**ADDIS ABABA UNIVERSITY**

**COLLEGE OF HEALTH SCIENCES**

**SCHOOL OF MEDICINE**

**DEPARTMENT OF ANESTHESIA**

# THE EFFECT OF ANESTHETIC TECHNIQUE ON FETAL OUTCOME AMONG MOTHERS UNDERGOING CAESAREAN SECTION FOR NON-REASSURING FETAL STATUS AT ADDIS ABABA, PUBLIC HOSPITALS

**Berihu Tadesse (B.Sc.)**

**Advisors**

**Sileshi Abiy (B.Sc. M.Sc.)**

**Selamawit (B.Sc. M.Sc.)**

**A RESEARCH THESIS SUBMITTED TO DEPARTMENT OF ANESTHESIA, COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR M.Sc. IN CLINICAL ANESTHESIA**

**ADDIS ABABA UNIVERSITY**

**COLLEGE OF HEALTH SCIENCE**

**DEPARTMENT OF ANESTHESIA**

| | |
|---|---|
| NAME OF INVESTIGATOR | BERIHU TADESSE(BSc.) |
| NAME OF ADVISORS | SILESHI ABIY (B.Sc., M.Sc.)<br>SELAMAWIT (B.Sc., M.Ss.) |
| FULL TITLE OF THE RESEARCH PROJECT | THE EFFECT OF ANESTHETIC TECHNIQUE ON FETAL OUTCOME AMONG MOTHERS UNDERGOING CAESAREAN SECTION FOR NON-REASSURING FETAL STATUS AT ADDIS ABABA, PUBLIC HOSPITALS |
| DURATION OF PROJECT | NOVEMBER JUNE 2020 |
| STUDY AREA | ADDIS ABABA PUBLIC HOSPITALS, ETHIOPIA (GANDHI MEMORIAL HOSPITAL, YEKATIT 12 HOSPITAL MEDICAL COLLEGE, ST. PAUL'S HOSPITAL) |
| ADDRESS OF INVESTIGATOR | **TEL: +251-914-204827**<br>**E-mail: berihutadesse100@gmail.com** |

## Addis Ababa University

## School of Graduate Studies

This is to certify that the thesis prepared by Berihu Tadesse Tesfamariam, entitled: "The Effect Of Anesthetic Technique On Fetal Outcome Among Mothers Undergoing Caesarean Section For Non-Reassuring Fetal Status At Addis Ababa Public Hospitals, Addis Ababa Ethiopia" and submitted in partial fulfillment of the requirements for M.Sc. in clinical anesthesia complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the examining committee:

Internal examiner: _____ Signature _____ Date ----------

External examiner:_____Signature_____Date----------

Advisor: _____ Signature_____Date----------

Advisor:_____Signatur_____Date----------

Head, Department or Graduate Program Coordinator

## Acknowledgment

I would like to acknowledge Addis Ababa University for giving me the educational opportunity and Mekelle University for granting my study leave.

I would like to express my deepest gratitude and appreciation to my advisor Mr. Sileshi Abiy (B.Sc. M.Sc.) and Selamawit (B.Sc. M.Sc.) for their unreserved, continuous support, generous assistance, constructive criticism, guidance, and valuable comments in each & every step of this thesis work and for the opportunity giving me to prepare this thesis work.

.

## Abstract

**Background:** Emergency Cesarean Sections are performed for various reasons. One of the reasons to do Cesarean Section (CS) is non-reassuring fetal status. Cases with emergency caesarean sections like non-reassuring fetal status are challenging for the obstetric anesthetist and obstetrician because such cases are highly associated with life-threatening complications for the fetus and/or the mother. So, choosing appropriate anesthetic technique in such cases is essential in decreasing fetal and maternal morbidity and mortality.

**Objective:** To assess the effects of anesthetic technique, General Anesthesia (GA) versus Spinal Anesthesia (SA), over neonatal outcome of newborns delivered by CS for the indication of non-reassuring fetal status in Addis Ababa government hospitals, in 2019/2020

**Methods: A** prospective cohort study was conducted on 200 pregnant mothers who came for CS for the indication of non-reassuring fetal status and fulfill the inclusion criteria for the study. Patients in SA group (n = 100) received spinal anesthesia with 10 mg of bupivacaine while the GA group (n = 100) received general anesthesia. Study participants were selected by systematic random sampling technique after proportional allocation to the study hospitals. Data were collected using preoperative chart review, maternal interview and intraoperative observation. Comparisons of numerical variables between study groups were done using independent sample t-test and categorical variables were performed using chi-square test. Significance was determined at p-value < 0.05.

**Results**: There was a significant difference in the mean of 1 minute Apgar score between SA and GA groups among newborns delivered by caesarean section for the indication of non-reassuring fetal heart status (Mean = 7.28, SD = 1.16) and (M = 6.64, SD = 1.44; p = 0.001) for SA and GA respectively. But there was no significant difference in 5 minute Apgar score. There was no significant difference in neonatal intensive care unit admission between GA and SA groups, $\chi 2$ (1) = 0.31, p =0.57.

**Conclusions:** this study revealed that newborns delivered under SA had better 1 minute mean Apgar score when compared with GA. Based on this we recommend SA for mothers with the diagnosis of non-reassuring fetal status.

***Keywords*:** non-reassuring fetal status, general anesthesia Spinal anesthesia, Ethiopia.

**List of Abbreviations/Acronyms**

| | |
|---|---|
| WHO | World Health Organization |
| RCOG | Royal College of Obstetricians and Gynecologists |
| C/S | Caesarean Section |
| APGAR | Appearance, Pulse, Grimace, Activity, Respiration |
| GA | General Anesthesia |
| SA | Spinal Anesthesia |
| ASA | American society of anesthesiologists |
| SPSS | Statistical Packages for Social Science |
| DDI | Decision to Delivery Interval |
| ICU | Intensive Care Unit |
| RSSA | Rapid Sequence Spinal Anesthesia |
| RSGA | Rapid sequence general anesthesia |
| FHR | Fetal Heart Rate |
| MSc | Master of Science |
| ANC | Antenatal Care |
| YHMC | Yekatit 12 Hospital Medical College |
| SPC | St. Paul's Hospital Millennium Medical College |
| GMH | Gandhi Memorial Hospital |
| SD | Standard Deviation |
| DX | Diagnosis |
| NRFS | Non-reassuring fetal status |

## Table of Contents

## List of tables

## List of figures

# 1. INTRODUCTION

## 1.1. Background

Non-reassuring fetal status is a term used to define suspected fetal hypoxia/asphyxia and is used interchangeably with the more omnipresent term "fetal distress." Fetal distress which is defined as progressive fetal hypoxia and acidemia secondary to inadequate oxygen supply to the fetus is a term that is used to indicate changes in fetal heart patterns, decreased fetal movement, fetal growth restriction, and meconium-stained fluid. Even though fetal distress may be associated with neonatal encephalopathy, the term may not indicate the actual the neonatal outcome; most newborns were vigorous and healthy when delivered despite the diagnosis of fetal distress. Fetal distress can only be diagnosed indirectly via electronic fetal heart rate monitoring or directly by measuring blood PH. Hence, many professionals recommend avoiding the term fetal distress and replacing it with the term non-reassuring fetal status to describe the clinical interpretation of a newborn's condition (1, 2).

The term cesarean section may be used to describe the delivery of a fetus through a surgical incision of anterior uterine wall i.e. the birth of a fetus via laparotomy and then incision through the uterus (3, 4). Caesarean section is usually indicated when vaginal delivery is a risk for the mother's as well as the fetus's health and life (3-5). Emergency C-sections are performed for various reasons. Cases with emergency caesarean section are challenging for the obstetric anesthetist and obstetrician because such cases are highly associated with life-threatening complications for the fetus or the mother (4).They are associated with significant morbidity and mortality for both lives i.e. the mother and her newborn (3).

Despite the fact that cesarean procedure has become very safe over the years, it is still associated with high rates of maternal and fetal complications (6). The global postoperative morbidity rate associated with cesarean births among mothers and neonates is 35.7%. Adverse events for the newborn include lacerations during the procedure and respiratory distress. The higher mortality and morbidity rates might not be only associated with the surgical procedure but also to the anesthetic technique and type preferred (7).

Foetal asphyxia typically referred to as foetal distress, can lead to ischemic injury. Compensatory mechanisms involving the redistribution of blood to vital organs enable the foetus to survive asphyxia, provided that the duration of asphyxia is limited (8-10).

The Apgar score, a 10‑point assessment score devised by Dr. Virginia APGAR in 1952 has been used rapidly to assess the condition of newborns and prediction of survival (9, 11). APGAR score is a clinical test performed on a newborn one and five minutes after birth. It comprises five components: Heart rate, respiratory effort, muscle tone, reflex irritability, and color; and each component is given a score of 0, 1, or 3. It is being used as a standardized tool for stating the physiologic condition of newborns at birth and also to record fetal to neonatal transition among health professionals throughout the world (12). Despite the above advantages, the Apgar score has major limitations like having a limited time frame and is subjected to subjectivity (13, 14).

The type of anesthesia is determined according to medical indications and contraindications and patient preference. Maternal and fetal well-being should be taken into consideration while planning for anesthetic for cesarean delivery. Spinal anesthesia is the preferred technique than general anesthesia for emergency and elective cesarean section (CS) and the most common method of anesthesia for the delivery because it allows the mother to be awake and immediately interact with her baby, and also it avoids intubation related complications. On the other hand, other studies recommend GA for emergency cesarean sections like non-reassuring fetal status to save time (11, 15). In addition, General anesthesia is associated with a lower incidence of adverse neonatal outcome in emergency CS including fetal distress. Research done in Malaysia showed that subarachnoid block is the first choice of anesthesia for patients undergoing Caesarean section due to fetal distress (8, 15). However, a meta-analysis Performed by Afolabi and Lesi for both elective and emergency CS did not show any evidence for the superiority of SA over general anesthesia (GA) (16).

## 1.2. Statement of the Problem

Non-reassuring fetal status is a very serious condition and delayed intervention usually leads to fetal death or serious neurological consequence. A number of studies have been done in the western world in which 30 minutes has been adopted as a standard practice for the decision to delivery interval for CS for fetal distress though this is difficult to achieve (17, 18).

Although the use of GA for CS has declined while the use of regional techniques has increased, both elective and emergency CS still continue to be performed under GA (13)

For women requiring an emergency cesarean section, a 30-minute decision-to-delivery interval (DDI) for cesarean section has become the standard target in clinical practice, although DDIs of 30–75 minutes have been proposed (19). The guidelines by the Royal College of Obstetricians and Gynecologists (RCOG) suggest that cesarean section should be performed "within the appropriate time frame to decrease risk to the baby and the safety of the mother", as soon as the target decision to delivery interval is established. Given the limited time and increased risk, both maternal and fetal outcome depend on the coordination and vigilance of the anesthetist, and the choice of anesthetic type is of vital importance. Mothers with non-reassuring fetal status are also candidates for the emergency cesarean section and there is controversy on the anesthesia technique preferable for this group of mothers (19,12).

The choice of anesthesia for fetal distress might vary because of different maternal and fetal factors. Some studies support GA for fetal distress/non-reassuring fetal status and other studies are support SA considering the time taken to give anesthesia and other factors (20-22).

Fetal distress is one of the indications for emergency cesarean. In such a case, CS should be performed as fast as possible to decrease fetal neurologic complications and even sometimes fetal death. The choice of anesthetic technique for such cases is general anesthesia with rapid sequence induction. But recent literatures recommend SA; because studies show that the incidence of low Apgar score decreased in SA when compared to GA (23). Most studies recommend 30 minutes decision to delivery interval but the latest recommendation of the German Society for Gynecology and Obstetrics recommends 20 minutes decision-to-delivery time.

Some Authors believe general anesthesia (GA) is the fastest method for anesthetizing mothers with fetal distress than spinal anesthesia (SA) but is associated with increased maternal morbidity and mortality. However, other studies found both that SA and GA are comparable regarding the decision to delivery interval. Spinal anesthesia has become the standard technique in emergency cesarean sections if the case gives time to perform SA; as it results in less maternal and neonatal morbidity than general anesthesia. However, rapid sequence general anesthesia

(RSGA) is currently being challenged due to the risk of hypoxia, aspiration, and controversies regarding the technique practiced choice, and doses of drugs. If SA can be performed faster, it will become a more acceptable option in fetal distress. A specific approach of spinal anesthesia called rapid sequence spinal anesthesia (RSSA) for emergency cases like in fetal distress has been described (13).

There is a discrepancy in choosing an anesthetic technique for fetal distress in mothers undergoing CS. Spinal anesthesia is the most commonly practiced anesthetic technique for the majority of cesarean sections performed in many hospitals. While many emergency cesarean sections are performed each year, limited data are available regarding the effect of anesthetic technique on fetal outcome in mothers with fetal distress. There are no enough studies done on neonatal outcome related to fetal distress diagnosed in cases with an emergency cesarean section (8,24).

So, this study will try to assess the effect of anesthetic technique on fetal outcome i.e. Apgar score and NICU admission and solve the controversy in selecting a better anesthetic technique for mothers with fetal distress/non-reassuring fetal status.

## 1.3. Justification of the study

Fetal distress is one of the common indications for cesarean delivery among pregnant mothers. Managing such case is challenging for the attending anesthetist as well as for the attending obstetrician because such cases are typically associated with life-threatening complications for the fetus and/or the mother. Moreover, once cesarean section is decided for pregnant mothers with fetal distress, it should be performed in a very short period of time to decrease morbidity and mortality that could happen on the mother and/or the fetus. So, the anesthetists have limited time to give anesthesia for such cases.

Unquestionably, spinal anesthesia is the choice of anesthesia for the caesarean section when there is adequate time and there is no immediate threat to the life of the mother and the fetus. But in the case of fetal distress, there is no adequate guideline with regard to which anesthetic technique to be used. There is a lack of clear data on which anesthetic technique (i.e. whether spinal or general anesthesia) is safer and best for pregnant mothers undergoing cesarean section for fetal distress. Though several randomized trials have compared the maternal and fetal

outcome in elective and emergency cesarean sections between these two anesthetic techniques, the studies with respect to fetal distress are very limited (34, 35).

Some studies recommend general anesthesia for pregnant mothers undergoing cesarean delivery for non-reassuring fetal status to shorten the time to give spinal anesthesia. But other studies recommend spinal anesthesia to avoid the depressant effect of the drugs used for GA and other complications of GA like difficult intubation, difficult ventilation, and aspiration pneumonitis, and so on. In our country, some anesthetists prefer to give GA for mothers with fetal distress and some of them prefer to give spinal anesthesia. This shows a lack of adequate guidelines and a lack of common understanding.

This issue has been studied in different parts of the world. Despite the studies in different corners of the world; still there are controversies on which anesthetic technique to use in cases of fetal distress/non-reassuring fetal heart status.

Having evidence-based knowledge on the fetal outcome in spinal versus general anesthesia will help anesthetists to decrease the incidence of poor outcome in newborns, to decrease neonatal morbidity and mortality, to decrease the intensive care unit (ICU) admission, to improve quality of obstetric anesthesia care in general. This study will provide evidence-based knowledge on fetal outcome in general versus spinal anesthesia and it will try to identify the best anesthetic technique for mothers undergoing CS for NRFS. This study can also be used as a baseline for further studies and will help in the development of guidelines for anesthesia for fetal distress. The purpose of this study is to provide all anesthetists and other responsible health professionals on comparing fetal outcome in spinal versus general anesthesia in pregnant mothers undergoing C/S for fetal distress. Moreover, it will help us avoid anesthetists' variation in preferring anesthetic technique for fetal distress and help anesthetists come to common understanding and practice.

## 1.4. Literature review

Different researches were conducted on the issue of anesthetic technique on non-reassuring fetal status. These different literatures had different results regarding the Apgar score (25, 26). Apgar score 10‑point assessment score devised by Dr. Virginia APGAR in 1952 has been used rapidly to assess the condition of newborns, is routinely used for assessment of newborns immediately after birth commonly measured at 1 and 5 minute, and consists of five variables. Respiratory efforts, heart rate, color, muscle tone, and reflex irritability. It is being used as a standardized tool for expressing the physiologic condition of newborn at birth and also to record fetal to neonatal transition (19, 27).

Single-center prospective observational study was conducted in India by Chitra et al to determine the Influence of anesthetic technique on maternal and fetal outcome in category Ⅰ C/S. 50% of the C/S in this study was done for fetal bradycardia. The 1-minute Apgar score was significantly lower in the GA group **[**7.5 (4–8)] than the SA group [8 (8–8), P = 0.02]. But Apgar score at 5 minute was comparable between the groups [9 (9-9) vs (9 ( 8-9)] in SA and GA respectively (25).

Another study indicated that the mean 1 minute Apgar score was significantly lower in newborns delivered under GA group than those delivered under SA (<0.01). At 5 minute the difference between in Apgar score of newborns between the two groups was not statistically significant in general they conclude that RA provides better maternal and fetal advantage even in the diagnosis of fetal distress (28).

In prospective cohort in India in which 16.4% of mothers had undergone CS for the indication of fetal distress under spinal anesthesia and 37% of the mothers had undergone CS under general anesthesia. In this study, the mean Apgar score at 1 minute was 7.66 ± 1.27 and 6.52 ± 1.16 respectively which is statistically significant. Apgar score at 5 minute did not show any significant difference (23).

A study by Vanita Ahuja *et al* Apgar score at 1 and 5 minute was significantly higher in SA groups when compared to GA groups (p-value 0.03 and 0.04 respectively). The mean and standard deviation of Apgar score at 1 minute in SA and GA was 6.87 ± 0.35 and 6.07 ± 0.96 in SA and GA respectively. The mean and standard deviation of Apgar score at 5 minute in SA and

GA was 9.00 ± 0.00 and 8.20 ± 0.94 respectively (29). Among the 15.7% newborns with poor outcome, 13 were stillbirths and 21 had Apgar score of less than 7(17). Another study conducted in India that compared rapid sequence general anesthesia and rapid sequence spinal anesthesia showed that; there was no significant difference in 5 minute mean Apgar score between the two groups. (5) Bhattacharya et al found that mean Apgar score at 5 min after birth was not statistically different between both groups (GA: 7.03 ± 1.99 vs. SA: 7.40 ± 1.83, P = 0.461) (30). Hiroyuki Sumikura concludes that GA should be avoided even in emergency CS whenever possible because of its side effects. Another study by Beckmann also found that GA for category 1 CS is associated with low Apgar score. Hiroyuki Sumikura concludes that GA should be avoided even in emergency CS whenever possible because of its side effects (31, 22).

A study conducted in Indonesia in the period of 2002-2004 showed that 25.5% of newborns born by Emergency CS from mothers with fetal distress had a low Apgar score and suffered from severe asphyxia. After resuscitation, the magnitude had declined from 25.55 to 6.67% and only 1 baby (0.42) died despite the resuscitation (24).

The study conducted in Indonesia show that fetal distress due to toxemia constituted 25% of patients while those with bleeding constituted only 7. 08%. The Apgar score of 1 - 5 minutes was of the group having heartbeats significantly higher than the normal threshold ($p<0.05$) compared to the group of bradycardia. In groups of normal threshold, there was not any significant difference of Apgar score of 1 - 5 minutes ($p>0.05$) to tachycardia group. 22.50% of babies having 1 minute Apgar score and delivered through a Caesarian section with fetal distress diagnosis would suffer from serious or severe asphyxia and after resuscitation was undertaken, the percentage decreased to 6.67% and only one baby (0.42%) died. The study result showed that 1 and 5 minute Apgar score of the group of the subarachnoid block was significantly higher compared ($p<0.05$) to that of the group of general anesthesia (24).

The mean Apgar score at minute 5, for neonates born under spinal anesthesia, was 8.03 with a standard deviation of 1.39, and for those who born under general anesthesia, the mean Apgar score 5 was 6.89 with a standard deviation of 1.4. Neonates with low birth weight were found to be associated with a low Apgar score (4).

In a study conducted in Zambia which involved 216 mothers that had a caesarean section for fetal distress, 182 (84.3%) had good newborn outcome while 34 (15.7%) had bad newborn outcome. This research disclosed that among mothers with fetal distress under general anesthesia 17.6% of the newborns had good outcome and 82.4% of the newborns delivered under spinal anesthesia had good outcome ( 5 minute Apgar score >=7) (17). Research conducted in turkey found that the 1 minute Apgar score was significantly lower in GA group when compared with SA group (p = 0.045). However, the 5 minute Apgar score did not show significant difference between the two groups (8).

Neonatal intensive care unit admission is another parameter used to measure neonatal outcome used by different researchers. The neonatal intensive care unit Admission was not significant comparing the two groups. In both general and spinal anesthesia groups, 34 newborns (29.8%) of the total newborns were admitted to NICU 24 newborns (35.8%) in group GA and 10 (21.3%) in group SA, P = 0.095. Neonatal resuscitation in the form of oxygen supplementation with bag and mask ventilation was required in 46.7% newborns in the GA and 13.3% neonates in the SA groups There were two stillbirths in group GA while there was no stillbirth in group SA (25, 32).

Since the 1980s, several organizations have developed many guidelines on the decision to delivery interval for cesarean section. The Royal College of Obstetricians and Gynecologists was institution stating that the decision-to-delivery interval for cesarean section should be less than 30 minutes (30-minute rule). The validity of this guideline has been questionable. This idea was followed by many other guidelines with different ideas. Despite these controversies, there was an agreement that hospitals that provide caesarean section service should be equipped to start C/S within 30 minutes if C/S was decided. This 30-minute rule was for selected emergency cases (8).

The mean decision to delivery time for both GA and SA was 202.5 minutes (3hrs and 22 minutes) with a minimum time of the decision to delivery interval 33 minutes and the maximum was 955 minutes (15 hours and 55 minutes). Newborns with poor fetal outcome had DDI of 233.8 minutes compares to 196.7 for those with good fetal outcome. But this difference was statistically insignificant (9). Research conducted in Turkey showed that the decision to delivery interval was 21.50 ± 4.82 and 20.48 ± 3.79 minutes in RA and GA respectively p- 0.363 (8).

The mean duration from induction to skin incision was 67 ± 12 that ranged 55 to 90 minutes. The abdomen was cleaned and draped before induction. In contrast, in regional anesthesia group, abdominal preparation was done after spinal anesthesia was given and the time from SA was given to skin incision was 5.3±0.52 with the highest and lowest 6 and 4 minutes respectively. There was no correlation with the umbilical PH and Apgar score of the newborn (28).

In a study conducted in India by Susmita et al; the time required to give anesthesia was more in the GA group (144.80 ± 3.42) than the SA group (131.20 ± 3.40), which was statistically significant ($P < 0.001$). The incision to delivery time was 181.73±6.87 vs. 178.26±9.31 0.107 in GA and SA respectively (30).

Induction to incision time was significantly longer by 4.8 minutes longer in the SA group when compared to the GA group (P-value = 0.001), but the duration of time from uterine incision to delivery was comparable (P-value = 0.198) (29).

Cord blood pH was significantly lower in group GA (7.16 ± 0.17) when compared with SA (7.24 ± 0.1, P = 0.043) (25) Fetal scalp capillary blood pH ranged from in the general anesthesia group and from 7.26 in the regional analgesia group, with similar mean values. The mean scalp capillary blood was similar in both groups with (7.12 to 7.26) and 7.13 to 7.26 in regional anesthesia group. There was no difference between the mean umbilical artery blood pH values of the two regional and spinal anesthesia (28).

### 1.4. 1. Research hypothesis

The mean 1 and 5 minute Apgar score of newborns delivered by CS from mothers with the indication of non-reassuring fetal status under general anesthesia is different compared to those who delivered under spinal anesthesia.

HO: There is no significant difference in 1 and 5 minute Apgar score of newborns between GA and SA groups.

HA: There is significant difference in 1 and 5 minute Apgar score of newborns between the two groups.

HO: There is no significant difference in NICU admission rate between GA and SA groups.

HA: There is significant difference in NICU admission rate between GA and SA groups.

# 2. OBJECTIVES

## 2.1. General Objective

To assess the effects of anesthetic technique (general versus spinal anesthesia) over outcome of newborns delivered by cesarean sections for the indication of non-reassuring fetal status from November 2019 to March 2020 in Addis Ababa public hospitals.

## 2.2. Specific objective

1) To determine the 1 and 5 minute mean Apgar score of newborns delivered by CS under spinal anesthesia and general anesthesia for the indication of NRFS
2) To compare the 1 and 5 minute mean Apgar of newborns delivered by CS under general versus spinal anesthesia for the indication of with NRFS.
3) To compare the NICU admission rate b/n the two groups

# 3. METHODS AND MATERIALS

## 3.1. Study area and period

The study was conducted in Addis Ababa, which is capital city of Ethiopia. It is located in the center of the country with a total area of 527 km2. Based on a 2007 figure from the Central Statistics Agency of the country; Addis Ababa city has an estimated total population of 3.2 million projected for the year 2014. The city has ten sub-city and 116 woredas. There are 51 hospitals in Addis Ababa. Six of them are owned by Addis Ababa City Administration Health Bureau, four by Federal Ministry of Health, one by Addis Ababa University, three by the Nongovernmental organization, 3 by Defense Force and Police and thirty of them are owned by private owners. Out of these 10 of them are MCH hospitals (33). This study was carried out among the mothers who gave birth by Caesarean section for the indication non-reassuring fetal heart status in the selected public hospitals (Gandhi Memorial Hospital, yekatit 12 hospital medical college, and St. Paul's hospital). In addition to the clinical service they give, yekatit 12 hospital, and St. Paul's hospital are also teaching centers for different medical and health professionals. The study was conducted from November 2029 to June 2020.

Gandhi Memorial Hospital was established in 1958 G.C and it was called the only maternity hospital in Ethiopia. The hospital was named as Gandhi Memorial Hospital for the memory of Mahatma Gandhi. It is one of the thirteen governmental hospitals found Addis Ababa and one of the hospitals which was administered by Addis Ababa Health Bureau. The Hospital primarily gives services for women and children. It provides Gynecologic, Obstetric, and reproductive health services including Mother and Child Health (MCH), infertility, and sexual violence services. Currently, it is providing inpatient, outpatient services, and emergency cases. In October 2016, the hospital established a neonatal unit and currently serves as an inpatient unit for at least 120 neonates per month. The hospital has 110 beds and delivers 25 neonates each day. The hospital has four operation theatres and the average number of caesarian deliveries done at the hospital is eight to ten per day.

Yekatit 12 hospital medical college is also one of the specialized Hospitals found in Addis Ababa providing comprehensive medical service under the management of Addis Ababa Health Bureau. It is serving more than 5 million people in the catchment area.

St. Paul's Hospital Millennium Medical College is the second-largest hospital in Ethiopia. The hospital has 350 beds and sees an annual average of 300,000. It has a catchment population of more than 5 million.

## 3.2. Study design

A prospective cohort study was employed

## 3.3. Source Population

All pregnant mothers who underwent emergency cesarean delivery at Addis Ababa public hospitals for the indication of non-reassuring fetal status.

## 3.4. Study population

All pregnant mothers who underwent emergency cesarean delivery at selected Addis Ababa public hospitals for the indication of non-reassuring fetal status.

## 3.5. Study subjects

Selected mothers who underwent emergency cesarean delivery at selected Addis Ababa public hospitals for the indication of non-reassuring fetal status

## 3.6. Inclusion criteria and Exclusion criteria

### 3.6.1. Inclusion criteria

All pregnant women with the diagnosis of non-reassuring fetal status aged, 18–49 years.

### 3.6.2. Exclusion criteria

Lack of consent (patient refusal), parturient received sedative drugs during labor, block performance time >5 min, obesity BMI >/= 30 kg/m2, difficult airway, lumbar puncture trial > 5 minutes, ASA Ⅲ and above mothers, Unsuccessful SA or SA converted to GA, gestation <28 weeks, Hypersensitivity to any of the drugs was excluded from our study.

## 3.7. Sample size determination and sampling techniques

### 3.7.1. Sample Size Determination

As far as my knowledge there was no previous study done in Africa on the same title, so, the sample size was determined after conducting a pilot study in the study area. To calculate the

sample size for the pilot study, a study conducted in India was selected. After getting ethical clearance, by taking 10% (as a pilot) of a sample size of a previous study done in India which enrolled 30 patients in each group was used to calculate the sample size of our study (8). Sample size was calculated for all outcome variables and the highest sample size was taken. Therefore, sample size was calculated based on 1 minute Apgar score, by taking 80% power; alpha 5% and 5% attrition was added. According to the pilot study result, the mean and SD of 1 minute Apgar score of newborns delivered by C/S for the indication of non-reassuring fetal heart status under SA was 6 ± 0.98 and those who delivered under GA was 6 ± 6.58. So, the formula used to calculate the sample size was;

$$n = \frac{(z_1 + z_2)^2 \times 2 \times (s^2)}{(\mu_2 - \mu_1)^2}$$

n = Sample size per group

$z_1$ = 1.96 for $\alpha$ error of 5% (95% confidence level)

$z_2$ = 0.84 for 80% power

s = Standard deviation of the outcome in control group

$\mu_2 - \mu_1$ = Minimum meaningful difference between means of the two groups (The mean difference in Apgar score in group SA and GA in our case)

Therefore, $n = \frac{(1.96 + 0.84)^2 \times 2 \times (0.98)^2}{(6.98\text{-}6.58)^2} = \approx 95$ the sample size for each group was 95,

And 190 for both groups. We add 5% attrition rate and we have used a total of 200 sample size, 100 samples in each group.

### 3.7.2. Sampling technique

Study participants were selected using a systematic random sampling technique in each of the study hospitals after proportional allocation of sample size to each hospital. Based on the situational analysis the average number of CS done for the indication of non-reassuring fetal status in the study period was 460, (GA = 160, SA = 300), 400, (GA = 120, SA = 280) and 310,

(GA =104, SA=206) cases in Gandhi memorial hospital, St. Paul's hospital millennium medical college and Yekatit hospital medical college respectively. Sampling interval (**K**) was determined for each study hospital and each group by the formula $\mathbf{K^{th}}$= N/n. Where N= number of units in the population and n= the desired sample size. The first sample (Random start) was selected by lottery method then every $k^{th}$ value was included in the study sampling procedure. So, the $\mathbf{k^{th}}$ value for GA group was, n=384/100, = 4. A random number 2 was chosen by lottery method and then every 4th new study subject was included in our study. Since the total population in SA group based on the proportional allocation was 786, the $k^{th}$ value was =786/100 = 8. A random number 4 was chosen by lottery method and then every 8th new study subject was included in our study (Figure 1).

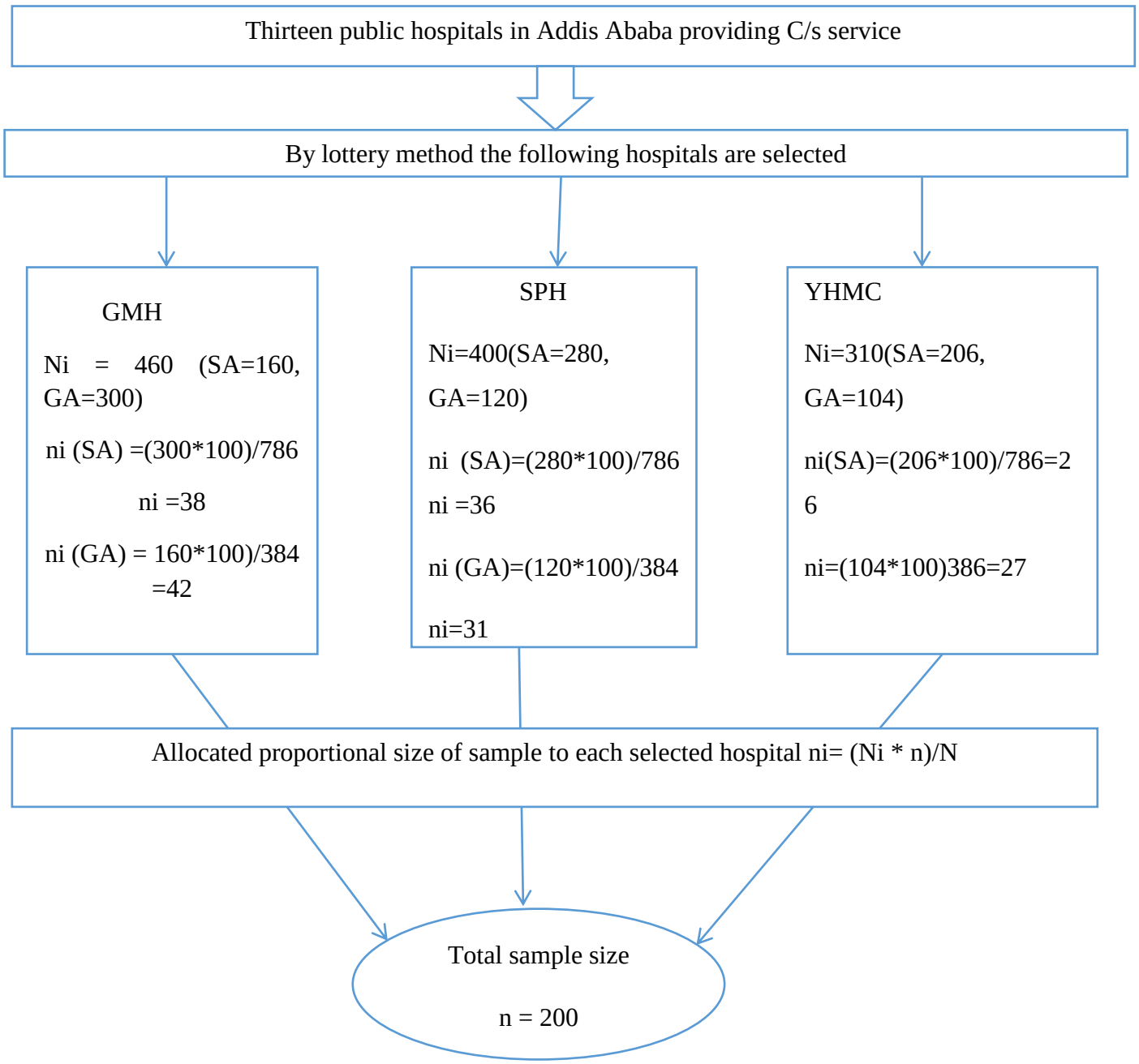


**Figure 1**: Diagrammatic presentation of sampling procedure

## 3.8. Study variables

Dependent/response variable**:** Apgar score of newborn babies from mothers undergoing CS for the indication of non-reassuring fetal status.

Independent Variable

- personal and Socio-demographic factors (age, BMI, occupation, educational level,)
- Gynecological/obstetric and other factors: indication for CS, Gestational age, birth weight, gravidity, parity
- Surgery/anesthesia-related: type of anesthesia, DDI, induction to delivery time, type of agent/s administered.

## 3.9. Data collection

### 3.9.1. Data source, Data collection tools, procedure and personnel

Selected mothers more than 18 years who underwent CS for the indication non-reassuring fetal status was during the study period were recruited for the study after obtaining written informed consent from each parturient. Since all mothers undergo brief preoperative assessment in the preoperative waiting area or in the operating table; the American Society of Anaesthesiologists classification physical status is always determined by the responsible anesthetist and was recorded from the anesthesia record sheet. On the operation table, hemodynamic parameters like heart rate, noninvasive blood pressure, and oxygen saturation were monitored for all parturients throughout the surgery according to the standard of the hospital protocol. The mode of anesthesia technique (General or Spinal anesthesia) was decided by the attending anesthetist. GA was often considered for patients with suspected maternal coagulation disorder, and maternal preference to take GA.

In the siting position, the patients' back was cleaned with iodine. In the meantime, the spinal anesthetic drug and local anesthetic drug for skin infiltration was prepared. After cleaning the iodine with alcohol, 2 mL of 0.5% (10 mg) isobaric bupivacaine was administered at L3-L4 interspace into the subarachnoid space using 25 G spinal needle while mother is in sitting position. Later, the mothers were kept in a supine position. Oxygen was administered for all mothers using nasal prongs despite good hemoglobin oxygen saturation.

For General anesthesia, mothers were positioned supine. They were then preoxygentated with four vital capacity breaths as the mothers 'abdomen was cleaned and draped by the responsible gynecologist/resident with the responsible scrub nurse. Then mothers were induced with rapid sequence induction using the precalculated dose of ketamine or thiopentone. After induction with these drugs, suxamethonium was given for relaxation followed by endotracheal intubation. Then maintenance of anesthesia was done with Isoflurane. Until the delivery of the baby opioids or benzodiazepines were not given. After the newborn was got delivered, fentanyl or pethidine was given to mothers.

The time interval between the decision to delivery and skin incision to delivery was noted. Apgar scores at 1 and 5 min were noted from the gynecologist's/resident's record. Newborns were transferred to the mother's side or neonatal intensive care unit (NICU) as advised by the attending gynecologist/gynecology resident and responsible anesthetist. If the newborn was admitted to NICU, the indication/reason for admission was noted.

Data was collected using pretested structured questionnaires by three BSc holder anesthetists and supervised by one MSc holder anesthetist. After delivery of the fetus, Apgar score determination was done by the attending obstetrician/gynecology resident and attending anesthetist according to the protocol prescribed by the neonatal Advanced Life Support advocated by the American Pediatric Association. NICU admission was also decided by these professionals. Evaluation of the newborn using Apgar scores was done at one and five minutes.

It was based on the appearance (skin color), pulse rate (heart rate), grimace response (reflexes), muscle tone (activity), and respiratory effort of neonate each carrying a score from 0 to 2. Total scores are between 0 and 10 a newborn who scores 7 and above is considered as = satisfactory. Apgar below 7 is considered as = unsatisfactory Apgar score. Apgar score was done as per the protocol of neonatal advanced life support advocated by the American pediatric association (APA).

Data was collected from patient charts and anesthesia record sheets using structured data extraction tools, Cesarean Delivery Outcomes Tracking Tool prepared in English which was

adapted from WHO and other literatures with some adjustment for this study. The questionnaire mainly addressed socio-demographic variables of mothers (age, residence); obstetrics history (parity, gestational age, indication for Cesarean section, etc.); condition of newborn baby particularly Apgar score (Weight of newborn, Gestational age at birth, etc.) decision to delivery interval (decision time and incision time) indication for CS, Profession of the operator (Gyni/obs Specialist/gynecology resident, MD/GP and type of anesthesia used (spinal anesthesia, general anesthesia).

Data was collected by B.Sc. holder anesthetist working in the selected hospital particularly the CS room after appropriate training and orientation. The principal investigator checked the completeness of data every day. Generally, every necessary data for the study was obtained from chart review and asking the attending resident/senior and anesthetist.

### 3.9.2. Data quality control

Training was given for one day to the data collectors. Orientation was also given by the principal investigator (PI) and the supervisor as needed. The principal investigator and the supervisor were closely supervising the data collection on a daily bases. Besides, the PI wisely entered the data into EpiData Entry Client and was carefully cleaned the data before starting the analysis. Overall, data analysis was performed under the supervision of biostatistician.

### 3.9.3. Data Analysis and Interpretation

Data was checked manually for completeness, was coded and entered into Epi info version7 computer software, for cleaning, and then it was exported to SPSS Version 25 for analysis, and analysis was done using this version of SPSS. Descriptive statistics was used to explore the socio-demographic characteristics of patients and data was presented as mean ± Standard deviation for normally distributed and median and interquartile range for asymmetric data. Plot, skewness, and kurtosis, curve with histogram and Shapiro Wilk were used to test the normality of data distributions while homogeneity of equal variance was assessed using Levene's test. Comparison of numerical data between groups was evaluated using Independent t-test. Frequency (proportions) and percentage was used to describe the categorical variable and statistical difference between groups was tested using Chi-square test. P-Value of less than 0.05 was considered as statistically significant.

## 3.10. Ethical considerations

The duration of the study was from November/2019 to May/2020. Ethical clearance was obtained from Addis Ababa University, College of health sciences, school of medicine, anesthesia department ethical clearance committee before the start of the study. The purpose and importance of the study was explained and consent was obtained from each participant for participating in the study. Confidentiality was maintained at all levels of the study by avoiding the name of participants and using codes to identify them. The participant's involvement in this study was on a voluntary basis; participants who were not willing to participate in the study and those who wished to quit their participation at any stage were informed and allowed to do so without any restrictions.

# 4. RESULTS

## 4.1. Socio-demographic characteristics

This prospective cohort study was conducted from November 2019 to May 2020. All the 200 pregnant mothers who were included in the study was analyzed. 147 (73.3%) of them were urban residents and the remaining 53 (26.5%) of the mothers were rural residents. 100 of them took SA and the rest of 100 mothers took GA for the CS. None of the 200 mothers was Alcoholic or smoker. Regarding maternal age, the mean age of mothers was 26.93 ± 4.54 years with the highest and lowest maternal age 37 & 18 years respectively.

One hundred ninety four of the 200 mothers had antenatal follow up during their pregnancy period. The median gestational was 39 (38–40) weeks. The mean fetal birth weight was 2891 ± 2969 gm. There were 4 newborns with intrauterine growth retardation, 2 in each mode of anesthesia. There was no still birth and no neonatal death before ICU admission in both groups. For all the neonates who needed resuscitation in this study facemask connected with 100 % $o_2$ source was used. In this study, fetal bradycardia was the most common indication for non-reassuring fetal heart status 141 (70.5%) followed by fetal tachycardia 59 (29.5%).

Both groups were comparable regarding their socio-demographic status. The mean age of mothers was 26.93 ± 4.54 yrs. The mean height and weight of laboring mothers was 160.41 ± 13.09 centimeter and 63.22 ± 6.95 kg respectively. The mean body mass index of laboring mothers was 24.34 $Kg/m^2$. There was no incidence of block failure in the SA group. The decision to delivery interval was also comparable between the groups with the mean and standard 29.45 ± 5.78 and 29.98 ± 3.8 in spinal and general anesthesia respectively the induction to incision/(SA) to incision was also comparable between the groups. The mean and SD of induction to incision or SA to incision was 8.15 ± 3.13 and 7.48 ± 2.23, $p = 0.082$in SA and GA respectively (Table 1).

**Table 1:** Socio-demographic and personal characteristics of laboring mothers of newborns delivered by cesarean sections for the indication of non-reassuring fetal status under GA and SA in Addis Ababa public Hospitals, 2019/2020

| variable | Mean ± SD | | p-value |
|---|---|---|---|
| | SA | GA | |
| Age (years) | 26.43 ± 4.31 | 27.42 ± 4.73 | 0.64 |
| Height (cm) | 160.95 ± 6.59 | 159.88 ± 17.34 | 0.56 |
| Weight (kg) | 62.33 ± 7.27 | 64.11 ± 6.52 | 0.07 |
| BMI ($kg/m^2$) | 24.06 | 24.62 | 0.133 |

The gestational age, gravida, para, and number of abortions was comparable between both groups (p value > 0.05) (table 2)

**Table 2:** Maternal obstetric conditions of laboring mothers of newborns delivered by cesarean sections for the indication of non-reassuring fetal status under SA and GA in Addis Ababa public Hospitals, 2019/2020

| Variable | Mean ± SD/Median | | p-value |
|---|---|---|---|
| | GA | SA | |
| Gestational age (weeks) | 39 (38-40)** | 39 (38-40)** | 0.126 |
| Gravida | 2.15 ± 1.18* | 1.92 ± 1.07* | 0.151 |
| Para | 1.08 ± 1.07* | 0.79 ± 1.07* | 0.06 |
| Abortion | 0.08 ± 0.27* | 0.09 ± 0.27* | 0.90 |

** represents for median and interquartile range

* represents for mean and standard deviation

An independent-samples t-test was conducted to compare the 1 minute Apgar scores for SA and GA groups. The independent-Sample T-test result showed that there was a significant difference in the mean of 1 minute Apgar score between general and spinal anesthesia groups among newborns delivered by cesarean section for the indication of non-reassuring fetal heart status i.e. (Mean = 7.28, SD = 1.16) and (M = 6.64, SD = 1.44; p = 0.001) for SA and GA respectively.

The result indicated that the mean Apgar score of newborns who were delivered under SA was significantly better than those newborns were delivered under GA (table 3).

**Table 3**: Mean Apgar score at 1 and 5 minute among newborns delivered by C/S for the indication of on reassuring fetal status under SA and GA in Addis Ababa public Hospitals, 2019/2020.

| Apgar score | Spinal anesthesia (n = 100) | General anesthesia (n = 100) | p-value |
|---|---|---|---|
| 1 minute (mean + SD) | 7.28 ± 1.16 | 6.64 ± 1.44 | 0.001 |
| 5 minute (mean + SD) | 8.12 ± 1.12 | 7.86 ± 1.17 | 0.59 |

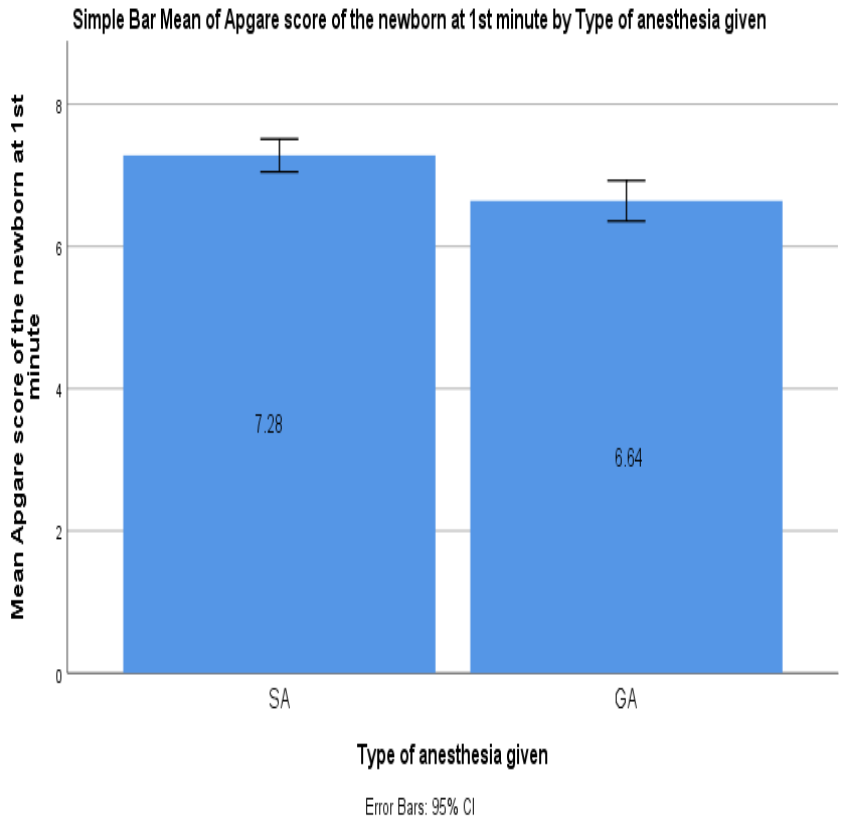


**Figure 2**: Comparison of 1 minute mean Apgar score among newborns delivered by CS under SA vs GA for the indication of NRFS in 2019/2020 in Addis Ababa public Hospitals.

In contrary to the significant mean difference in 1 minute Apgar score, the 5 minute Apgar score did not show a significant difference. The independent–T-test showed that there was no significant difference in the mean of 1 minute Apgar score between general and spinal anesthesia groups among newborns delivered by cesarean section for the indication of non-reassuring fetal heart status. The result was M = 8.12, SD = 7.12 and M = 7.86, SD = 1.27; t (200) = 1.62, p = 0.59) among spinal anesthesia vs. general anesthesia groups respectively.

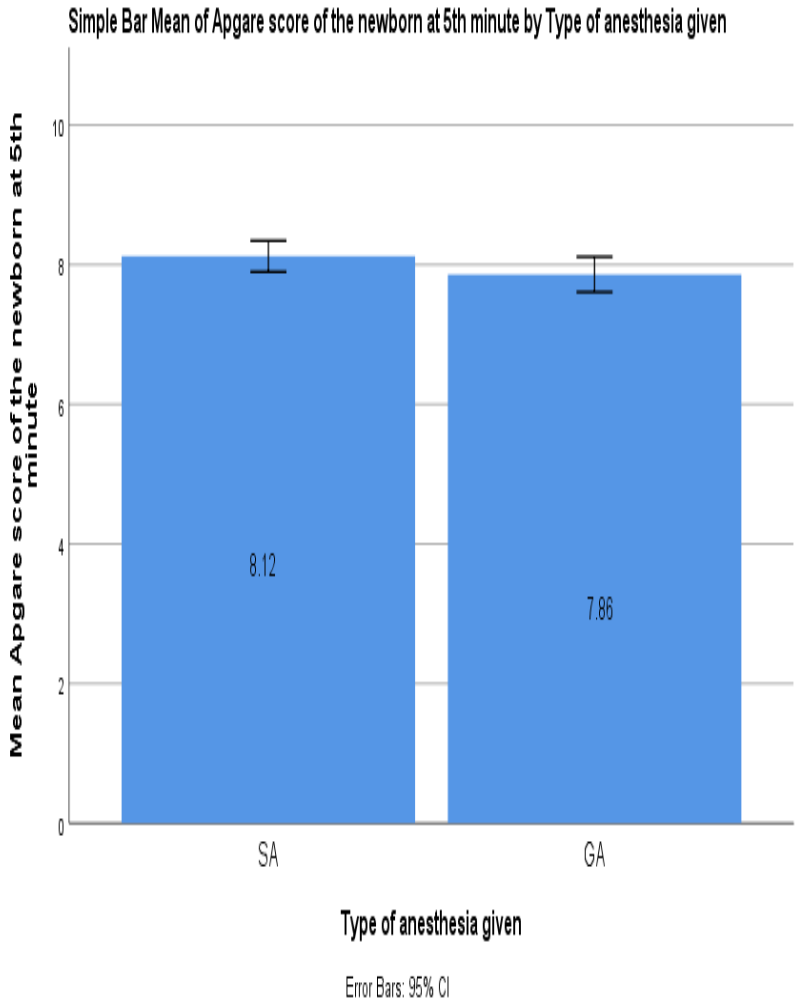


**Figure 3**: Comparison of 5 minute mean Apgar score among newborns delivered by CS under SA vs GA for the indication of NRFS in 2019/2020 in Addis Ababa public Hospitals.

On the other hand, Apgar score can be categorized into two low Apgar score (<7) and satisfactory Apgar score (7 and above). To compare spinal and general anesthesia 36% of the

newborns delivered by C/S under General anesthesia had low Apgar score (<7) and 18% of the newborns delivered under spinal anesthesia low Apgar score. But when we see the proportion low 5 minute Apgar score, it is 15% and 8% in GA and SA respectively (Fig. 4).

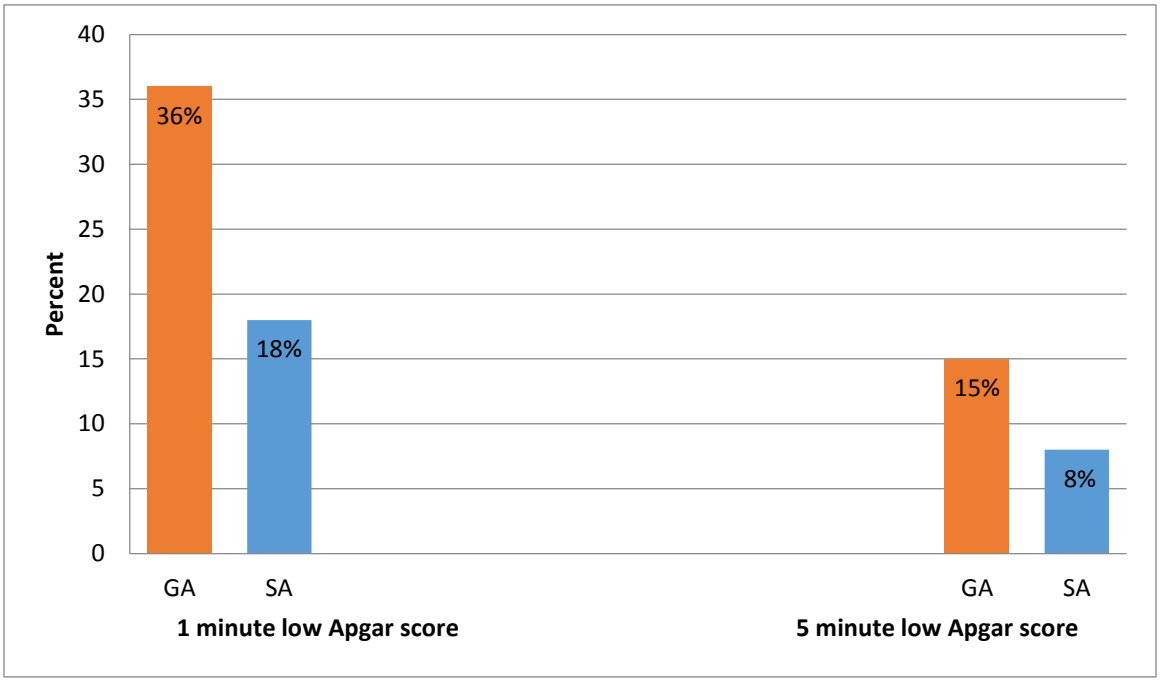


**Figure 4**: Comparison percentage of low Apgar score at 1 and 5 minute among newborns delivered by C/S for the indication of non-reassuring fetal heart status under SA vs GA for the indication of NRFS in in Addis Ababa public Hospitals, 2019/2020

Chi-square test was done to detect if there is any association between level of low 1 minute Apgar score (<7) and type of anesthesia among newborns delivered by C/S for the indication of non-reassuring fetal heart status under general and spinal anesthesia. All expected cell frequencies were greater than five.

The Chi-square test for independence (Continuity Correction) indicated that there is a significant association between the low level of 1 minute Apgar score and type of anesthesia in this group newborns, $\chi 2$ (1) = 7.33, $p$ = .007. This means that the proportion of low Apgar score in GA group is significantly different from the proportion of low Apgar score in SA group. Therefore, the chi-square test indicated that newborns delivered under GA are more likely to have low Apgar score than newborns delivered under SA.

Since the effect size/) phi coefficient = value is 0.2, according to Cohen's (1988) criteria of .10 for small effect, .30 for medium effect and .50 for large effect. The type/mode of anesthesia had a moderate effect on the level of 1 minute Apgar score.

A chi-square test of independence was conducted between the level of low (<7) 5 minute Apgar score and type of anesthesia among newborns delivered by C/S for the indication of non-reassuring fetal heart status under general and spinal anesthesia. All expected cell frequencies were greater than five.

The Chi-square test for independence (Continuity Correction) indicated that there was no statistically significant association between low 5 minute Apgar score and type of anesthesia in this group newborns, $\chi 2$ (1) = 1.77, $p$ = 0.18. Phi coefficient = 0.1. This means that the proportion of low 5 minute Apgar score in GA group is not significantly different from the proportion of low 5 monute Apgar score in SA group. Therefore, the chi-square test indicated that newborns delivered under GA have no significantly different chance of having low 5 minute Apgar score than newborns who delivered under SA.

The total NICU admission was 35 (17.5%) of the total newborns included in our study. Of these 35 neonates admitted to NICU 16 (16%) of them are from SA group and 19 (19%) of them are from GA group. (Table 5)

**Table 4**: the proportion of NICU admission by type of anesthesia among newborns delivered by C/S for the indication of non-reassuring fetal heart status under SA vs GA for the indication of NRFS in 2019/2020 in Addis Ababa public Hospitals.

| Type Of Anesthesia | NICU Admission (%) | Total (%) |
|---|---|---|
| General Anesthesia | 19 (19) | 19 (19) |
| Spinal Anesthesia | 16 (16) | 16 (16) |
| Total | 35 (17.5) | 35 (17.5) |

A chi-square test of independence was conducted between NICU Admission and type of anesthesia among newborns delivered by C/S for the indication of non-reassuring fetal heart status under general and spinal anesthesia. All expected cell frequencies were greater than five.

The Chi-square test for independence (continuity correction) indicated that there was no statistically significant association between NICU admission and type of anesthesia $\chi 2$ (1) = 0.14, p = 0.7.

The association was small (Cohen, 1988) phi coefficient = 0.04. This means that the proportion of NICU admission in GA group is not significantly different from the proportion NICU admission in SA group. Therefore, the chi-square test indicated that newborns delivered under GA have no significantly different chance of NICU admission than newborns who delivered under SA.

# 5. DISCUSSION

The anesthetic management of pregnant mothers coming for C/S with the indication of non-reassuring fetal heart status is difficult for both the obstetric anesthesiologist and obstetrician. The consequence of undiagnosed or poorly managed perinatal emergencies can have a devastating effects ranging from neurologic deficits to fetal death. Intrauterine asphyxia at term remains a significant cause of infant death and different development impairments. There is a controversy in the choice of anesthesia in these situations. The choice of anesthesia in these critical situations consists of general anesthesia with rapid-sequence induction or fast spinal anesthesia. The choice of anesthesia depends on the preference and the skill of the anesthetist (26).

Various confounding factors such as socio-demographic factors and perioperative factors may have a negative or positive effect on fetal outcome. In our study factors such as age, BMI, weight, height, para, gravida, and previous abortion were comparable between the two groups. Other factors that could affect the result had also been excluded from our study; thus the difference in 1 minute Apgar score, 5 minute Apgar score and NICU admission between the two groups were likely due to the type of anesthesia given for the mothers.

The findings in this study showed that pregnant mothers received spinal anesthesia had significantly better fetal outcome when compared to pregnant mothers who received general anesthesia for cesarean section for the indication of non-reassuring fetal status. There was no stillbirth in both groups and also there was no neonatal death before NICU admission.

In a study in India (2018) in both GA and SA groups, 34 (29.8%) newborns were admitted to NICU, 10 (21.3%) in SA group, P = 0.095). This was in line with our study in which the total Admission rate was 35 (17.5%) and the NICU admission in SA was 16% (95% CI, 9.8% - 24.1%) P = 0.57. On the other hand, the NICU in in GA group in this study was 24 (35.8%), P = 0.095. This was higher than our study in which NICU admission in GA was 19% (95% CI, 12.3%-27.5% P = 0.57. This could be because due to the availability of adequate NICU set up in their study hospital than ours. Since they have adequate NICU setup they might admit all neonates in need of NICU admission. However, in Ethiopia we can't admit all neonates in need of NICU because of shortage of NICU setup. So, in the study above in India there was no

statistically significant association between type of anesthesia and NICU Admission p = 0.095. Our study also revealed that the type of anesthesia was not associated with NICU admission (*p = 0.57* ) (25).

In another study conducted in Nigeria in 2019, the total NICU admission was 14%. The NICU admission by type of anesthesia was 14.3% in SA and 85.7% in GA p = 0.000. This was in line with our study regarding SA, (95% CI 9.8%-24.1 p 0.57). But the NICU admission in GA (85.7%) was higher than ours (95% CI, 12.3%-27.5 p 0.57). this could be due to lack of adequate NICU setup in our study area.

In our study, the 1 minute Apgar score was significantly lower in the GA group when compared with the SA group. The mean and SD of 1 minute Apgar score was 7.28 ± 1.16 and 6.64 ± 1.44 in SA and GA respectively with a mean difference of 0.64; (95 CI 0.27-1.00 p = 0.001). This was in line with a study conducted in India by Chitra et al in which the median and interquartile range was [8 (8–8) vs 7.5 (4–8), p = 0.02] in SA and GA respectively. In contrary to the 1 minute the Apgar score, the 5 minute Apgar score didn't show significant difference between the two groups. The median & interquartile range in this study was 8 (8–8) vs [7.5 (4–8), *p = 0.057*]. And mean & SD of 5 minute Apgar score in our study was 8.12 ± 1.12 and 7.86 ± 1.27 in SA and GA respectively with a mean difference of 0.26; (95 CI -0.07-0.59 p = 0.13).This was also in line with our study (25).

Another study conducted in India showed that Apgar score at 1 minute was higher in SA group than the GA group. The mean and SD of 1 minute Apgar score in this study was 8.44 ± 0.51and 6.90 ± 0.71in SA and GA respectively (*p = <0.001*) which was comparable with our study. Apgar score at 5 minute was also higher in SA group than the GA group with a mean and SD of 9.71 ± 0.25 in SA and 9.04 ± 0.77 in GA, *p = <0.001*. this was not in line with our study, in which the 5 minute was comparable between GA and SA this could be because we use facemask to resuscitate all newborns who need resuscitation even for those who have mild depression(26). G. F. Marx and co-workers reported that the mean 1 minute Apgar score was significantly lower in newborns delivered under GA group than those delivered under RA (<0.01). At 5 minute the difference between in Apgar score of newborns between the two groups was not statistically significant. This was comparable with our study which showed there was a

significant difference in 1 minute Apgar score and no significant difference in 5 minute Apgar score of newborns delivered by C/S for the indication of non-reassuring fetal status (28).

Another Prospective cohort in India which 16.4% of mothers had undergone CS for the indication of fetal distress under spinal anesthesia and general anesthesia showed that the mean 1 minute Apgar score showed a significant difference (7.66 ± 1.27 and 6.52 ± 1.16) in SA and GA respectively but the mean 5 minute Apgar score didn't show any significant difference which was in line with our study (23).

In a study by Vanita Ahuja *et al* in 2011Apgar score record at 1 minute was significantly higher in SA groups when compared to GA groups. The mean and SD in this study was 6.07 ± 0.96 in GA and 6.87 ± 0.35 in SA with a mean difference of 0.8, *p = 0.04*. This is in line with our study, (95 CI 0.27-1.00 p = 0.001). When we compare the 5 minute mean Apgar score, it was 8.20 ± 0.94 in GA and 9.00 ± 0.00 in SA with a mean difference of 0.8, *p = 0.03.* This is higher than our study. This difference could be because pediatrician and anesthesiologist were participated in the resuscitation of the newborns (29).

A study in India in 2016 that compared rapid sequence general anesthesia and rapid sequence spinal anesthesia showed that; there was no significant differences in 5 minute mean Apgar score between the two groups (GA: 7.03 ± 1.99 vs. SA: 7.40 ± 1.83, *P = 0.461*) which were concurrent with our study (30). Another study by Beckmann also found that GA for category 1 CS is associated with low Apgar score which is also concurrent with our study. (25) In addition to that Hiroyuki Sumikura concludes that GA should be avoided even in emergency CS whenever possible because of its side effects (31).

Sri Wahjoeningsih & Widowati Witjaksono revealed that 1 Apgar score of the SA group was significantly higher than the GA group. The median 1 minute Apgar score was 7, p = 000. This finding was in line with our study. On the other hand the median 5 minute Apgar score was 8 which was comparable between the groups *p = .0.05*which is also in line with our study.

Another research conducted in turkey also showed that the 1 minute Apgar score was significantly lower in GA group when compared with SA. The mean and SD was 6.84 ± 1.65 in SA and 6.07 ± 1.61 in GA group with a mean difference of 0.77, (p = 0.045) . This was

concurrent with our study. However, the 5 minute Apgar score did not show a significant difference between the two groups. The 5 minute mean Apgar score in GA was 8.45 ± 1.52 and that of SA was 8.55 ± 1.92 with the mean difference of 0.1, $p = 0.46$. This is in line with our study which showed insignificant difference between the two groups (8).

## 6. Conclusions and Recommendations

It is found that newborns delivered under spinal anesthesia had better mean Apgar score when compared with GA. So, we conclude that spinal anesthesia is better option than general anesthesia for mothers undergoing C/S for the indication of non-reassuring fetal status. NICU admission is not significantly different between the two groups. Hence, we recommend:-

**To Anesthetist**

Spinal anesthesia for mothers undergoing C/S for the indication of non-reassuring fetal status.

**To researchers**

Further study with a randomized control design is recommended

## 7. Strengths and Limitations of the study

We have tried to make the two groups comparable in terms of socio-demographic characteristics, perioperative factors that affect the Apgar score and the same surgical procedure so that the difference observed may be due to exposure factors. However, the Apgar score may not be reflecting the real newborn status since it is subjective. Measuring blood PH is the reasonably reliable indicator of fetal status but we didn't consider it in our study since, this is not available in our study area and all over the country**.** We don't have information on neonatal condition after NICU Admission because we didn't follow them in ICU.

## REFERENCES


1. Gravett C, Eckert LO, Gravett MG, Dudley DJ, Stringer EM, Bodjick T, et al. Non-reassuring fetal status : Case definition & guidelines for data collection , analysis , and presentation of immunization safety data. Vaccine [Internet]. 2016;34(49):6084–92. Available from: http://dx.doi.org/10.1016/j.vaccine.2016.03.043

2. Kim WH, Hur M, Park S, Yoo S, Lim T, Yoon HK, et al. Comparison between general , spinal , epidural , and combined spinal-epidural anesthesia for cesarean delivery : a network. Int J Obstet Anesth [Internet]. 2019;37:5–15. Available from: https://doi.org/10.1016/j.ijoa.2018.09.012

3. Lie SA, Mok MUS. Peri-operative management of caesarean section for the occasional obstetric anaesthetist – an aide memoire. Proc Singapore Healthc. 2017;26(3):180–8.

4. Abdissa Z, Awoke T, Belayneh T, Tefera Y. Birth outcome after caesarean section among mothers who delivered by caesarean section under general and spinal anesthesia at Gondar University teaching hospital north-west Ethiopia. J Anesth Clin Res. 2013;4(7):4–8.

5. Gibbons L, Belizán JM, Lauer JA, Betrán AP, Merialdi M, Althabe F. The Global Numbers and Costs of Additionally Needed and Unnecessary Caesarean Sections Performed per Year: Overuse as a Barrier to Universal Coverage World Health Report (2010) Background Paper, 30 HEALTH SYSTEMS FINANCING. World Heal Rep. 2010;

6. Saygı Aİ, Özdamar Ö, Gün İ, Emirkadı H, Müngen E, Akpak YK. Comparison of maternal and fetal outcomes among patients undergoing cesarean section under general and spinal anesthesia: a randomized clinical trial. Sao Paulo Med J. 2015;133(3):227–34.

7. Jenniskens K, Janssen PA. Newborn Outcomes in British Columbia After Caesarean Section for Non-Reassuring Fetal Status. J Obstet Gynaecol Canada [Internet]. 2015;37(3):207–13. Available from: http://dx.doi.org/10.1016/S1701-2163(15)30306-6

8. Edipoglu IS, Celik F, Marangoz EC, Orcan GH. Effect of anaesthetic technique on neonatal morbidity in emergency caesarean section for foetal distress. PLoS One.

2018;13(11):e0207388.

9. Abdallah MW, Elzayyat NS, Abdelhaq MM, Gado AAM, Dick WF, Dahl V, et al. Caesarean section for fetal distress. Int J Obstet Anesth [Internet]. 2016;4(2):4–8. Available from: http://dx.doi.org/10.1186/s40981-016-0037-6

10. Nwafor MI, Aniebue UU, Nwankwo TO, Onyeka TC, Okafor VU. Perinatal outcome of preterm cesarean section in a resource ‐ limited centre : A comparison between general anaesthesia and subarachnoid block. 2014;17(5):613–8.

11. Abdallah MW, Elzayyat NS, Abdelhaq MM, Gado AAM. A comparative study of general anesthesia versus combined spinal-epidural anesthesia on the fetus in cesarean section. Egypt J Anaesth [Internet]. 2014;30(2):155–60. Available from: http://dx.doi.org/10.1016/j.egja.2013.12.002

12. Ajah LO, Ibekwe PC, Onu FA, Onwe OE, Ezeonu TC, Omeje I. Evaluation of clinical diagnosis of fetal distress and perinatal outcome in a low resource Nigerian setting. J Clin Diagnostic Res. 2016;10(4):QC08-QC11.

13. Algert CS, Bowen JR, Giles WB, Knoblanche GE, Lain SJ, Roberts CL. Regional block versus general anaesthesia for caesarean section and neonatal outcomes: A population-based study. BMC Med. 2009;7:1–7.

14. Algert CS, Bowen JR, Giles WB, Knoblanche GE, Lain SJ, Roberts CL. Regional block versus general anaesthesia for caesarean section and neonatal outcomes : a population-based study. 2009;7:1–7.

15. Gurvani DR, Chandrakar DDV. Rapid Sequence Spinal Anesthesia Vs General Anesthesia for Category-I Urgency Caesarean Section. Int J Innov Res Med Sci. 2018;3(01):1608–11.

16. Hanoof A, M AA, S AF, A AD, O AA, Zakai Ghadeer H, Alrowithi Abdullah S, Buhlaigah Afnan M, Alharbi Abdullah A, Hakami Abrar H A, et al. Prevalence of caesarean section and its indicating factors among pregnant women attending delivery at King Abdulaziz University Hospital, Jeddah city during 2016. EC Gynaecol [Internet]. 2018;7.2(2):43–51. Available from: https://www.ecronicon.com/ecgy/pdf/ECGY-07-

00187.pdf

17. SAMUTUMWA NJEKWA. Immediate Fetal Outcomes of Caesarean Sections Done for Fetal Distress At Term At University Teaching Hospital Lusaka Zambia. Dissertation Submitted to the University of Zambia in Partial Fullfillement of the Requirements for the Degree of Master of Medic. 2014;1–25. Available from: http://dspace.unza.zm:8080/xmlui/bitstream/handle/123456789/3571/Samutumwa.pdf?sequence=1

18. Dahl V, Spreng UJ. Anaesthesia for urgent (grade 1) caesarean section. Curr Opin Anaesthesiol. 2009;22(3):352–6.

19. Ige O, Ruth A, John C, Stephen A, Toma B. Knowledge and application of APGAR score among residents in a tertiary hospital. Sahel Med J. 2015;18(1):9.

20. Collier C. Is a non-touch technique really necessary for spinal/epidural needle insertion? [7]. Int J Obstet Anesth. 2003;12(2):144–5.

21. Afolayan JM, Olajumoke TO, Esangbedo SE, Edomwonyi NP. Spinal anaesthesia for caesarean section in pregnant women with fetal distress: Time for reappraisal. Int J Biomed Sci. 2014;10(2):103–10.

22. Gurung RT, Gurung G, Shrestha R, Gurung T, Sharma P. Prevalence and Outcome of Cesarean Section at Gandaki Medical College Teaching Hospital and Research Centre, Pokhara, Nepal. J Gandaki Med Coll. 2017;9(2):1–6.

23. Chattopadhyay S, Das A, Pahari S. Fetomaternal outcome in severe preeclamptic women undergoing emergency cesarean section under either general or spinal anesthesia. J Pregnancy. 2014;2014.

24. Dyer RA, Els I, Farbas J, Torr GJ, Schoeman LK, James MF. Prospective, randomized trial comparing general with spinal anesthesia for cesarean delivery in preeclamptic patients with a nonreassuring fetal heart trace. Anesthesiology. 2003;99(3):561–9.

25. Chitra Rajeswari Thangaswamy, Pankaj Kundra SVLNA, Veena P. Basics of CPB. Indian J Anaesth. 2005;49(4):257–62.

26. Wahjoeningsih S, Witjaksono W. Evaluation of anaesthesia methods in caesarean section for foetal distress. Malaysian J Med Sci. 2007;14(2):41–6.

27. K.S S. Comparison of Apgar Score in Neonates: Spinal Versus Genaral Anaesthesia for Elective Caesarean Section. J Evol Med Dent Sci. 2014;03(03):538–43.

28. Marx GF, Luykx WM, Cohen S. FETAL-NEONATAL STATUS FOLLOWING CAESAREAN SECTION FOR FETAL DISTRESS. Br J Anaesth [Internet]. 1984;56(9):1009–13. Available from: http://dx.doi.org/10.1093/bja/56.9.1009

29. Jain K, Kaur J, Ahuja V, Ghai B, Datta S. Best neonatal outcome following emergency cesarean delivery in nonreassuring fetal heart rate: General or a low-dose spinal anesthesia. J Obstet Anaesth Crit Care. 2011;1(2):67.

30. Bhattacharya S, Chattopadhya U, Saha D, Saha M, Ghosh S, Bisai S. Rapid sequence spinal anesthesia versus general anesthesia: A prospective randomized study of anesthesia to delivery time in category-1 caesarean section. J Obstet Anaesth Crit Care. 2016;6(2):75.

31. Sumikura H. Anesthetic management of urgent cesarean section. Hypertens Res Pregnancy. 2016;4(1):1–5.

32. Id A, Author NC, Jung M, Author SS, Jung M, Authors SO, et al. Does the Decision-to-incision Time Affect Neonatal Outcomes in the Emergency Cesarean Section ? Does the Decision-to-incision Time Affect Neonatal Outcomes in the Emergency Cesarean Section ? 2016;1–6.

33. Ayano B, Guto A. Indications and Outcomes of Emergency Caesarean Section at St Paul ' s HospitalMedical College , Addis Ababa , Ethiopia 2017 : ( Afoul Month Retrospective Cohort Study ). 2018;

34. Ajah LO, Ibekwe PC, Onu FA, Onwe OE, Ezeonu TC, Omeje I. Evaluation of clinical diagnosis of fetal distress and perinatal outcome in a low resource Nigerian setting. J Clin Diagnostic Res. 2016;10(4):QC08-QC11.

35. Saygı Aİ, Özdamar Ö, Gün İ, Emirkadı H, Müngen E, Akpak YK. Comparison of maternal and fetal outcomes among patients undergoing cesarean section under general and spinal anesthesia: a randomized clinical trial. Sao Paulo Med J. 2015; 133(3):227–34.

## Annex I

### Apgar stands for

"Appearance, Pulse, Grimace, Activity, and Respiration."

1) **A**ppearance (skin color)
2) **P**ulse (heart rate)
3) **G**rimace response (reflexes)
4) **A**ctivity (muscle tone)
5) **R**espiration (breathing rate and effort)

| Apgar Sign | 0 | 1 | 2 |
|---|---|---|---|
| **Appearance** (skin color) | Bluish-gray or pale all over | Normal color (but hands and feet are bluish) | Normal color all over (hands and feet are pink) |
| **Pulse** (heart rate) | Absent (no pulse) | Below 100 beats per minute | Normal (100beats per minute and above) |
| **Grimace** ("reflex irritability") | Absent (no response to stimulation) | Facial movement only (grimace) with stimulation | Pulls away, sneezes coughs or cries with stimulation |
| **Activity** (muscle tone) | No movement "floppy" tone | Arms and legs flexed with little movement | Active, spontaneous movement |
| **Respiration** (breathing rate and effort) | Absent (no breathing) | Slower or irregular breathing, weak cry) | Normal rate and effort |

Apgar scoring based on neonatal advanced life support advocated by the American Pediatric association.

## Annex II Assurance of principal investigator

I the undersigned agrees to accept responsibility for the scientific ethical and technical Conduct of the research project and for provision of required progress reports as Per terms and conditions of the Research Publications Office in effect at the time of Grant is forwarded as the result of this application.

**Name of the principal investigator:**

Date. June Signature _____

**Name of the advisor:**

Date. June Signature _____

## Annex III Information sheet

Hello.

My name is _____.

I am a researcher and I have been attending a postgraduate program in the field of Anesthesia Addis Ababa University. I am going to conduct a research on, **comparing the effect of anesthetic technique on fetal outcome among mothers undergoing cesarean section for non-reassuring fetal status** from November 2019 to March 2020 in Gandhi memorial hospital, St. Paul's hospital millennium medical college. The information going to be obtained will help the government and other responsible bodies to improve neonatal outcome. Your participation is very valuable for the success of this project. Also be mindful that whatever we will get here is for research purposes only and the information will not be used by any other person apart from this research and therefore, confidentiality cannot be guaranteed. However, your names will not be mentioned or be attached to anything that you say.

Do you want to continue yes---------- No---------- (Thank you in advance for your help)

Name and contact address of investigator: Berihu Tadesse

Email: berihutadesse100@gmail.com Cell phone +251-914-20-48-27

Identification card no. ----------

## Annex IV Questionnaire

### Part I: Personal and socio-demographic characteristics

| | | | Remark |
|---|---|---|---|
| 1 | Age | | |
| 2 | weight | | |
| 3 | height | | |
| 4 | Occupation | Housewife……1<br>Governmental employee……2<br>Merchant……3<br>Daily laborer……..4<br>Student……...5 | |
| 5 | Residence | Urban……1<br>Rural…….2 | |
| 6 | Smoking status | Smoker…….1<br>Non-smoker…….2 | |
| 7 | Alcohol drinking | Alcohol drunker……..1<br>Non-Alcohol drunker……..2 | |
| 8 | Education status | No (illiterate)……..1<br>Primary school……2<br>High school…….3<br>College……4<br>University……5<br>Other(please specify)……...6 | |

MRN……..

**Part II. Clinical characteristics**

| | | | |
|---|---|---|---|
| 9 | Pregnancy state | Gravida_____ Para_____<br>Abortion_____ | |
| 10 | Gestational age(in weeks) | | Remark |
| 11 | Type of pregnancy | Single……1<br>Twin …….2<br>Multiple……3 | |
| 12 | ANC follow up | Yes……..1<br>No……2 | |
| 13 | Does the fetus have IUGR? | Yes……..1<br>No……2 | |
| 14 | Maternal Co-existing diseases (if she has co-existing disease) | Hypertension……1<br>Diabetes mellitus …….2<br>Asthma ……3<br>PIH……...4<br>Renal disease……...5<br>Others (specify)……...6 | |
| 15 | Indication for C/S | Fetal bradycardia……1<br>Fetal tachycardia……2<br>Non reassuring fetal heart rate…3<br>Meconium in liquor……4<br>Others (specify) …….5 | |
| 16 | Fetal heart rate just before anesthesia given | | |
| 17 | Uterotonic drugs administered | Oxytocin……..1<br>Ergometrine…….2<br>Other (please specify)…..3 | |
| 18 | Dose and route administration, if uterotonic drug was administered | | |
| 19 | Maternal Vital sign before anesthetic agent administered | BP……<br>SPO2……<br>HR…….. | |

| | | | |
|---|---|---|---|
| 20 | Maternal Vital sign 1 minute after anesthetic agent administered | BP……<br>SPO2……<br>HR…… | |
| 21 | Maternal Vital sign 3 minutes after Anesthetic agent administered | BP……<br>SPO2……<br>HR…… | |
| 22 | Maternal Vital sign 6 minutes after Anesthetic agent administered | BP……<br>SPO2……<br>HR…… | |
| 23 | Maternal Vital sign 9 minutes after Anesthetic agent administered | BP……<br>SPO2……<br>HR…… | |
| 24 | Maternal Vital sign 12 minutes after Anesthetic agent administered | BP……<br>SPO2……<br>HR…… | |
| 25 | Fluid administered for Preloading? | Yes……1<br>If yes specify the type of fluid<br>…….<br>No……..2 | |
| 26 | Amount of preloading (if preloaded) | If the answer for the above question is yes, write the amount of fluid given in ml ……. | |
| 27 | Does prophylactic vasopressor used before giving SA? | Yes----------1<br>If yes, specify the drug and write it's dose_____<br>No----------2 | |
| 28 | Does vasopressor used for treatment of hypotension before delivery of the fetus? | Yes…….1<br>If yes specify the drug used…….<br>No……2 | |
| 29 | Type of anesthesia | SA……1 GA……..2 | |
| 30 | Operator status | Resident……...1 | |

| | | | |
|---|---|---|---|
| | | Senior……...2 | |
| 31 | Time taken to give SA | | |
| 32 | Time taken to give GA | | |
| 33 | Induction to incision time | | |
| 34 | Decision to delivery time | | |
| 35 | Induction to delivery time | | |
| 36 | Skin incision to delivery time | | |
| 37 | Uterine incision to delivery time | | |
| 38 | Anesthetic agents used and dose given for induction | | |
| 39 | Maintenance used and dose/MAC used | | |
| 40 | Drug/s used for SA and its dose | | |
| 41 | Adjuvants used for SA and dose given (if used) | | |
| 42 | Sex of the newborn | Male……..1 Female……...2 | |
| 43 | Apgar score | At 1 minute……..1<br>At 5 minute …….2<br>After resuscitation at 5 minute (if resuscitation was done) …….3 | |
| 44 | Fetal birth weight | | |
| 45 | Type of Neonatal resuscitation (if done) | Assisted ventilation (facemask) …..1<br>Nasal continuous airway support….2<br>Intubation and ventilation……3<br>Cardiopulmonary resuscitation……4 | |
| 46 | NICU admission | Yes……1<br>If yes what was the indication for NICU admission_____<br>No……..2 | |
| 47 | Stillbirth | Yes……..1 No……2 | |