**ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE**

**DEPARTMENT OF ANESTHESIA**

# RESEARCH THESIS ON COMPARING HEMODYNAMIC RESPONSE TO LMA INESRTION VERSUS ENDOTRACHEAL INTUBATION IN SURGICAL PATIENTS, A PROSPECTVE OBSERVATIONAL COHORT STUDY,ADDIS ABABA ETHOPIA.

A RESEARCH THESIS SUBMITTED TO THE DEPARTMENT OF ANESTHESIA, ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ANESTHESIA.

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## ADDIS ABABA UNIVERSITY

## COLLEGE OF HEALTH SCIENCES

## DEPARTMENT OF ANESTHESIA

RESEARCH THESIS ON COMPARING HEMODYNAMIC RESPONSE TO LMA INESRTION VERSUS ENDOTRACHEAL INTUBATION IN SURGICAL PATIENTS, A PROSPECTVE OBSERVATIONAL COHORT STUDY,ADDIS ABABA ETHOPIA.

I agree, as the person signing this, to whole responsibilities for the scientific and ethical validity of this research project and declare that this thesis is my own work in partial fulfillment of the requirement for the Masters of Science in Anesthesia.

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## Acronym and Abbreviation

| | |
|---|---|
| ETT | Endotracheal Tube |
| ETI | Endotracheal intubation |
| BP | Blood Pressure |
| DBP | Diastolic Blood Pressure |
| HR | Heart Rate |
| LMA | Laryngeal Mask Airway |
| SPSS | Statistical Package for social science |
| SBP | Systolic blood pressure |
| MAP | Mean arterial pressure |
| OPV | Oral pharyngeal view |
| ASA | American Society of Anesthesiologist |
| BMI | Body mass index |

# ABSTRACT

**Introduction:** Effective airway management is essential in anesthesia, with endotracheal intubation (ETI) widely regarded as the standard technique. However, ETI is associated with significant hemodynamic responses due to sympathetic stimulation during laryngoscopy, which may pose risks, particularly in patients with cardiovascular compromise. Laryngeal mask airways (LMAs) offer a less invasive alternative and are increasingly used in clinical practice. Despite their growing adoption, limited evidence exists comparing the hemodynamic effects of LMA insertion versus ETI in surgical patients.

**Objective:** To compare the hemodynamic response to Laryngeal Mask Airway insertion versus Endotracheal Tube intubation among surgical patients at selected governmental hospitals in Addis Ababa from January 1, 2025 to April 15, 2025.

**Methods:** An institution-based, multi-center prospective cohort study was conducted at selected governmental hospitals in Addis Ababa from January 1, 2025, to May 2025. The study included surgical patients scheduled for elective surgery under general anesthesia. A consecutive sampling technique was used to select 81 patients for each group: those receiving LMA and those undergoing endotracheal intubation. Hemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP)were recorded at baseline (before induction), immediately after induction, at 1 min, 5mins, 10mins, 15mins and 20 minutes after airway insertion. The collected data were entered and analyzed using SPSS version 25. An independent *t*-test was used to compare hemodynamic changes between the LMA and ETT groups. A *p*-value of $<0.05$ was considered statistically significant.

**Result:** There was a statistically significant difference between the two groups in terms of age, height, weight, BMI, and sex distribution ($P < 0.001$). The mean pulse rate was consistently higher in the LMA group than in the ETT group at all measured time intervals, with the highest mean observed at 5 minutes post-insertion ($87.81 \pm 11.42$ bpm vs. $81.46 \pm 9.45$ bpm(beats per minute), $P < 0.001$). Systolic and diastolic blood pressures were also significantly elevated in the ETT group across all time points ($P < 0.001$), with the peak systolic pressure reaching $94.3 \pm 6.1$ mmHg in the ETT group compared to $83.7 \pm 10.1$ mmHg in the LMA group at 5 minutes. Similarly, diastolic pressure peaked at $72.1 \pm 4.9$ mmHg in the ETT group versus $65.8 \pm 7.3$ mmHg in the LMA group. These findings indicate that ETT insertion is associated with a greater and more sustained hemodynamic response than LMA. Regarding oxygen saturation, $SpO_2$ remained within normal limits in both groups throughout the study period. However, statistically significant differences were observed at the 10th and 15th minutes, with slightly higher values in the ETT group ($p = 0.001$ and $p < 0.0001$, respectively), although these differences were not clinically significant.

**Conclusion:** This study concludes that endotracheal intubation (ETT) is associated with greater hemodynamic disturbances—specifically higher systolic, diastolic compared to laryngeal mask airway (LMA) insertion, while LMA was linked to higher pulse rates. Despite these differences, both techniques maintained effective oxygenation.



**Keywords: Hemodynamic parameters, laryngeal mask airway, endotracheal tube**

# Chapter One: Introduction

## 1.1. Background of the Study

Airway management is a cornerstone of anesthesia, emergency, and critical care medicine. Among the various airway management techniques, Endotracheal tube intubation (ETI) is the gold standard procedure for airway management (15). ETI involves direct laryngoscopy to place a tube into the trachea, ensuring airway patency, prevention of aspiration, and effective delivery of anesthetic gases. Direct laryngoscopy and intubation, first demonstrated by King et al. in 1951, were initially considered safe. In contrast, the Laryngeal Mask Airway (LMA) is a supraglottic airway device designed to sit above the vocal cords, providing a less invasive alternative to ETI. It was introduced in April 2007 by Intavent Orthofix Co. (Maidenhead, UK), the LMA-S features an oval-shaped airway tube that facilitates easier insertion without the need for manual manipulation within the patient's mouth (10). So far, many studies have been conducted on the use of laryngeal masks available in different forms: LMA-C, LMA for intubation (ILMA), LMA-Supreme (LMA-S), LMA- ProSeal and i-gel (11,12). LMAs offer a non-invasive alternative to tracheal intubation, providing a secure and hands-free method for achieving a gas-tight airway (13).The American Society of Anesthesiologists' task force on difficult airway management recommends using supraglottic airway devices when intubation challenges arise in patients with previously undetected difficult airways, particularly in "cannot ventilate, cannot intubate" scenarios.

Hemodynamic stability is an important aspect to the anesthesia providers for the benefit of the patients especially during intubations, and laryngeal mask insertion. Due to the strong stimulation of the sympathetic nervous system during laryngoscopy and endotracheal intubation, hemodynamics might vary dramatically(2). Hemodynamic changes, such as tachycardia, hypertension, and arrhythmias can occur during intubation, which can cause myocardial ischemia. These serious complications can be a threat for the patients with underlying cardio-cerebrovascular diseases(3–6). To prevent adverse cardiovascular responses during airway management, a laryngeal mask airway (LMA) may be used as an alternative to laryngoscopy and tracheal intubation(7).With the widespread success of the laryngeal mask airway (LMA), researchers are increasingly developing supraglottic airway devices (8,9).

## 1.2. Statement of The problem

Airway management during anesthesia is a critical component of patient safety, with the choice between Endotracheal Intubation (ETI) and Laryngeal Mask Airway (LMA) having significant implications on hemodynamic stability. ETI, although widely accepted as the gold standard, is associated with marked sympathetic stimulation due to laryngoscopy and tracheal manipulation, which may result in abrupt increases in heart rate and blood pressure. These responses can lead to serious complications such as myocardial ischemia, hemorrhagic stroke, and cardiovascular collapse, especially in patients with underlying cardiac conditions (21, 22). Conversely, LMA is a less invasive alternative that does not stimulate the trachea directly and is often associated with reduced hemodynamic responses (7, 35).

Despite extensive studies globally, there is a lack of comprehensive data in the Ethiopian context comparing the hemodynamic outcomes of these two airway devices. Previous local studies have been limited to pediatric ophthalmic surgeries and conducted in single centers with small sample sizes (36). Furthermore, in routine clinical practice, anesthesia providers in Ethiopia may not be fully aware of the potential impact of hemodynamic fluctuations on perioperative outcomes (25).

Several intrinsic and extrinsic factors are known to influence the magnitude of hemodynamic response to airway insertion. These include age, BMI, baseline anxiety, depth of anesthesia, number of insertion attempts, and the clinical experience of the provider (40, 46, 47). For example, patients with cardiovascular comorbidities may experience exaggerated responses to ETI, and repeated intubation attempts can further aggravate sympathetic stimulation (54). However, these contributing factors are often overlooked or inadequately documented in local practice, limiting targeted interventions.

To date, no structured national or institutional intervention has been implemented in Ethiopia to reduce the incidence or severity of hemodynamic disturbances associated with airway management. While the use of LMA has increased, there remains no clear guideline to support its preferential use over ETT in specific populations, such as those with high cardiovascular risk. This lack of standardization poses a significant challenge to achieving safe, evidence-based anesthesia care.

## 1.3. Justification of the study

Previous study in Ethiopia regarding airway management techniques has been limited to single-center studies with small sample sizes, focusing exclusively on pediatric ophthalmic patients. This study expands upon previous research by employing a multicenter approach with a larger sample size, encompassing all surgical patients who are candidates for either Laryngeal Mask Airway (LMA) or endotracheal tube insertion. This research will help health care providers, governmental, and non-governmental organizations make the most of efforts to prevent hemodynamic instability while also serving as a valuable resource for other researchers. It will also serve as a guide for future research.

The results of this study help to anesthesia care provider to select best mode of intubation to minimize hemodynamic change following LMA or endotracheal intubation in our setup. It also an evidence based prevention mechanism of hemodynamic change following LMA or ETT intubation among Anesthesia care providers. The finding from this study will important to patients' safety, evidence based practice in air way management, and for future researcher as base line data. In addition it will serve as a base line data for future studies.

**Significance of the study**

This study holds significant value across multiple levels of healthcare beneficiaries. For patients, it aims to identify the airway management technique—Laryngeal Mask Airway (LMA) or Endotracheal Tube (ETT)—that minimizes hemodynamic disturbances, thereby enhancing safety and reducing the risk of complications, particularly in those with cardiovascular conditions. For anesthetists, the study offers evidence-based, context-specific data to support informed decision-making and promote safer, less invasive practices during induction. At the hospital level, reducing adverse events related to airway management can improve patient outcomes, shorten recovery times, and optimize resource use, especially in high-demand public facilities. Finally, for policy makers and budget allocators, the findings can inform cost-effective procurement strategies, guide clinical training priorities, and support the development of protocols that enhance perioperative care quality and safety within the healthcare system.

## Chapter Two: Literature Review

Endotracheal intubation is an art and science of securing the airway and endotracheal intubation refers to the medical procedure performed in an hospital setting to provide oxygenation and ventilation(29). A laryngeal mask airway (LMA), also known as laryngeal mask, is a medical device that keeps a patient's airway open during anesthesia or while they are unconscious. It is a type of supraglottic airway device. They are most commonly used by anesthetists to channel oxygen or inhalational anesthetic to the lungs during surgery(30).

The primary advantage of the LMA is obtaining, securing, and maintaining a patent airway is the fundamental benefit of the LMA over the face mask during general anesthesia. The most frequent reason for upper airway obstruction in patients who are not intubated is removed when the laryngeal mask airway is passed past the tongue, creating a seal with the laryngeal inlet. Comparing the LMA to the face mask, it has been shown to maintain a patent airway with fewer instances of oxygen de-saturation(31).It has been demonstrated that the LMA encloses the esophagus and laryngeal inlet, creating a direct channel between them and there have been reports of aspiration(32).

This study found that systolic blood pressure (SBP) increased significantly more in the ETT group than in the LMA group, particularly immediately after insertion (ETT: $139.30 \pm 19.56$ mmHg vs. LMA: $123.88 \pm 8.74$ mmHg; $P < 0.001$). While baseline and post-induction SBP values were comparable between groups, the ETT group showed a sharp rise at 1 minute post-insertion ($126.33 \pm 17.06$ mmHg vs. $114.20 \pm 9.88$ mmHg; $P < 0.001$), followed by gradual normalization by 3 and 5 minutes. These results confirm that ETT causes a stronger short-term hemodynamic response than LMA due to greater airway stimulation (19).

The evidence suggests that LMA insertion is associated with fewer hemodynamic disturbances compared to endotracheal intubation, particularly in surgical patients with cardiovascular risks. Understanding the physiological responses to airway management techniques, patient factors, and anesthetic choices is essential for optimizing patient outcomes (34).The choice of airway management technique is crucial in anesthesia, impacting patient outcomes and hemodynamic stability. According to a study done in Estonia in 2015 shows that maintaining the airway using laryngeal mask airway is associated with less cardiovascular responses compared to direct laryngoscopy and tracheal intubation ; but There were no differences in the mean SBP and DBPs between the three groups at the other time points (36). The literature consistently indicates that LMA insertion is associated with fewer hemodynamic disturbances compared to endotracheal intubation. This is particularly relevant for surgical patients with cardiovascular risks, where maintaining hemodynamic stability is paramount (37).

A study done in India by Allahyari et. al in 2021 to compare endotracheal intubation, laryngeal mask airway to measure hemodynamic changes by measuring found that mean arterial pressure (MAP), IOP, and systolic and diastolic blood pressures were significantly different at immediately after the insertion of airway devices , heart rate (HR) was significantly different immediately (38).

## 2.1. Hemodynamic Changes during Airway Management

According to a study conducted by Ubale, et al:2020 showed that while baseline heart rate and blood pressure were similar between the LMA and ETT groups, endotracheal intubation caused significantly greater increases in heart rate, systolic, and diastolic blood pressure at insertion and up to five minutes afterward, including post-extubation (all $P < 0.01$). For example, heart rate at insertion rose to 114.3 ± 8.3 bpm in the ETT group compared to 98.9 ± 6.1 bpm in the LMA group, and systolic blood pressure peaked at 148.3 ± 5.3 mmHg versus 128.0 ± 5.9 mmHg, respectively. These findings indicate that ETT provokes a stronger hemodynamic response than LMA, likely due to greater sympathetic stimulation during intubation (8).

According to a study conducted in India highlighted that the mean age of participants in the LMA group was 39.3 ± 8 years, while that of the ETT group was 40.1 ± 9.4 years. Most participants in both groups weighed between 51 and 60 kg. Regarding gender distribution, 40% of the LMA group and 50% of the ETT group were male (8).

### 2.1.1. Endotracheal Intubation (ETI):

Sympathetic activation during process of laryngoscopy and intubation stimulates the sympathetic nervous system, leading to increased heart rate (tachycardia) and elevated blood pressure (39).ETI is often associated with significant hemodynamic changes due to the stimulation of the airway and sympathetic response. Studies have shown that ETI can lead to increased heart rate and blood pressure immediately following the procedure(36) .The stress response elicited by laryngoscopy and intubation can result in tachycardia and hypertension, particularly in patients with pre-existing cardiovascular conditions (38).The duration of these hemodynamic changes can vary, but they generally return to baseline within 5-10 minutes post-intubation (40).

### 2.1.2. Laryngeal Mask Airway (LMA) Insertion:

LMA insertion is generally associated with less cardiovascular stimulation compared to ETI. Research indicates that hemodynamic responses during LMA placement are significantly milder, with minimal increases in heart rate and blood pressure. A study by Wei, Cheng Fong and Chung, Yung Tai et al. (2023) demonstrated that LMA insertion resulted in a more stable hemodynamic profile, making it a preferred choice in patients with cardiovascular comorbidities (41). Another study by Jarineshin et al. (2015) reinforced these findings, noting that LMA use resulted in a more stable hemodynamic profile, particularly in high-risk surgical patients(35). The reduced stress response during LMA insertion is attributed to the less invasive nature of the procedure, which avoids the need for laryngoscopy (42).

A study by Kiran A Patil, et al. (2018) in India highlighted that LMA use is associated with improved hemodynamic stability in patients with cardiovascular comorbidities (43). Randomized Controlled Trials done by Ja-SungLee,et al. (2015) found that patients receiving LMA experienced significantly lower heart rate and blood pressure fluctuations compared to those undergoing ETI (44).

Several studies have directly compared hemodynamic changes during ETI and LMA insertion. A randomized controlled trial by Zaman et al. (2022) in Netherlands found that patients undergoing LMA insertion exhibited significantly lower heart rate and blood pressure fluctuations compared to those who underwent ETI (45).

### 2.1.3. Factors Influencing Hemodynamic Changes during LMA and ETT insertion:

**Patient Factors:** Patient characteristics, such as age, sex, body mass index (BMI), and underlying medical conditions, can influence hemodynamic responses to airway management(46). Elderly patients or those with pre-existing hypertension may experience more pronounced changes during ETI than younger, healthier individuals (47).

**Anesthesia Technique:** The choice of anesthetic agents and techniques can also influence hemodynamic responses. Inhalational agents may exacerbate cardiovascular instability during

ETI, while intravenous agents can mitigate these effects during both procedures (48). The choice of anesthetic agents can further modulate hemodynamic responses.The choice of muscle relaxants and their dosages can further impact hemodynamics, highlighting the importance of tailored anesthesia management strategies (40).

**LMA Type, size and size of ETT:** Different types and size of LMAs, such as the classic LMA, the ProSeal LMA, and the i-gel, may have varying effects on hemodynamic stability (49). Some studies have suggested that the ProSeal LMA may be associated with less hemodynamic disturbance compared to the classic LMA and large size ETT (50).

**Clinical Experience:** The experience of the anesthesia care provider performing the airway management can also influence hemodynamic responses. More experienced anesthesiologists may be able to minimize the hemodynamic disturbance associated with both LMA insertion and ETI (34).

## 2.2. Conceptual frame work (Figure 1)

The conceptual framework of this study illustrates a linear relationship between various categories of factors ranging from distal to proximal that influence hemodynamic changes during airway management with either ETT or LMA insertion. At the distal level, socio-demographic factors such as age, sex, and BMI affect baseline cardiovascular responsiveness. Pharmacologic factors, including the type and dose of induction agents, premedication, analgesics, muscle relaxants, maintenance drugs, and depth of anesthesia, represent intermediate factors that can be adjusted to optimize hemodynamic stability. Instrumental factors such as the size and type of the airway device and laryngoscope blade influence the degree of airway stimulation. Clinical characteristics like preoperative anxiety, baseline hemodynamic instability, and the presence of co-existing diseases further shape the body's response to airway manipulation. At the most proximal level, provider-related factors including the number of insertion attempts and the anesthesia provider's experience directly impact the intensity of sympathetic stimulation during airway insertion. Together, these layered influences determine the extent of hemodynamic changes during induction, measured by heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure.

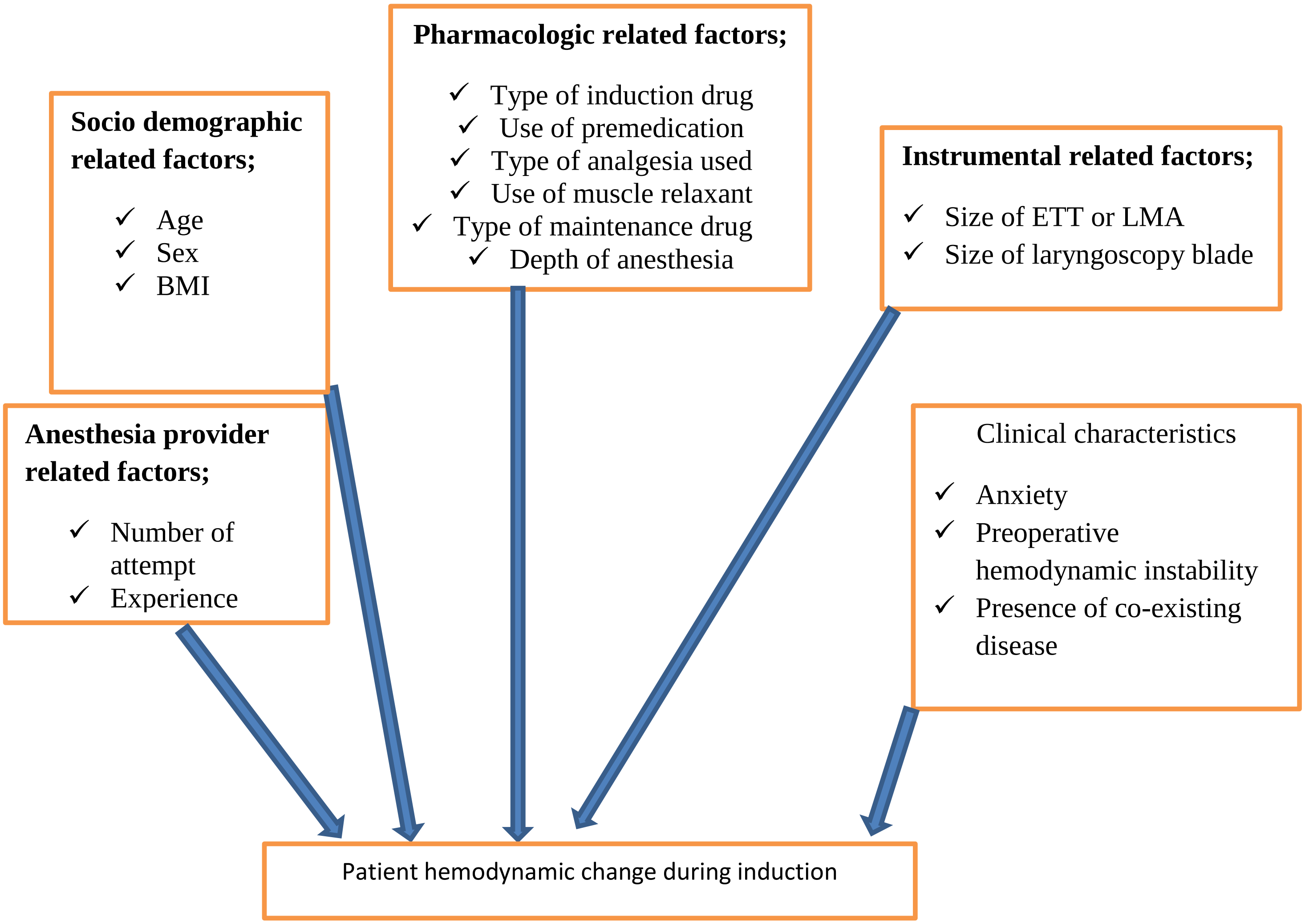


**Figure 1:Conceptual frame work that shows factors affecting hemodynamic changes during induction while securing airway via ETT vs LMA(35,37,45,51)**

# Chapter Three: Objective of the Study

## 3.1. General objective of the study

- ✓ To compare the hemodynamic changes among patients undergoing Elective surgery under general anesthesia with LMA versus endotracheal intubation.

## 3.2. Specific objectives of the study

- ✓ To compare the BP change between LMA insertion and endotracheal intubation among Elective surgical patients.
- ✓ To compare HR between two groups.
- ✓ To compare Spo2 between two groups.

# Chapter Four: Method of the Study

## 4.1. Study Area

The study was conducted at purposively selected governmental hospitals in Addis Ababa, namely Yekatit 12 Hospital Medical College and Tikur Anbessa Specialized Hospital. These institutions were selected based on preliminary assessments indicating the routine and consistent use of both Laryngeal Mask Airway (LMA) and Endotracheal Tube (ETT**)** in elective surgical procedures under general anesthesia. In addition to this Tikur Anbessa Specialized Hospital and Yekatit 12 Hospital Medical College were selected due to their high surgical volumes, with multiple elective surgeries performed daily across various specialties. This ensured the feasibility of patient recruitment and the generalizability of findings.

Addis Ababa is the capital and largest city in Ethiopia, with a population size estimated at more than 5.4 million, according to the world population review 2023 report. Currently, Addis Ababa has 13 governmental hospitals. The study will be conducted at Tikur Anbessa specialized hospital in Addis Ababa. Tikur Anbessa specialized Hospital was established in 1972 and is located in Lideta, sub city of Addis Ababa, Ethiopia. The hospital is teaching hospital of AAU and a major referral center for all region of the country, with more than 700 beds and 14 operation room. The hospital giving training for under and post graduates studies medical students, anesthesia, pharmacists, nurses, laboratory technicians and variety of specialty and sub-specialty program. Yekatit 12 Hospital Medical College is under the Addis Ababa City Health Bureau administration. It routinely serves Addis Ababa and other referral regional states. It has nine departments, six units, 265 beds, 7 operation room and seven ICUs.

## 4.2. Study design and Period

Prospective observational Cohort study design was employed at selected governmental hospital in Addis Ababa from January 1, 2025 to April 15, 2025 G.C.

## 4.3. Source population

All surgical patients who underwent elective surgery under general anesthesia at selected governmental hospitals in Addis Ababa during the study period.

## 4.4. Study population

All eligible patients scheduled for elective surgical procedures received general anesthesia with either endotracheal intubation (ETT) or laryngeal mask airway (LMA) during the study period.

## 4.5. Inclusion and exclusion criteria

### 4.5.1. Inclusion criteria

Elective surgical patients ASA 1, without anticipated difficulty airway was included in the study.

### 4.5.2. Exclusion criteria

Patients with anticipated difficult airway, patients classified as ASA physical status class II or above, patients younger than 5 years or older than 65 years, patients who underwent only mask ventilation without the use of LMA or endotracheal tube, patients in whom LMA was converted to endotracheal intubation intraoperatively for any reason (e.g., failed insertion, inadequate ventilation, airway obstruction).

## 4.6. Sample size and Sampling Technique

### 4.6.1. Sample size calculation

In order to calculate the sample size of this study, continuous outcomes formula(ANOVA) was used to calculate the sample size based on a previous study done in India(52)which showed a heart rate mean and standard deviation of previous study.

- Mean (N1) and standard deviation (S1) 94.24, and 13.47 respectively

- ❖ Mean (N2) and Standard deviation (S2) 88.72 and 10.27 respectively among patients endotracheal intubation and laryngeal mask airway groups
- ❖ Where **Z α/2** =1.96 for a **p** = 0.05 (95% confidence interval), **Zβ** = 0.84 for 20% beta error, **S** = pooled standard deviation, and **μ** =heart rate mean and n=sample size
- ❖ n = sample size needed for each group
- ❖ S = pooled standard deviation
- ❖ **Calculating the Pooled Standard Deviation (S)**
- ❖ Since the standard deviations are different, we need to calculate the pooled standard deviation by using the formula below which combines the different standard deviations
- ❖ **S = (S1 + S2) / 2**
- ❖ S = (13.47 + 10.27) / 2
- ❖ **(Pooled standard deviation) = 11.87**
- ❖ The sample size will be calculated based on the following formula
- ❖ **$n = 2 * (Z\alpha/2 + Z\beta) * S / (\mu 1 - \mu 2)^2$**
- ❖ $n = 2 *(1.96 + 0.84) * 11.87 / (94.24 - 88.72)^2$
- ❖ $n = 2 \times (2.8 \times 11.87 / 5.52)^2$
- ❖ $n = 2 \times (33.236 / 5.52)^2$
- ❖ $n = 2 \times (6.021)^2$
- ❖ n = 2 × 36.25
- ❖ n = 72.5
- ❖ n=73

Sample size was increased by 10% in order to replace for any dropouts so that the total sample size (*n*) became 81 in each group.

### 4.6.2 Sampling technique

A consecutive sampling technique was employed, whereby all eligible surgical patients undergoing elective surgeries under general anesthesia and meeting the inclusion criteria were recruited until the required sample size was achieved. The recruitment continued at each hospital until the total required sample size of 81 patients per group (LMA and ETT) was achieved. This method was chosen based on practicality and feasibility, considering the differences in surgical caseload and patient flow at each facility.

## 4.7. Variable of the study

### 4.7.1. Dependent Variable

Hemodynamic response measured as changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR).

### 4.7.2. Independent Variable

**Socio demographic related factors;** Age, Sex, BMI

**Pharmacologic related factors;** Type of induction drug, Type of analgesia used, Use of muscle relaxant and Type of maintenance drug

**Instrumental related factors;** Size of ETT or LMA and Size of laryngoscope blade

**Clinical characteristics;** Anxiety, Preoperative hemodynamic instability and Presence of co-existing disease

**Anesthesia provider related factors;** Number of attempt and Experience

## 4.8. Operational definitions

**Hemodynamic change**; refers to the measurable alterations in cardiovascular parameters, specifically heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP**)**, in response to airway device insertion (ETT or LMA) under general anesthesia.

**Multiple attempts Intubation** is try to intubate greater than or equal to 3 intubation attempts(54).

**LMA insertion** is the process of inserting a laryngeal mask airway (LMA) into a patient's oropharynx to keep their airway open(55)

**Endotracheal tube insertion** is a medical procedure that involves inserting a flexible tube into the trachea (windpipe) to keep an open airway(56).

### *4.8.1. Data Collection tool and Process*

A structured, paper-based questionnaire adapted from previous studies (57, 58) was used for data collection, and a pretest was conducted on 10% of the total sample size at Minilik II Memorial Hospital in Addis Ababa; data from the pretest were excluded from the main study. Preoperative evaluation included demographic information (age, sex, weight, and height), BMI calculation, ASA physical status classification, and assessment of preoperative anxiety through patient interview and chart review. All patients in the study underwent anesthetic induction with propofol (2–2.5 mg/kg), fentanyl (1–2 mcg/kg), and suxamethonium (2 mg/kg) for muscle relaxation, as per the standard clinical practice. Anesthesia was maintained with isoflurane in 100% oxygen. Airway management was performed by anesthesia professionals and students under supervision, and the experience level of the performer was documented. Hemodynamic parameters including heart rate, blood pressure (systolic, diastolic, and mean arterial), and oxygen saturation were recorded at baseline (pre-induction), immediately after airway insertion, and at the 1st, 5th, 10th, and 20th minutes post-insertion. Data were collected through direct observation in the operating room and from the patient's chart by trained data collectors not involved in the clinical procedures.

### 4.8. 2. Data quality control and management

All collected data were checked for the completion and clarity just on time of collection of the tools by the researcher. Data collectors were trained prior to data collection on how to accurately and consistently record measurements such as heart rate, blood pressure, and $SpO_2$ at designated time intervals. They were also trained on ethical considerations and confidentiality.

### 4.8.3. Data processing and Analysis

The collected data were first checked manually for completeness, then entered into SPSS version 25 for analysis. To assess the distribution of the data, the Shapiro-Wilk test was used, which helped determine whether continuous variables such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation ($SpO_2$) were normally distributed. For comparing the variance between the LMA and ETT groups, Levene's test for equality of variances was performed. The results from Levene's test indicated that the variances between the two groups were approximately equal, validating the use of the independent sample t-test for comparing normally distributed continuous variables. For variables not meeting the assumptions of normality or equal variance, the Mann-Whitney U test was applied. Categorical variables were analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value less than 0.05 was considered statistically significant throughout the analysis.

## 4.9. Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of the College of health science, Addis Ababa University and Addis Ababa health bureau. It was sent to the head of the respective hospital's management. The confidentiality of the patients was respected, and their identities was not be disclosed. All eligible participants or their legal guardians (for minors) were provided with a detailed information sheet about the study, and written informed consent was obtained prior to data collection, ensuring voluntary participation and the right to withdraw at any stage without affecting their medical care.

## 4.10. Dissemination of results

The research's findings will be distributed to the College of Health Science, the Department of Anesthesia, and Addis Ababa University. Next, the study findings will be disseminated to the respective health facilities. The outcomes will be released for peer-reviewed academic publication.

## Chapter Five: Result

### 5.1 Sociodemographic Characteristics of the Participants

A total of 162 participants were included, evenly divided between the Endotracheal Tube (ETT) group and the Laryngeal Mask Airway (LMA) group (81 each). The LMA group had a significantly younger mean age (16.4 ± 8.9 years) compared to the ETT group (33.0 ± 10.2 years, P < 0.001). Participants in the LMA group also had significantly lower mean height (1.46 ± 0.18 m vs. 1.63 ± 0.08 m), body weight (39.7 ± 18.1 kg vs. 60.5 ± 7.14 kg), and body mass index (BMI) (17.4 ± 4.5 kg/m² vs. 22.7 ± 1.67 kg/m²), all with P < 0.001.

Sex distribution differed significantly between groups (P = 0.001). The LMA group had a higher proportion of male participants (71.6%) compared to females (28.4%), whereas the ETT group included more females (53.1%) than males (46.9%). (As shown table1)

**Table 1: Socio-Demographic Characteristics of Patients Undergoing Surgery Under General Anesthesia with LMA vs. ETT at Selected Governmental Hospitals in Addis Ababa, Ethiopia, 2025**

| Variable | | ETT group (n=81) | LMA group (n=81) | P value |
|---|---|---|---|---|
| Age (year) | | 33±10.2 | 16.4±8.9 | 0.714 |
| Height (cm) | | 1.63±0.08 | 1.46±0.18 | <0.001 |
| Weight (kg) | | 60.5±7.14 | 39.7±18.1 | <0.001 |
| BMI (kg/m2) | | 22.7±1.67 | 17.4±4.5 | <0.001 |
| Sex | M | 38(46.9) | 58(71.6) | 0.001 |
| | F | 43(53.1) | 23(28.4) | |

**Note:** Values are presented as **Mean ± Standard Deviation** for continuous variables (analyzed using the *Independent t-test*) and as **Number (%)** for categorical variables (analyzed using the *Chi-square test*). *P < 0.05* is considered statistically significant.

## 5.2 Preoperative Characteristics between ETT and LMA Groups

Regarding preoperative factors, there was a statistically significant difference in OPV status. A greater proportion of patients in the LMA group were classified as OPV Class I (77.8%) compared to the ETT group (42%), whereas more patients in the ETT group were classified as OPV Class II (58%) compared to the LMA group (22.2%) ($P < 0.001$). In contrast, no significant differences were observed between the groups in terms of preoperative anxiety (11.1% in ETT vs. 13.6% in LMA, $P = 0.316$), preemptive analgesia use (96.3% in ETT vs. 97.5% in LMA, $P = 0.65$), or preoperative pain (0% in ETT vs. 1.2% in LMA, $P = 0.316$). (As shown in table 2)

**Table 2: Preoperative Characteristics of Patients Undergoing Surgery Under General Anesthesia with ETT vs. LMA at Selected Governmental Hospitals in Addis Ababa, Ethiopia, 2025**

| Variable | | ETT group (n=81) | LMA group (n=81) | Total | P value |
|---|---|---|---|---|---|
| OPV | Class I | 34 (42%) | 63 (77.8%) | 97 (59.9%) | <0.001 |
| | Class II | 47 (58%) | 18 (22.2%) | 65 (40.1%) | |
| Preoperative Anxiety | yes | 9 (11.1%) | 11 (13.6%) | 20 (12.3%) | 0.316 |
| | no | 72 (88.9%) | 70 (86.4%) | 142 (87.7%) | |
| Preemptive analgesia use | yes | 78 (96.3%) | 79 (97.5%) | 157 (96.9%) | 0.65 |
| | no | 3 (3.7%) | 2 (2.5%) | 5 (3.1%) | |
| Preoperative Pain | yes | 0 (0.0%) | 1(1.2%) | 1(0.6%) | 0.316 |
| | no | 81 (100.0%) | 80 (98.8%) | 161 (99.4%) | |
| Preoperative fasting time | | 8.2±0.68 | 7.61±1.03 | | <0.001 |

**Clinician Experience and Insertion Attempts as Factors Influencing Hemodynamic Response**

The distribution of clinician experience levels showed that most airway management procedures were performed by providers with 2–5 years of experience, accounting for 69.1% in the ETT group and 64.2% in the LMA group. Clinicians with 1–2 years of experience performed 21.0% of ETT and 18.5% of LMA procedures, while those with more than 5 years of experience were more involved in the LMA group (17.3%) than in the ETT group (9.9%). This indicates that the majority of airway insertions were carried out by early-career professionals, with slightly greater involvement of more experienced clinicians in cases managed with LMA.

Most airway insertions were successful on the first attempt in both groups. First-attempt success was higher in the LMA group (96.3%) compared to the ETT group (87.7%). Conversely, 12.3% of patients in the ETT group required a second attempt, compared to only 3.7% in the LMA group. These results suggest that LMA insertion was associated with a higher ease of placement and greater success on the first attempt compared to ETT intubation.

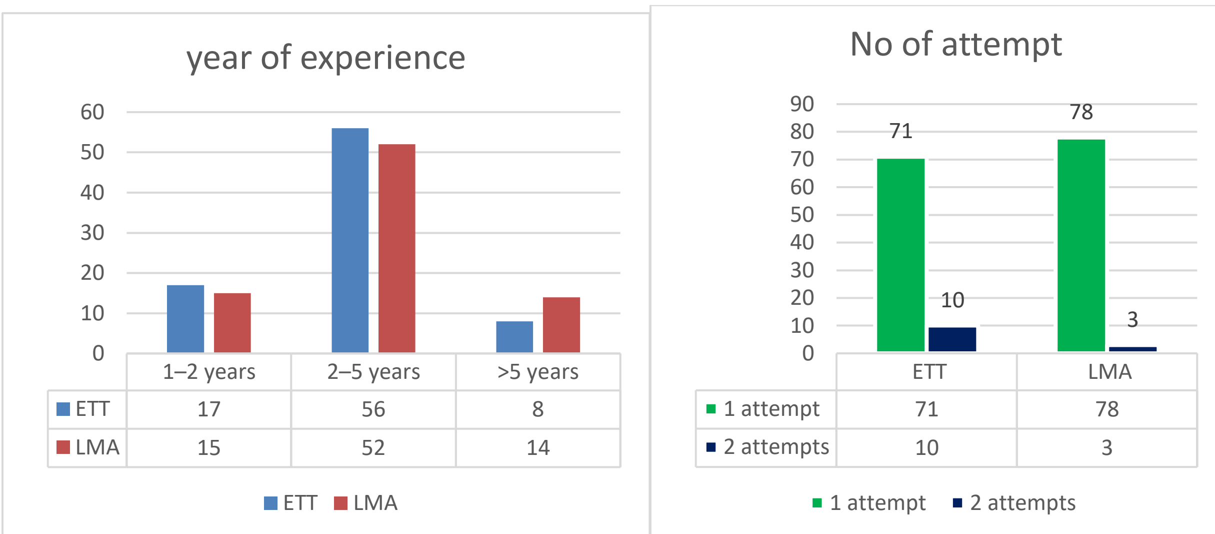


**Figure 2 Bar charts showing the difference in year of experience and number of attempt in surgical patients undergoing general anesthesia with LMA versus ETT insertion at selected governmental hospitals, Addis Ababa, Ethiopia, 2025.**

## 5.3 Comparison of Pulse Rate between Groups

A statistically significant difference in pulse rate was observed between the LMA and ETT groups across all measured time points. At pre-induction, the mean pulse rate was significantly higher in the LMA group (82.94 ± 11.25 bpm) compared to the ETT group (76.19 ± 8.74 bpm; $P < 0.001$). This trend continued at 1, 5, 10, 15, and 20 minutes post-insertion, with the LMA group consistently demonstrating higher pulse rates than the ETT group ($P < 0.05$ for all comparisons). The most pronounced difference was observed at 5 minutes after insertion, where the pulse rate peaked at 87.81 ± 11.42 bpm in the LMA group vs 81.46 ± 9.45 bpm in the ETT group.

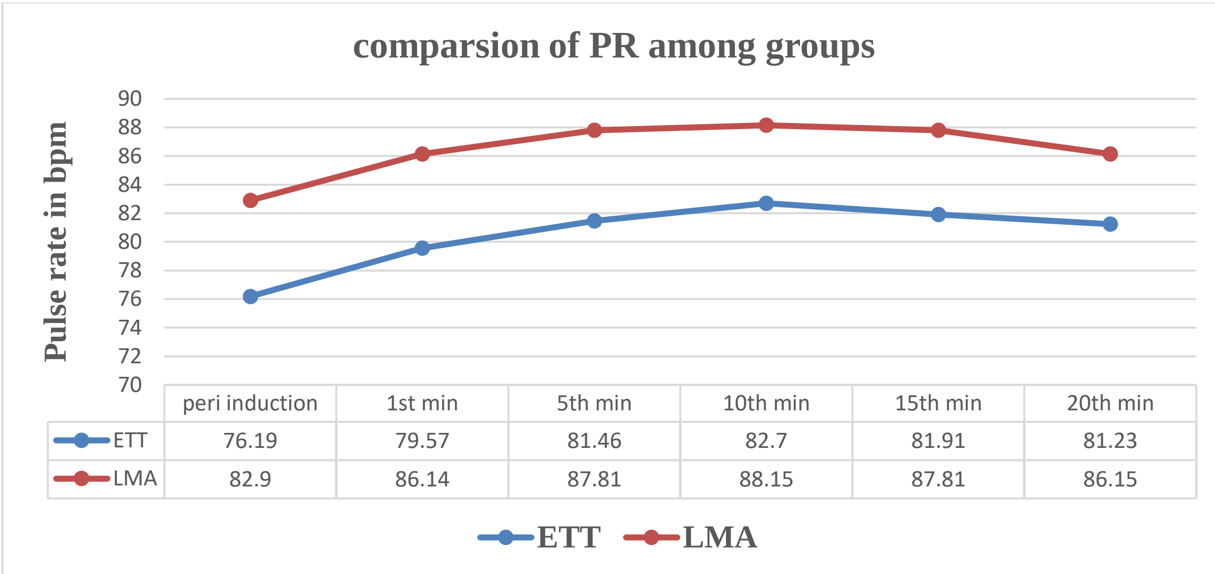


**Figure 3: Line graph showing pulse rate in( bpm)measurements at different time intervals in surgical patients undergoing general anesthesia with LMA versus ETT insertion at selected governmental hospitals, Addis Ababa, Ethiopia, 2025.**

## 5.4 Comparison of SBP between groups

Measurement of systolic blood pressure immediately after airway device insertion and at 1, 5, 10, 15, and 20 minutes showed significantly higher values in the endotracheal tube (ETT) group compared to the laryngeal mask airway (LMA) group ($p < 0.001$). The peak increased systolic blood pressure was observed in the ETT group compared to the LMA group throughout the observation period.

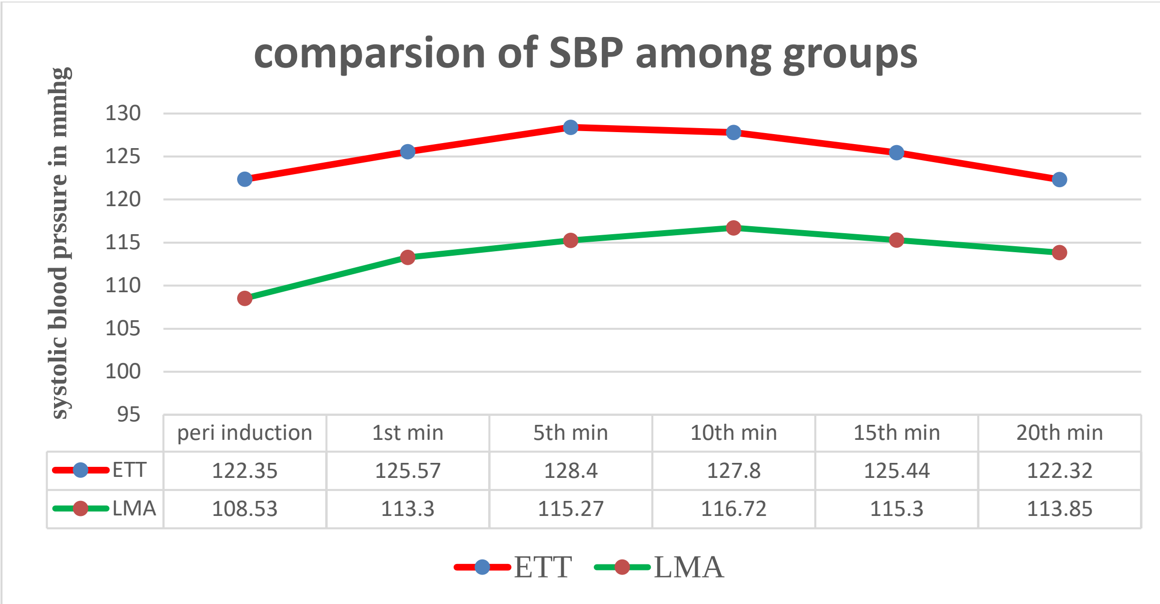


**Figure 4: Line graph showing systolic blood pressure (mmHg) measurements at different time intervals in surgical patients undergoing general anesthesia with LMA versus ETT insertion at selected governmental hospitals, Addis Ababa, Ethiopia, 2025.**

## 5.5 Comparison of DBP between groups

Measurements of DBP at 1, 5, 10, 15, and 20 minutes after airway device insertion showed consistently higher values in the ETT group compared to the LMA group (P < 0.05). The elevation in DBP was evident immediately after induction and persisted throughout the monitoring period, with the most pronounced difference observed at 5 minutes. The sustained elevation in DBP among the ETT group may be attributed to greater sympathetic stimulation during intubation compared to LMA insertion.

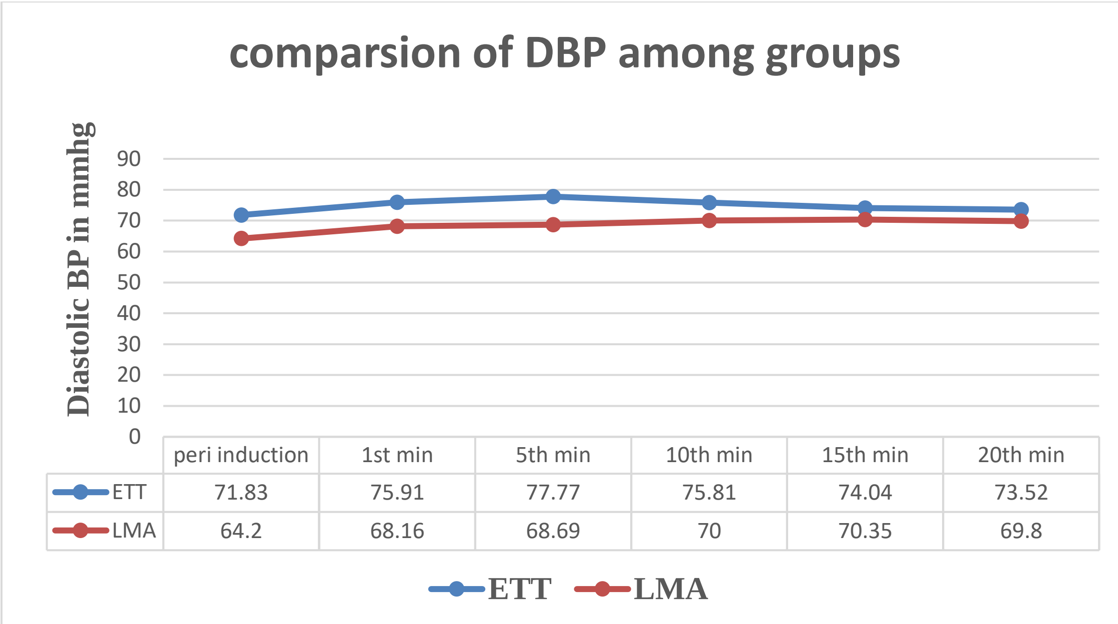


**Figure 5: Line graph showing diastolic blood pressure (mmHg) measurements at different time intervals in surgical patients undergoing general anesthesia with LMA versus ETT insertion at selected governmental hospitals, Addis Ababa, Ethiopia, 2025.**

### 5.6 Comparison of MAP between groups

An independent T test demonstrated that mean arterial pressure (MAP) was significantly higher in patients who received general anesthesia with endotracheal tube (ETT) insertion compared to those with laryngeal mask airway (LMA) at all measured time intervals. From pre-induction through 20 minutes post-induction, the MAP values in the ETT group remained consistently and significantly elevated relative to the LMA group ($p < 0.0001$ for all time points), indicating a strong and sustained hemodynamic response associated with endotracheal intubation.

In contrast, peripheral oxygen saturation ($SpO_2$) remained within a clinically acceptable range in both groups across all time points. However, statistically significant differences in $SpO_2$ between the ETT and LMA groups were observed only at 10 minutes ($p = 0.001$) and 15 minutes ($p < 0.0001$) post-induction, with slightly higher values in the ETT group. At other time points—pre-induction, 1 minute, 5 minutes, and 20 minutes—no statistically significant differences were observed ($p > 0.05$). These findings suggest that while both airway devices effectively maintained oxygenation.

**Table 3 : Mean Arterial Pressure (MAP) (mmHg) measurements at different time intervals in surgical patients undergoing general anesthesia with Laryngeal Mask Airway (LMA) versus Endotracheal Tube (ETT) insertion at selected governmental hospitals, Addis Ababa, Ethiopia, 2025.**

| | MAP | | | Spo2 | | |
|---|---|---|---|---|---|---|
| Time | ETT | LMA | P- value | ETT | LMA | P-value |
| Pre induction | 87.7±6.81 | 78.4±9.7 | <0.0001 | 96.4 ± 1.78 | 95.86 ± 1.78 | <0.666 |
| 1 min | 91.7±7.4 | 82.5±9.7 | <0.0001 | 97.9 ± 1.52 | 97.54 ± 1.50 | <0.292 |
| 5 min | 94.3±6.1 | 83.7±10.1 | <0.0001 | 98.4 ± 0.80 | 98.40 ± 0.75 | 0.944 |
| 10 min | 92.7±4.8 | 85±8.9 | <0.0001 | 98.5 ± 1.07 | 98.74 ± 0.57 | 0.001 |
| 15 min | 90.9±4.8 | 84.7±8.8 | <0.0001 | 98.7 ± 1.09 | 98.94 ± 0.46 | <0.0001 |
| 20 min | 89.4±5.2 | 83.9 ±8.8 | <0.0001 | 99.0 ± 1.0 | 99.17 ± 0.47 | <0.643 |

## CHAPTER SIX: DISSCUSION

This study aimed to compare hemodynamic responses to Laryngeal Mask Airway (LMA) insertion versus Endotracheal Tube (ETT) intubation in patients undergoing surgery under general anesthesia at selected governmental hospitals in Addis Ababa. The findings indicate that LMA insertion was associated with greater hemodynamic stability compared to ETT intubation, as evidenced by lower systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) at all measured intervals. However, some demographic imbalances between groups necessitate careful interpretation of the results.

A significant age difference was observed between the groups, with the LMA group having a much younger mean age (16.4 ± 8.9 years) compared to the ETT group (33.0 ± 10.2 years). This contrasts with previous studies such as those by Ubale and Jadhav (2015), where the age distribution was more balanced and typically centered around the third to fourth decades of life. The younger age in the LMA group may reflect clinical practice trends where LMA is more frequently used in pediatric or younger patients due to its less invasive nature and ease of insertion. Younger patients often have different cardiovascular dynamics, including higher baseline heart rates and more labile autonomic responses, which can influence hemodynamic measurements during induction and airway manipulation (Choudhury et al., 2019).

In addition to age, other baseline differences were significant—height, weight, BMI, and sex distribution all varied between groups. The LMA group comprised significantly lighter patients with lower BMI and a higher proportion of males. These demographic differences may partially account for the observed hemodynamic patterns. For instance, younger, leaner individuals may exhibit heightened sympathetic activity, particularly in heart rate response, due to either lighter anesthesia or stress-related stimulation (Alahyari et al., 2021). Nevertheless, despite these confounding variables, the consistently higher SBP, DBP, and MAP values in the ETT group from pre-induction through 20 minutes post-insertion suggest that the airway device itself exerts a distinct physiological effect on cardiovascular parameters.

Our findings align with previous studies that have consistently shown increased cardiovascular responses following ETT intubation compared to LMA insertion. A study conducted in Estonia (Kask et al., 2015) reported that LMA usage was associated with significantly attenuated hemodynamic changes following airway management. Similarly, Allahyari et al. (2021) demonstrated lower MAP, SBP, and DBP in patients managed with LMA, reinforcing our observations. In our study, peak SBP values occurred at 5 minutes post-insertion—128.4 mmHg in the ETT group versus 116.72 mmHg in the LMA group—underscoring the more pronounced hemodynamic stimulation associated with ETT. This is in line with Ubale and Jadhav's findings, where SBP immediately post-intubation was significantly higher in the ETT group (139.30 ± 19.56 mmHg vs. 123.88 ± 8.74 mmHg; $p < 0.001$).

The greater hemodynamic response with ETT can be explained by the need for direct laryngoscopy and the stimulation of oropharyngeal and laryngeal structures during intubation, which triggers a marked sympathetic surge and catecholamine release (King et al., 1951). This response is typically less pronounced with LMA, as its insertion avoids the glottic stimulation associated with laryngoscopy, resulting in better cardiovascular stability—an advantage particularly relevant in patients with hypertension or cardiovascular risk.

An unexpected finding in this study was the consistently higher heart rate in the LMA group across all time intervals. This contradicts the majority of previous literature, which often shows either no difference or a lower heart rate response with LMA use (Singh et al., 2017; Mishra et al., 2020). One plausible explanation is the significantly younger age of the LMA group in this study. Younger individuals tend to have higher resting heart rates and may be more reactive to surgical and anesthetic stimuli. Furthermore, lighter body weight and lower anesthetic depth in pediatric or adolescent populations can contribute to elevated heart rates, even in the context of less invasive airway procedures. Thus, the elevated pulse rates in the LMA group may reflect underlying physiological traits rather than a procedural effect.

In line with existing literature, our study also found that LMA was associated with a higher first-attempt success rate (96.3%) compared to ETT (87.7%). This supports findings from various trials that LMA is easier to insert, especially by less experienced practitioners, and may contribute to its popularity in routine elective surgeries (Kapoor et al., 2014; Oczenski et al., 1999). The ease of LMA insertion, combined with its favorable hemodynamic profile, reinforces its role as a safer and more practical airway option in selected patient populations.

The most salient finding of this study was the greater hemodynamic stability observed in patients who underwent LMA insertion compared to those who received ETT. This aligns with multiple prior studies. For instance, a study conducted in Estonia (2015) found that LMA usage was associated with significantly reduced cardiovascular responses compared to ETT intubation, despite no difference in SBP or DBP at later time points (36). Similarly, Allahyari et al. (2021) demonstrated that MAP, SBP, and DBP were significantly lower following LMA insertion, corroborating our findings.

In this study, the ETT group exhibited significantly higher SBP, DBP, and MAP values at all measured intervals from pre-induction through 20 minutes post-insertion. These findings are consistent with the physiological mechanism of endotracheal intubation, which often requires direct laryngoscopy and stimulation of the oropharyngeal structures—provoking a marked sympathetic response and catecholamine release. This heightened response can be particularly concerning in patients with underlying cardiovascular risks, where abrupt increases in blood pressure may exacerbate morbidity.

Despite the valuable findings of this study, several limitations should be acknowledged. First, the study was conducted in selected governmental hospitals in Addis Ababa, which may limit the generalizability of the results to other settings or populations with different demographic or clinical characteristics. Second, there was a significant baseline difference in age between the LMA and ETT groups, which could have influenced the hemodynamic responses independently of the airway device used. Additionally, the observational cohort design, while suitable for real-time data collection, does not allow for control of all potential confounding variables that might affect cardiovascular responses. Lastly, the sample size, although adequate for detecting statistical differences, may still be insufficient to assess rare adverse events or subtle hemodynamic changes. Future research with larger, randomized controlled trials across diverse populations would help strengthen the evidence on this topic.

# Chapter seven

## 7.1 Conclusion and Recommendation

This study found that insertion of a laryngeal mask airway (LMA) was associated with less pronounced hemodynamic fluctuations, particularly lower increases in systolic blood pressure, diastolic blood pressure, and mean arterial pressure, compared to endotracheal tube (ETT) intubation in patients undergoing elective surgery under general anesthesia. Although the LMA group exhibited slightly higher pulse rates, both groups maintained effective oxygenation throughout the intraoperative period. Additionally, the higher first-attempt success rate observed with LMA suggests technical ease of placement.
However, baseline differences in hemodynamic parameters between the two groups should be considered when interpreting these findings, as they may have influenced the magnitude of the observed responses. Future studies with more tightly matched baseline characteristics are recommended to validate these results .These findings are particularly relevant for patients at risk of cardiovascular complications, where hemodynamic stability is critical. Thus, LMA may serve as a preferable alternative to ETT in suitable surgical candidates.

### 7.2 Recommendations

Based on the findings of this study, anesthetists are encouraged to consider the use of Laryngeal Mask Airway (LMA) for elective surgical patients, particularly in those where minimizing hemodynamic fluctuations is clinically desirable, such as individuals with cardiovascular risk. Hospital administrators and surgical teams should support the availability and use of LMA through procurement and protocol updates that promote individualized airway management. Educators and clinical trainers should incorporate evidence on the differential hemodynamic effects of airway devices into training curricula to enhance evidence-based practice. Meanwhile, researchers are advised to conduct further multicenter, randomized studies that account for baseline demographic variability and assess long-term outcomes of airway device selection. Through these coordinated efforts, the safety and effectiveness of airway management in surgical care can be improved.

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## Annex I

**Information sheet and consent form**

Greeting: my name is ----------------------------------I am postgraduate student in advanced clinical anesthesia at Addis Ababa College of Medicine and health science department of anesthesia. I am doing research entitled Comparing Hemodynamic Response to Laryngeal Mask Airway Insertion Versus Endotracheal Tube Intubation in Surgical Patients A Prospective Observational Study conducted at selected governmental hospital in Addis Ababa Ethiopia. The objective of this study is to compare the Hemodynamic Change during Laryngeal Mask Airway Insertion vs Endotracheal Intubation in Surgical Patients, Prospective observational Study at selected governmental hospital in Addis Ababa. You are selected for this study because you are in the study group with the hope that you will cooperate with us. There is no known risk associated with this research and there is no incentive or any payment to be gained by taking part in this project. The information gathered from you is kept confidential and stored in file, without name by assigning a code number to it. In addition, your name or identity not included in the questioner and the data is not accessible by anyone except Principal, co investigators and data collectors. Additionally, you have full right to refuse from participating in this research. Finally, you are kindly requested to give your permission.

Would you be willing to participate?

Yes ☐

No ☐

Data collectors Name…………………. signature …... Date…………

Supervisors Name………………………. ….. Signature…………

## Annex II:

Compare Hemodynamic Response to Laryngeal Mask Airway Insertion vs Endotracheal Intubation.

Section I: Socio demographic factors

| S.no | Variable | Response | Code |
|---|---|---|---|
| 201 | Age | …………………..year | |
| 202 | Sex | A, male<br>B, Female | |
| 203 | Weight | …………………kg | |
| 204 | Height | ………………….meter | |
| 205 | BMI | …………………..kg/cm$^2$ | |

Section II: Preoperative factors

| S.no | VARIABLE | RESPONSE | CODE |
|---|---|---|---|
| 301 | OPV | A, I<br>B, II<br>C, III<br>D,IV | |
| 302 | Preoperative anxiety | A,yes | |
| | | B,no | |
| 305 | Preoperative fasting time | ………… in hours | |
| 306 | Preoperative anemia | A, yes<br>B, no | |
| 307 | Parenteral diazepam use | A, yes<br>B, no | |
| 308 | Preemptive analgesia use | A, yes<br>B, no | |
| 309 | Preoperative pain | A, yes<br>B, no | |

Section III: instrumental related characters and clinical practice

| S.no | Variables | Response | Code |
|---|---|---|---|
| 401 | Type of LMA | A, classic LMA<br>B, ProSeal LMA<br>C, intubating LMA<br>D, reinforced LMA | |
| 402 | Is the size of LMA calculated with patient weight | A, yes | |
| | | B, no | |
| 403 | Is the size of ETT calculated with patient's age and height | A, yes | |
| | | B, no | |
| 404 | Type of anesthesia | A, general anesthesia with ETT<br>B, , general anesthesia with LMA | |
| 405 | Year of experience of clinician | A, Practitioner | |
| | | B, 1-2 years | |
| | | C, 2-5 years | |
| | | D, >5 years | |
| 406 | Number of attempted to insert LMA/ETT | A, 1 times | |
| | | B,2-3 times | |
| | | C,>4 times | |

Section IV: hemodynamic assessment tool

| Vital signs | | Pre induction v/s | 1st min | 5th min | 10th min | 15th min | 20th min |
|---|---|---|---|---|---|---|---|
| Pulse rate | | | | | | | |
| Noninvasive blood pressure | Systolic | | | | | | |
| | Diastolic | | | | | | |
| | MAP | | | | | | |
| Oxygen saturation | | | | | | | |