic (39).

Prospective study done by V. Moorthy et al on 1602 non diabetic patient who undergone cardiac surgery, BMI (odds ratio [OR] 1.052, 95% confidence interval [CI] 1.025–1.08, P<.001), age (OR 1.0, 95% CI 1.019–1.0, P<.001), and intraoperative blood transfusion (OR 1.0, 95% CI 1.3–2.2, P<.001), were identified as independent risk factors for postoperative hyperglycemia (40).

## 2.4. Conceptual frame work

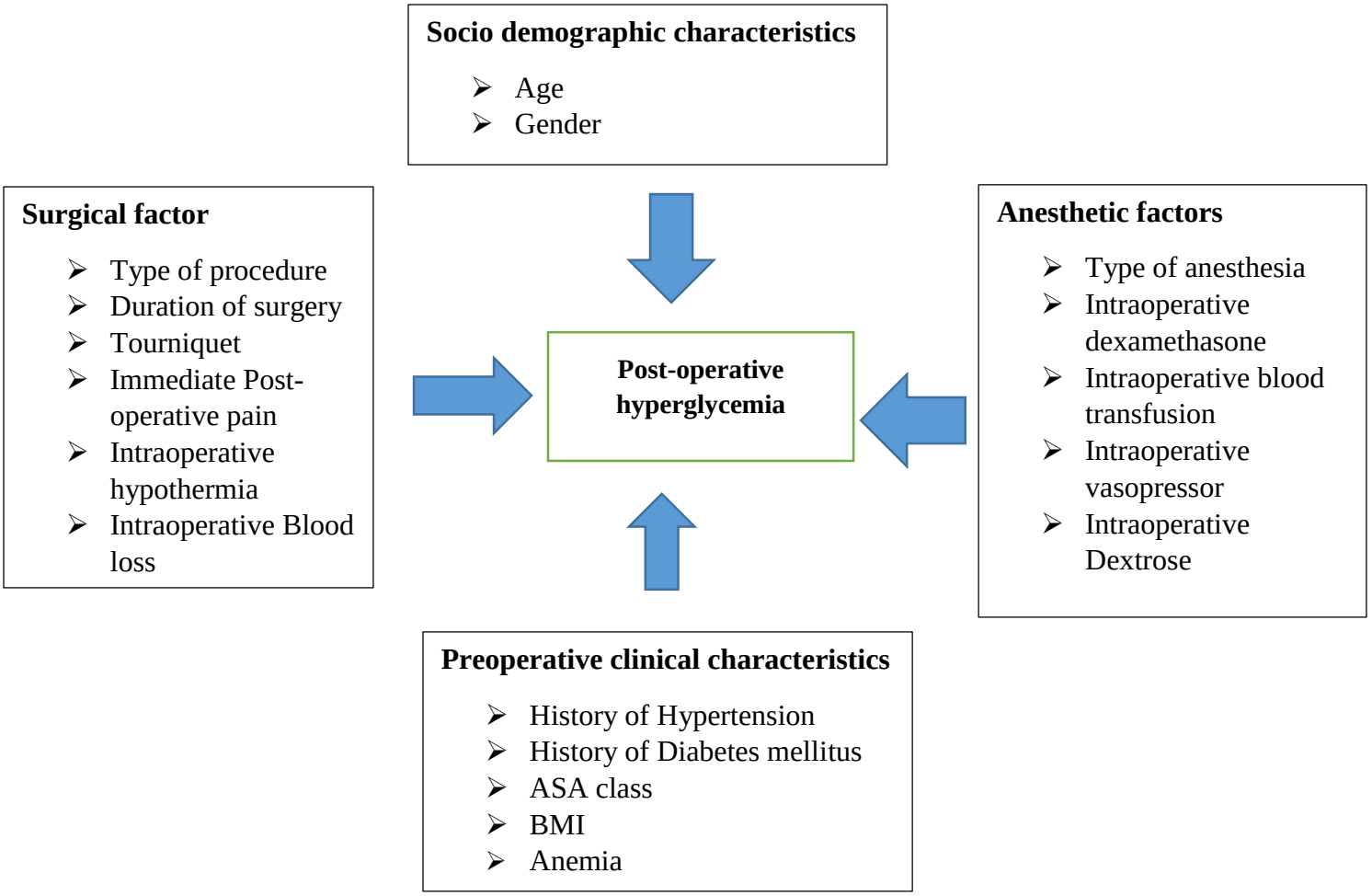


*Figure 1: Conceptual frame work of factors associated with post-operative hyperglycemia for patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, to March 30, 2020.*

# 3. Objective

## 3.1. General objective

- To assess the magnitude and associated factors for postoperative hyperglycemia among adult patients who underwent elective surgery at Tikur Anbessa specialized hospital, from January 1, to March 30, 2020.

## 3.2. Specific objectives

- To determine the magnitude of postoperative hyperglycemia among adult patients who underwent elective surgery.
- To identify associated factors of postoperative hyperglycemia among adult patients who underwent elective surgery.

# 4. Methods and materials

## 4.1. Study area

The study was conducted at Tikur Anbessa specialized Hospital (TASH) in Addis Ababa, the capital city of Ethiopia. Addis Abeba, with an area of 527 square kilometers and 10 sub cities, it is the largest city in the country. The city has 12 government hospitals. Tikur Anbessa specialized hospital is multi-specialist tertiary care teaching hospital in Ethiopia, opened since 1972 and, in 1998 transferred to school by FMOH since then it became a university teaching hospital. TASH is now the main teaching hospital for clinical and preclinical trainings of most disciplines. It is also an institution where specialized clinical services that are not available in other public or private institutions are rendered to the whole nation. It offers diagnosis and treatment for approximately 370,000- 400,000 patients a year with nearly 6000-8000 surgeries performed annually with 14 operation rooms (OR).

## 4.2. Study design and study period

- An institutional based cross sectional study was conducted from January 1, to March 30, 2020.

## 4.3. Source population

- All adult patients who underwent elective surgery at Tikur Anbessa specialized hospital.

## 4.4. Study population

- All eligible adult patients who underwent elective surgery at Tikur Anbessa specialized hospital during study period.

## 4.5. Study participants

- Selected adult patients who underwent elective surgery at Tikur Anbessa specialized hospital during study period.

## 4.6. Inclusion and exclusion criteria

### 4.6.1. Inclusion criteria

- All adult patients admitted to PACU

### 4.6.2. Exclusion criteria

- Baseline hyperglycemia or hypoglycemia

- Confirmed pregnancy

## 4.7. Study variables

### 4.7.1. Dependent variable

- Post-operative hyperglycemia- Yes/No

### 4.7.2. Independent variables

**Socio demographic characteristics**

- Age
- Gender

**Preoperative clinical characteristics**

- BMI
- History of Hypertension
- History of Diabetes mellitus
- ASA class
- Anemia

**Anesthetic factors**

- Type of anesthesia
- Intraoperative dexamethasone
- Intraoperative vasopressor
- Intraoperative blood transfusion
- Intraoperative 40%dextrose

**Surgical factors**

- Type of surgery
- Duration of surgery
- Intraoperative hypothermia
- Immediate post-operative pain
- Intraoperative blood loss
- Tourniquet

## 4.8. Sample size and sampling procedure

### 4.8.1. Sample size calculation

The sample size was determined using the single population proportion method for the first objective which is magnitude of postoperative hyperglycemia after elective surgery.

Since no related study was found in Ethiopia and Africa, P=0.5 was used for calculation to get maximum sample size, 95% level of significance, 5% margin of error and 5% for incomplete or as contingency data was used as parameters.

$$n = \frac{(z_{\alpha/2})^2 \times (p \times q)}{d^2}$$

$$n = \frac{1.962^2 \times (0.5 \times 0.5)}{0.05x0.05}$$

$$n = 384$$

By using correction formula for finite population since source population were less than 10,000

nf= n/1+n/N= 384/1+384/900= **269**. Adding 5% contingency= **282**

nf= Final sample size

n= sample size

N= total number of patients who undergone elective operation

### 4.8.2. Sampling procedure

Systematic random sampling method was used. Potential study subjects were all patients scheduled for elective surgery and their name selected and included in the surgery list. A list of all adult patients scheduled for elective surgery was collected from the theatre lists submitted to operating theatre by different surgical specialties a day prior to the scheduled surgical procedures.

After Situational analysis was done for 3 months before the start of the study, an average of 300 elective surgery are found to be done per month. So the number for 3 month is 900. K was determined using the formula: K=N/n; where, n = total sample size, N = population per 3 months. K=900 /282 ≈3. Therefore, the sampling interval was three and the first study participant (random start) was selected using lottery method from the daily surgery list. Each day before elective surgery begun patients were selected by systematic random sampling technique.

Then, every third cases from the daily surgical procedures were included in the study during the study period. The intention to include them in the study, the aim and benefit of the study, the data collection procedures were explained. A preliminary assessment whether the patient fulfills the inclusion criteria was made and those who met the inclusion criteria are included. This procedure was repeated in each day of data collection till the required sample size attained.

### 4.9. Data collection tool and procedure

Data was collected using structured pretested standardized questioner by data collectors from January 01, to March 30, 2020. Questions in the questioner include socio demographic data, Clinical patient characteristics and different surgical and anesthetic variables. Socio demographic and preoperative clinical data were extracted from patient's record on the morning of surgery. Intraoperative Anesthetic and Surgical data were collected from intraoperative anesthesia chart. Data was collected by four trained anesthetists, this was done on the morning of surgery, in intraoperative period and immediately after surgery at PACU and this continues until the desired number of patients are achieved for each surgical type.

Immediately, after the patient transferred to PACU, the data collector records fasting blood glucose level after the PACU nurse took and record it on the chart. The glucometer used at PACU to check for capillary blood glucose by PACU nurse was hemocue201 glucose analyzer which is based on glucose dehydrogenase method. The completeness of data was checked by principal investigator every day.

### 4.10. Data quality assurance

To assure the quality of data, training on the objectives and relevance of the study and brief Orientations on the assessment tools were provided for data collector. The questionnaire were prepared in English and pretested on 5% of the study population in Tikur Anbessa specialized hospital. The result of the pretest weren't included in the final analysis. During data collection, each questioner was revised by the investigator for being complete and appropriate. In case of missed measurement during intra-operative period, electronic data store were recalled and back traced and data was filled.

## 4.11. Data processing and analysis

At the end of each day data completeness were checked to ensure correctness and enable retrieval of any missing information. Data were coded, edited and then entered and cleaned using Epi Info version 7 and exported to Statistical package for Social Sciences (SPSS) software version 20.0.

Descriptive analysis were done and the population described by summarizing socio demographic data into means or medians for numeric variables such as age and percentage for categorical variable such as gender. Bivariate and multivariable logistic regression analysis were done to determine presence of associations between dependent and independent variables, and odds ratio with 95% confidence intervals were used to determine the degree of association between dependent and independent variables.

The prevalence was calculated as proportion of patients with postoperative hyperglycemia with 95% confidence interval. Variables with a p-value less than 0.25 in the bivariate logistic regression analysis were considered for multivariable analysis. After checking for multicollinearity, multivariable analysis were performed to adjust for possible confounders and to come up with significant predictors. All the statistical tests were performed at 5% significance level. Both crude and adjusted odds ratio with 95% confidence interval were reported. The results were presented by using text, tables, charts and graph.

## 4.12. Operational definition

- **Hyperglycemia:** Subjects with abnormally high blood glucose level or fasting blood sugar above 140mg/dl for non-diabetic and above 200mg/dl for diabetic (12).
- **Hypoglycemia:** Blood glucose level below 70mg/dl (12).
- **American Society of Anesthesiologists (ASA) physical status classification**: Classification developed by the ASA taskforce which classify patients according to their physical status (systemic well-being). The classification is on annex.
- **Baseline value:** Measurement taken before induction of anesthesia
- **Elective surgery:** Non-emergency surgery which is planned, allowing the doctor and the patient the best time and place for it.
- **Emergency surgery:** Surgery that cannot be delayed, for which there is no alternative therapy and a delay.

- **Preoperative:** The time that extends from decision to have surgery to induction of anesthesia.
- **Intraoperative:** The period that extends from induction of anesthesia until the patient is transported to PACU.
- **Postoperative:** Period after the patient is transferred to PACU.
- **Perioperative:** the period comprises all the three periods (preoperative, intraoperative and postoperative).
- **Body mass index:** A measure of body fat based on weight and height that applies to adult men and women. The classification is on annex.
- **Hypothermia:** Core body temperature below 36 degree Celsius.(48)
- **Anemia:** Hemoglobin below 13.6g/dl for male and 11.7g/dl for female.(39)
- **Immediate post-operative period:** The time that extend from patient admission to PACU until the first vital sign and blood glucose level is taken by a nurse.
- **Confirmed pregnancy:** Pregnancy confirmed by pregnancy tests.
- **Duration of surgery:** The time that extends from surgical incision to end of surgery ( skin closure)

### 4.13. Ethical consideration

Ethical clearance was obtained from the university ethical clearance committee before commencement of the study. A legal letter was also submitted to Tikur Anbessa specialized (TASH), where the study was take place. Verbal informed consent was obtained from all selected patients after full explanations of the goals and procedures of the study. After taking permission from the hospital and study participant the data collection was conducted.

### 4.14. Result dissemination plan

The copy of the research will be submitted to Addis Ababa University College of health science, Addis Ababa city health bureau and student research office. The result will be presented to department of Anesthesia as a part of MSc. in advanced clinical anesthesia thesis, communicated through annual students/staff research conference and annual national conference of Ethiopian Anesthetist association. Moreover, efforts will be done to publish the findings of the study.

# 5. Result

## 5.1. Socio demographic and preoperative clinical characteristics of patients

A total of 282 patients data were collected during the study period with response rate of 100%. The mean age of patients was 44.2 with ±15 standard deviation. The total number of female 140(49.6%) patients included in the study were almost near to males 142(50.4%). Majority (46.1%) of patient's age was found in 18-40 age group followed by age group 41-60 (36.9%) and the rest are above 60 years. With regard to American society of anesthesiologist (ASA) status, most of the patients were under ASA class I (47.5%) and ASA class II (44%), only 8.5% of patients were class III.

*Table 1: Socio demographic and preoperative clinical characteristic of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, to March 30, 2020. (n=282)*

| ***Variables*** | ***Category*** | | ***Frequency (%)*** |
|---|---|---|---|
| Gender | Male | | 142(50.4) |
| | Female | | 140(49.6) |
| Age | 18-40 | | 130(46) |
| | 41-60 | | 104(36.8) |
| | >60 | | 48(17.2) |
| ASA status | Class I | | 134(47.5) |
| | Class II | | 124(44) |
| | Class III | | 24(8.5) |
| BMI | <25 | | 260(92.2) |
| | 25-29 | | 15(5.3) |
| | >29 | | 7(2.5) |
| Co-existing disease | History of Diabetes mellitus | Yes | 11(3.9) |
| | | No | 271(96.1) |
| | History of Hypertension | Yes | 10(3.5) |
| | | No | 272(96.5) |
| | | Yes | 91(32.3) |

| | | | |
|---|---|---|---|
| | Anemia | No | 191(67.7) |

## 5.2. Anesthetic and surgical characteristics of patients

Of the total, majority of patients underwent surgeries under General anesthesia 192 (68.1%), the rests underwent under Regional anesthesia 46(16.3%) and Combined General-regional anesthesia 44 (15.6%). Majority of procedures took more than 60 minutes of duration 228(80.9%) and from the total procedures tourniquet applied only in 2 surgery. In the intraoperative period, 218 (77%) of patients developed at least one episode of hypothermia. Of total, 100(35.5%) of patients lost greater than 300ml of blood during intraoperative period and the rest of patients lost ≤300ml of blood. Numeric rating scale of pain was used during immediate post-operative period, of which 265(94%) of patients developed mild pain and the rest didn't show any sign of pain.

*Table 2: Anesthetic and surgical characteristic of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, to March 30, 2020. (n=282)*

| ***Variables*** | ***Category*** | ***Frequency (%)*** |
|---|---|---|
| Type of anesthesia | Combined | 44(15.6) |
| | Regional | 46(16.3) |
| | General | 192(68.1) |
| Duration of surgery | ≤60min | 54(19.1) |
| | >60min | 228(80.9) |
| Tourniquet applied | Yes | 2(0.7) |
| | No | 280(99.3) |
| Intraoperative dexamethasone administered | Yes | 32(11.3) |
| | No | 250(88.7) |
| Intraoperative vasopressor administered | Yes | 30(10.6) |
| | No | 252(89.4) |

| | | |
|---|---|---|
| Intraoperative 40% dextrose administered | Yes | 15(5.3) |
| | No | 267(94.7) |
| Intraoperative blood transfusion any | Yes | 50(17.7) |
| | No | 232(82.3) |
| Intraoperative hypothermia | Yes | 218(77) |
| | No | 64(23) |
| Intraoperative blood loss | ≤300ml | 182(74.5) |
| | >300ml | 100(25.5) |
| Immediate postoperative pain | Yes | 265(94) |
| | No | 17(6) |

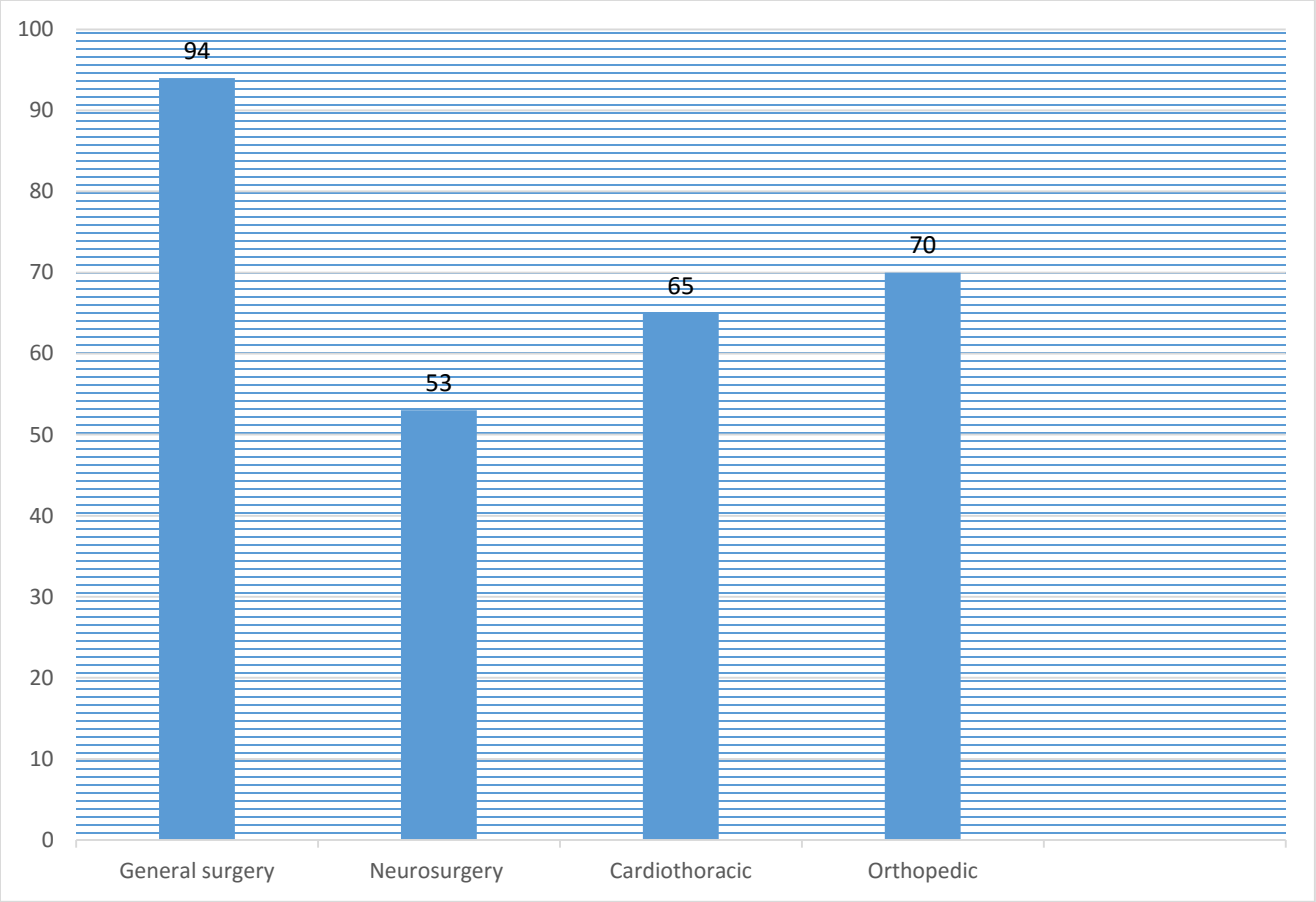


*Figure 2: Type of elective surgery performed at Tikur Anbessa specialized hospital from January 1, to March 30, 2020.*

## 5.3. Magnitude of postoperative hyperglycemia

Of total, six patients developed immediate post-operative hypoglycemia (fasting blood glucose <70mg/dl) and managed with 40% dextrose IV bolus by PACU nurses.

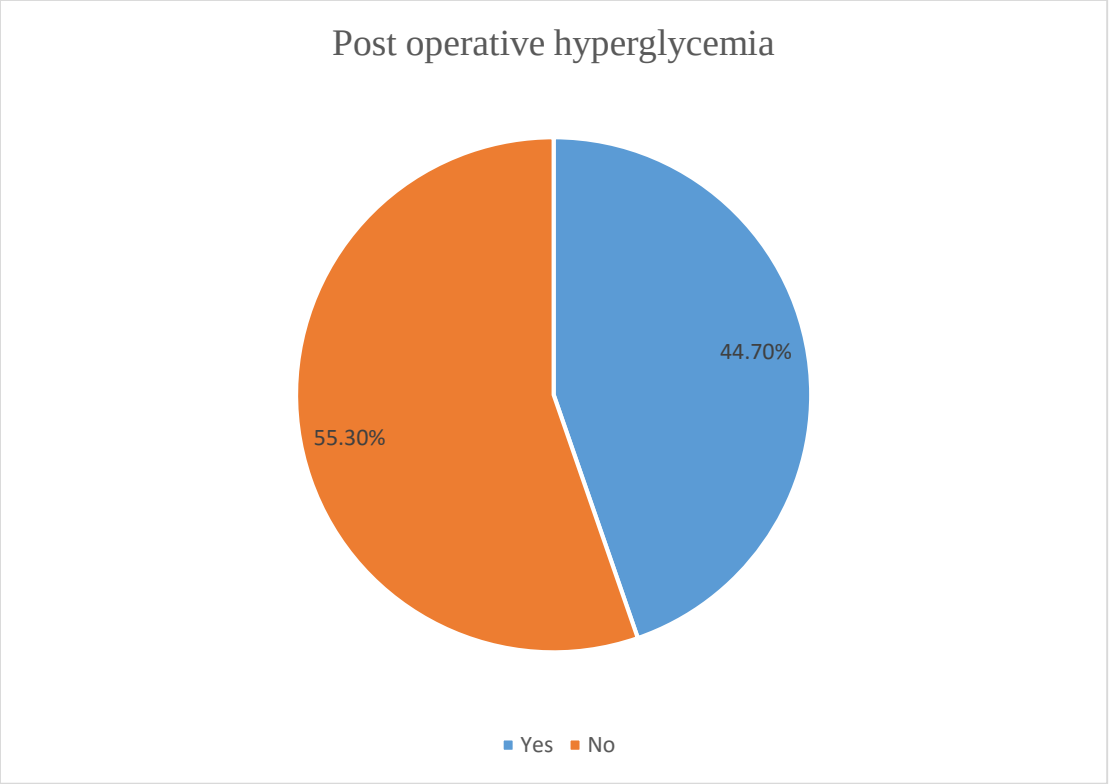


*Figure 3: Magnitude of post-operative hyperglycemia of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, to March 30, 2020.*

## 5.4. Factors associated with postoperative hyperglycemia

### 5.4.1. Result of bivariate analysis

Binary logistic regression analysis was conducted to see the association between independent variables and post-operative hyperglycemia. According to bivariate analysis, Being Male is 1.6 times more likely of developing post-operative hyperglycemia [COR=1.63; 95% CI :( 4.6-15)], in reference to female. Increasing age was associated with an increase in likelihood of exhibiting postoperative hyperglycemia by 8 times for age group between 41-60 years old [COR=8.34 ; 95% CI : (4.6-15)] and 10 times higher for age group above 60 years old [COR=10.7; 95% CI : (4.9-23)], than those whose age were between 18 and 40.

Patients having history of hypertension are more susceptible for post-operative hyperglycemia [(COR=5; 95% CI: (1.088-25)], compared with patients who don't have. An increase in ASA class was strongly associated with post-operative hyperglycemia. Post-operative hyperglycemia found to be twice after General surgery COR=2.2[1.02-4.85], 3.65 times higher after Cardiothoracic surgery [COR=3.65; 95%CI: (1.84-7.32)] and 5.4 times higher on Neurosurgery [COR=5.4 (5.5-11.42)] than those who underwent Orthopedic surgery.

Post-operative hyperglycemia after surgery longer than 1hr of duration were twice [COR=2; 95% CI :( 1.06-3.744)] of surgery that took less or equal to 1hr. In comparison to combined general-regional anesthesia, general anesthesia and regional anesthesia were strongly associated with postoperative hyperglycemia. The likelihood of developing post-operative hyperglycemia were 2.3 times [COR=2.3; 95% CI : (1.4-3.8)] higher among patients who lost greater than 300ml blood as in reference to patients who lost less or equal to 300ml during intraoperative period.

Patients who develop hypothermia during intraoperative period have reduction [COR=0.57; 95% CI: (0.32-1.02)] in developing post-operative hyperglycemia than those who had normal body temperature. Administration of vasopressor [COR=0.25; 95% CI: (0.1-0.6)] and post-operative pain [COR=0.7; 95% CI: (0.09-1.5)] were also strongly associated with postoperative hyperglycemia.

*Table 3: Factors associated with post-operative hyperglycemia of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, to March 30, 2020. (n=282)*

| ***Variables*** | ***Category*** | ***Hyperglycemia N (%)*** | | ***COR 95% CI*** | ***p value*** |
|---|---|---|---|---|---|
| | | Yes | No | | |
| **Gender** | Female | 54(38.6 ) | 86(61.4) | 1 | |
| | Male | 72(50.7) | 70(49.3) | 1.63; 1.02-2.63** | **0.041** |
| **Age** | 18-40 | 24(18.5) | 106(81.5) | 1 | |
| | 41-60 | 68(65.4) | 36(35.6) | 8.34; 4.6 -15** | **0.001** |
| | >60 | 34(70.8) | 14(29.2) | 10.7; 4.9-23** | **0.001** |

| | | | | | |
|---|---|---|---|---|---|
| **ASA class** | Class I | 42(31.3) | 92(68.7) | 1 | |
| | Class II | 64(51.6) | 60(48.4) | 2.33; 1.4- 3.88** | **0.001** |
| | Class III | 11(44.7) | 13(55.3) | 10.95; 3.5-23** | **0.001** |
| BMI | <25 | 116(44.6) | 144(55.4) | 1 | |
| | 25-29 | 8(53.3) | 7(46.7) | 1.4; 0.5-4.03 | 0.5 11 |
| | >29 | 2(28.6) | 5(71.4) | 0.4;0.95-2.6 | 0.408 |
| **History of Hypertension** | No | 118(43.4) | 154(56.6) | 1 | |
| | Yes | 8(80) | 2(20) | 5; 1.088-25** | **0.039** |
| DM | No | 120(44.3) | 151(55.7) | 1 | |
| | Yes | 6(54.5) | 5(45.5) | 0.6;0.12-2.2 | 0.5 |
| Anemia | No | 95(49.5) | 96(50.5) | 1 | |
| | Yes | 39(43) | 52(57) | 1.33;0.8-2.2 | 0.27 |
| Intraoperative Dexamethasone | No | 110(44) | 140(56) | 1 | |
| | Yes | 16(50) | 16(50) | 0.72;0.38-1.64 | 0.52 |
| Intraoperative 40 % dextrose | No | 118(44.2) | 149(55.8) | 1 | |
| | Yes | 8(53.3) | 7(46.7) | 0.69;0.24-1.96 | 0.49 |
| **Type of surgery** | Orthopedic | | | 1 | |
| | General surgery | 22(22.9) | 72(77.1) | 2.2;1.02-4.85** | **0.047** |
| | Cardiothoracic | 40(61.5) | 25(38.5) | 3.65; 1.84-7.32** | **0.001** |
| | Neurosurgery | 21(39.6) | 32(61.4) | 5.4;.5.5-11.42** | **0.001** |
| **Type of Anesthesia** | Combined | 26(59.1) | 18(40.9) | 1 | |
| | Regional | 8(17.4) | 38(82.9) | 6.8;2.6-18** | **0.001** |
| | General | 92(47.9) | 100(52.1) | 4.3;1.9-9.8** | **0.001** |
| **Duration of surgery** | <=60min | 17(31.5 ) | 37(68.5) | 1 | |
| | >60min | 109(47.8) | 119(52.2) | 2; 1.06-3.744 ** | **0.032** |
| Tourniquet | No | 125(44.6) | 155(55.4) | 1 | |
| | Yes | 1(50) | 1(50) | 0.8;0.05-13 | 0.88 |

| | | | | | |
|---|---|---|---|---|---|
| **Intraoperative blood Transfusion any** | No | 94(40.5) | 138(59.5) | 1 | |
| | Yes | 32(64) | 18(36) | 0.38; 0.2-0.72** | **0.003** |
| Intraoperative hypothermia | No | 22(34.4) | 42(63.6 ) | 1 | |
| | Yes | 104(47.7) | 114(52.3) | 0.57; 0.32-1.02 | 0.061 |
| **Intraoperative Blood loss** | ≤300ml | 68(37.4) | 114(62.6) | 1 | |
| | >300ml | 58(58) | 42(42) | 2.3;1.4-3.8 ** | **0.001** |
| **Post op Pain** | No | 1(5.9) | 16(94.1) | 1 | |
| | Yes | 126(47.2) | 139(52.8) | 0.7; 0.09-1.5** | **0. 01** |
| **Intraoperative Vasopressor** | No | 104(41.3) | 148(58.7) | 1 | |
| | Yes | 23(77.3) | 7(26.7 ) | 0.25; 0.1-0.6 ** | **0.002** |

**Statistically significant

### 5.4.2. Result of multivariable analysis

According to results of bivariable binary logistic regression analysis, Gender, Age, type of procedure, type of anesthesia, ASA class, history of hypertension, duration of surgery, intraoperative blood loss, intraoperative blood transfusion, intraoperative use of vasopressor, immediate post-operative pain were associated with post-operative hyperglycemia.

In the final model (multivariable binary logistic regression analysis), after excluding variables which doesn't fit for the model using P-value >0.25 in Likelihood ratio test and considering BMI as a candidate, multivariate analysis was performed for those variables; Age, ASA class, type of anesthesia and having hypertension as co-existing disease were associated with post-operative hyperglycemia.

Patients with age group of 41-60 were 11 times (AOR=11.25.; 95%CI :( 5.1 -24) and age group >60 were 12 times (AOR=12.2; 95%CI :( 4.5 -33) more likely of developing post-operative hyperglycemia compared to patients with age group of 18-40.

Patients with ASA class III were 6.3 times (AOR=6.3; 95%CI :( 1.44-27) higher risk of developing post-operative hyperglycemia than patients with ASA class I. Among the study subjects, patients who took General anesthesia were 5.6 times (AOR=5.63; 95%CI :( 1.28-24) more likely of

developing post-operative hyperglycemia than patients who undertook Combined general-regional anesthesia.

Patients having history of hypertension were 8 times more likely of developing post-operative hyperglycemia than patients who don't have (AOR=8.4**;** 95%CI :( 1.26-47)

*Table 4: factors associated with postoperative hyperglycemia of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, March 30, 2020. n=282*

| ***Variables*** | ***Category*** | ***Hyperglycemia N (%)*** | | ***COR 95% CI*** | ***AOR 95% CI*** | ***p value*** |
|---|---|---|---|---|---|---|
| | | Yes | No | | | |
| Gender | Female | 54(38.6 ) | 86(61.4) | 1 | | |
| | Male | 72(50.7) | 70(49.3) | 1.63; 1.02-2.63 | 1.6;0.8-3.3 | 0.18 |
| **Age** | 18-40 | 24(18.5) | 106(81.5) | 1 | | |
| | 41-60 | 68(65.4) | 36(35.6) | **8.34; 4.6 -15** | **11.2;5.2-24.5**** | **0.001** |
| | >60 | 34(70.8) | 14(29.2) | **10.7; 4.9-23** | **12.3;4.5-33.3**** | **0.001** |
| **ASA class** | Class I | 42(31.3) | 92(68.7) | 1 | | |
| | Class II | 64(51.6) | 60(48.4) | 2.33; 1.4-3.88 | 1.8;0.9-3.6 | 0.082 |
| | Class III | 11(44.7) | 13(55.3) | **10.95; 3.5-23** | **6.3;1.4-27**** | **0.014** |
| BMI | <25 | 116(44.6) | 144(55.4) | 1 | | |
| | 25-29 | 8(53.3) | 7(46.7) | .4; 0.5-4.03 | 1.23;0.29-5.4 | 0.76 |
| | >29 | 2(28.6) | 5(71.4) | 0.4;0.95-2.6 | 0.8;0.05-13 | 0.88 |
| Type of surgery | Orthopedic | | | 1 | | |
| | General surgery | 22(22.9) | 72(77.1) | 2.2;1.01-4.8 | 4.3;0.9-19 | 0.056 |
| | Cardiothoracic | 40(61.5) | 25(38.5) | 3.65; 1.84-7.32 | 1.6;0.4-5.8 | 0.48 |
| | Neurosurgery | 21(39.6) | 32(61.4) | 5.4;.5.5-11.42 | 4.3;0.7-16 | 0.117 |
| **Type of Anesthesia** | Combined | 26(59.1) | 18(40.9) | 1 | | |
| | Regional | 8(17.4) | 38(82.9) | 6.8;2.6-18 | 4.3;0.7-27 | 0.11 |
| | General | 92(47.9) | 100(52.1) | **4.3;1.9-9.8** | **5.6;1.3-24**** | **0.022** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Duration of surgery | ≤60min | 17(31.5 ) | 37(68.5) | 1 | | |
| | >60min | 109(47.8) | 119(52.2) | 2; 1.06-3.744 | 0.58;0.21-1.6 | 0.29 |
| **History of Hypertension** | No | 118(43.4) | 154(56.6) | 1 | | |
| | Yes | 8(80) | 2(20) | **5; 1.088-25** | **8.4;1.26-47**** | **0.027** |
| Intraoperative blood Transfusion any | No | 94(40.5) | 138(59.5) | 1 | | |
| | Yes | 32(64) | 18(36) | 0.38; 0.2-.72 | 0.8;0.33-2.2 | 0.75 |
| Intraoperative hypothermia | No | 22(34.4) | 42(63.6 ) | 1 | | |
| | Yes | 104(47.7) | 114(52.3) | 0.57; 0.32-1.02 | 0.54;0.24-1.1 | 0.125 |
| Intraoperative blood loss | <=300ml | 68(37.4) | 114(62.6) | 1 | | |
| | >300ml | 58(58) | 42(42) | 2.3;1.4-3.8 | 0.88;0.3-1.9 | 0.76 |
| Immediate post-operative Pain | No | 1(5.9) | 16(94.1) | 1 | | |
| | Yes | 126(47.2) | 139(52.8) | 0.07; 0.009-0.5 | 0.1;0.013-1 | 0.06 |
| Intraoperative vasopressor | No | 104(41.3) | 148(58.7) | 1 | | |
| | Yes | 23(77.3) | 7(26.7 ) | 0.25; 0.1-0.6 | 0.5;0.16-1.9 | 0.35 |

Statistically significant ** P < 0.05, AOR adjusted odds ratio, COR crude odds ratio, CI confidence interval.

## 6. Discussion

According to this study, there is higher magnitude of post-operative hyperglycemia who undergone elective surgery. In multivariable analysis, age, ASA class, type of anesthesia and hypertension were positively associated with post-operative hyperglycemia. Overall, 44.7% of patients had post-operative hyperglycemia in this study.

Our study finding is higher than studies conducted in Brazil at university of Sao Paulo. This study was done on non-diabetic elective surgical patient using cut off point >120mg/dl for postoperative hyperglycemia. The prevalence of postoperative hyperglycemia was 26.4%(28). Another retrospective study conducted in USA at university of Washington (BG>180mg/d) have found postoperative hyperglycemia to be 29.1%. This study was conducted to determine the relationship between perioperative hyperglycemia and insulin administration on both diabetic and non-diabetic elective surgical patients (38). Comparative cross sectional study was conducted at Tampere university hospital in Finland to identify risk factors for perioperative hyperglycemia after primary hip and knee replacement surgery. The finding of this study was nearly equal with our study result (BG>140mg/dl) 46%(39).

The magnitude of current finding is lower than a prospective observational study conducted on general surgical patients at Lucknow medical college in India. This study was conducted on 101 patents including both diabetic and non-diabetic patients. The prevalence of postoperative hyperglycemia was 56.4% by using cutoff point (BG>140mg/dl) (17). The magnitude postoperative hyperglycemia on another study done at Singapore general hospital was also higher than our study finding (BG>180mg/dl) 56.1%.(40) These variations could be attributed to size, setting and difference in the definition of post-operative hyperglycemia of the studies. Of course genetic and behavioral factors (diet) as the result of difference in insulin resistance may have played role on this disparity (49, 50).

In this study age is strongly associated with post-operative hyperglycemia. Patients with age group between 41-60 were 11 times and age above 60 were 12 times more likely to develop postoperative hyperglycemia compared to patients with age between 18-40. This result is consistent with the retrospective study conducted on 837 patients at PACU in university of Sao Paulo(28) and at two heart centers in Singapore (40). This might be explained by the fact that, with aging there are

changes in insulin secretion and peripheral resistance to its effect, as the result of increased abdominal fat mass (47, 51, 52).

It was also observed in this study that, an increase in ASA score is strongly associated with post-operative hyperglycemia. Patients with ASA class III are 6.3 times more likely to develop post-operative hyperglycemia than patients with ASA class I. This finding is in line with the prospective observational study conducted on a patients who undergone primary hip and knee replacement surgery at Tampere University in Finland (39). The possible reason for this increase might be alteration in glucose metabolism associated with insulin resistance in critically ill patients. Such alterations are due to adaptive activation of endocrine response, including increased release of catecholamine, cortisol and glucagon and reduced glucose uptake capacity (4, 5).

The type of anesthesia given was strongly associated with post-operative hyperglycemia. Based on our study finding, Patients who took general anesthesia were 5.6 times more prone to hyperglycemia than patients who undertook combined general-regional anesthesia. This finding is in line with the study done to identify the effect of different type of anesthesia on blood glucose level; the combined general-regional anesthesia has better blood glucose level than general anesthesia (53). Another study conducted to compare the effect of general anesthesia and spinal anesthesia on changes in blood glucose concentration in non-diabetic patients also supports our study result (54). This might also be related with volatile anesthetic agents inhibit insulin production and increasing hyperglycemic response to surgery (55).

History of hypertension is also another factor associated with the likelihood of exhibiting postoperative hyperglycemia compared with patients who were not diagnosed with hypertension. This finding is consistent with the study conducted in Brazil at university of Sao Paulo (28) in which patients having history of hypertension were 1.6 times more likely to develop postoperative hyperglycemia. The likely explanation is insulin resistance and impaired glucose tolerance, 50% of known hypertensive patients have insulin resistance or glucose intolerance (56). Increased tissue inflammation due to surgical stress, increased tissue rennin aldosterone system and increased sympathetic nervous system activation due to surgery might also have an effect (4-6).

# 7. Strength and limitation of the study

## 7.1. Strength

- Study weren't done on this title, this will make the study to be used as a baseline for further country wide study.

## 7.2. Limitations

- In developed world there is a test to check for pre diabetes. Pre diabetes test is performed on a patient who is not previously diagnosed with DM. This group of patients have greater risk of developing DM in the near future. Pre diabetic patients have impaired fasting glucose and impaired glucose tolerance test. The only way to identify this group of patient is to test for % of HgbA1c, IGT test and IFG test. These tests are expensive and are not done routinely.
- Some patients may have undiagnosed endocrine metabolic disorder (Thyroid and liver disease) which will predispose patients to have altered glucose metabolism.
- Representative samples are small in some subgroups. These issues might have effect on outcome variable, thus, the finding of this study should be interpreted with these limitations.

## 8. Conclusion

Nearly, half of the patients had post-operative hyperglycemia, age, ASA class, type of Anesthesia and history of Hypertension were predictors of post-operative hyperglycemia of patients who underwent elective surgery at Tikur Anbessa specialized hospital from January 1, March 30, 2020. Anesthetist's and PACU staffs understanding of these factors is important for close follow up of these patients regarding post-operative hyperglycemia.

## 9. Recommendation

***Based on the study findings, the recommendations forwarded by this study are:-***

***For Anesthesia and surgical team***

- Adopt guideline or develop local protocol that will help to treat post-operative hyperglycemia.
- Patients who will undertook General anesthesia, higher ASA class, aged and hypertensive patients should be identified a head of surgery and all the necessary precaution should be taken.

***For researchers***

- In some subgroups representative samples are small, so researchers are recommended to increase sample size and conduct study using this study as a base line.

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# 11.Annexes

## 11.1. Information sheet

Title of the Research Project: **The magnitude and associated factors of postoperative hyperglycemia in adult elective surgical patient**

Name of Principal Investigator**: Mitiku Desalegn**

Name of the Organization: **Addis Ababa University, College of Medicine and health science. Department of Anesthesia**

**Introduction: Greetings**! My name is **Mitiku Desalegn**. I am a student at Addis Ababa University Department of Anesthesia College of Medicine and Health Sciences in Masters of Science (MSc) in clinical anesthesia. As part of this degree I am undertaking a research Project "The incidence and associated factors of postoperative hyperglycemia in adult elective surgical patient."

**Purpose of the Research Project:** The aim of this study is to help doctors improve care given to the patient. The information gained from this research will be used to make clinical recommendations.

**Procedure**: The data collection will be conducted in TASH. Standard questioner was prepared to collect necessary information from the written document, working anesthetist during data collection and from devices used in the in surgical ward and operation room,

**Risk and /or Discomfort**: Blood sample to check blood sugar will be via a finger prick which will have little discomfort. Sterile technique will be performed thorough cleaning and sterilization of the skin using alcohol swab to remove blood. After removal gentle pressure will be applied.

**Confidentiality:** During data collection the patients name and card number was not taken in the questionnaire. All questionaries' collected was kept confidential. The information collected will be used only for research purpose. The thesis will be submitted to Addis Ababa University Department of Anesthesia College of Medicine and Health Sciences and displayed in the University Library and website. This study is also intended to be submitted for publication in scholarly journals.

**Right to Refusal or Withdraw:** Approval of the manager of the hospital and participant will be required to start data collection.

You are now free to ask questions related to this study to get clarification on any issue that may be unclear to you.

If you accept to be a part of this study please put your signature on a space provided.

**Person to contact:** If you have any further questions or would like to receive further information about the project, please contact

1. Mitiku Desalegn (Principal investigator):+251926247602

   **Advisors**

- Mulualem Sitot (B.Sc. M.Sc.)
- Lemlem Getachew (B.Sc. M.Sc.)

Thank you for reading the information sheet and asking any questions that you have might have had.

## 11.2. Consent form (English version)

Dear participant:

Hello, my name is _____ and I am a data collector for research aimed to determine the incidence and associated factors of postoperative hyperglycemia in adult elective surgical patient in BLH, Ethiopia. Since the study is not linked with any financial aid there is no direct incentives paid as a result of you taking part in the study. However, your legitimate participation in filling the questionnaire with real information is very important and highly appreciated.

I would like to assure you, that your name will not be written on this form and all the information gathered will be kept strictly confidential.

You can decide whether you want to take part in the questionnaire or not. I would like to assure you that there are no negative impacts you face because of taking part in the study. Please feel free to ask any questions data collector nearby.

You can also contact principal investigator with address below:

1. Mitiku Desalegn: +251926247602

**Advisors**

- Mulualem Sitot (B.Sc. M.Sc.)
- Lemlem Getachew (B.Sc. M.Sc.)

## 11.3. Consent form (Amharic version)

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## 11.4. Classification of obesity based on BMI

| BMI (kg/m2) | Description |
|---|---|
| <18.5 | Underweight |
| 18.5–24.9 | Normal |
| 25–29.9 | Overweight |
| 30–34.9 | Obesity (class I) |
| 35–39.9 | Obesity (class II) |
| ≥40 | morbid obesity (class III) |
| ≥50 | Super obesity |
| ≥60 | Super -super obesity |

Adopted from Paul Barash 5th edition

## 11.5. ASA classification

ASA class I: normal healthy patient except the surgical compliant he had

ASA class II: a patient with a mild systemic disease without substantive functional limitation

ASA class III: a patient with severe systemic disease with substantive functional limitation

ASA class IV: a patient with severe systemic disease that is a constant threat to life

ASA class V: moribund patient who is not expected to survive without the operation

Adopted from Paul Barash 5th edition

## 11.6. Data collection questioner

Questioner developed for collection of data for the study of "the magnitude and associated factors of postoperative hyperglycemia among adult patients who underwent elective surgery at Tikur Anbessa specialized hospital specialized hospital''

**Section one- Demographic data**

1. Age _____
2. Gender

i. Female
ii. Male

3. Weight_____

4. Height_____

5. ASA status i. class I ii. Class II iii. Class III iv. Class IV

**Section two- Preoperative data**

1. Base line Preoperative FBS_____ mg/dl
2. Preoperative hemoglobin_____ g/dl
3. Has history of Diabetes Mellitus?
   i. Yes
   ii. No
4. Has history of Hypertension?
   i. Yes
   ii. No

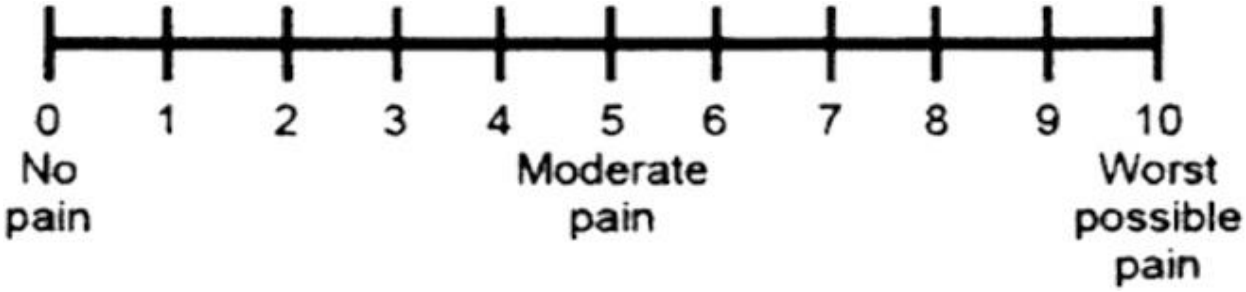
**Section three- Anesthetic and Surgical factors**

1. Type of procedure?
   i. General surgery
   ii. Neurosurgery
   iii. Cardiothoracic surgery
   iv. Orthopedic surgery
2. Type of anesthesia?
   i. General anesthesia
   ii. Regional anesthesia
   iii. Combined General and Regional anesthesia
3. Duration of surgery_____ hr.
4. Is tourniquet applied?
   i. Yes
   ii. No
5. Axillary body temperature in oC? After 30min of induction every one hour until immediate postoperative period.

| At 30min | At 1.5hr | At 2.5hr | At 3.5hr | At 4.5hr | Immediate post op |
|---|---|---|---|---|---|
| | | | | | |

6. Is dextrose containing fluid administered?, if yes
   i. Concentration_____% ii. Volume_____-ml
7. Estimated intraoperative blood loss_____ ml.
8. Is there intraoperative blood or blood product transfusion? i. yes ii. No If yes,
   i. Type _____ ii. Number of unit_____
9. Is there intraoperative corticosteroid use? i. yes ii. No If yes,
   i. Drug_____ ii. Dose in mg_____
10. Is there intraoperative vasopressor use? i. yes ii. No If yes,
    i. Drug_____ ii. Dose in mg_____

11. Post-operative pain assessment score. i. on immediate post op_____




**Section four-Laboratory result**

1. Fasting blood glucose level(mg/dl)

| On immediate post op period |
| --- |
| |

Name of data collector…….
signature……..

Name of supervisor……..
Signature…….