ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE
DEPARTMENT OF ANESTHESIA

MAGNITUDE AND ASSOCIATED FACTORS OF INTRAOPERATIVE LARYNGOSPASM AMONG PEDIATRIC PATIENTS WHO UNDERGO SURGERY UNDER GENERAL ANESTHESIA AT TIKUR ANBESA SPECIALIZED HOSPITAL,ADDIS ABABA.

INVESTIGATOR: SALIH MOHAMED (BSc, MSc STUDENT IN ANESTHESIA)

RESEARCH THESIS PREPARED FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTERS OF SCIENCES DEGREE IN ADVANCED CLINICAL ANESTHESIA.

JUNE, 2017,

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Abstract

Introduction: laryngospasm is a reflex closure of the upper airway due the glottis musculature spasm.It is one of the complications seen especially during induction of anesthesia or during emergence and its magnitude is high in pediatrics especially in infants.It may be due to patient-related associated factors like URTI, asthma, surgery-related associated factors like type of surgery and anesthesia-related associated factors like light anesthesia, type of airway device and type of anesthetic agent.

Objective: To assess magnitude and associated factors of intraoperative laryngospasm among pediatric patients who undergo surgery under general anesthesia at Tikur Anbesa Specialized Hospital from December 5,2016 to April 13,2017.

Methods: Institutional based cross sectional study design was conducted.Study participants were selected by systematic random sampling technique. Training was given for data collectors and supervisor. Regular supervision and follow up was made. Data was entered into Epi info version 7 computer software by investigators and was transported to SPSS version 20 computer program for analysis.Bivariate and multivariate logistic analyses were used to identify factors associated with laryngoscope. Statistical significance was sated at p value < 0.05 with 95% confidence interval.

Result:A total of 143 study subjects were included. The overall magnitude was 21.7%.Neonates and infants were statistically associated with intraoperative laryngospasm (P value of .027 and .042 respectively).On the other handamong all cases which anesthetized by degree anesthetists,31.4 % (N=22) were developedlaryngospasm(P value of 0.025). Children who were induced by ketamine had less chance for laryngospasm.It had been found that pediatrics with light plain of anesthesia were three times more likely to have laryngospasm thanthose whose anesthesia was deep (P value 0.000,AOR 2.756(95% CI (0.867-8.754).

Conclusion and recommendation-The result of the study indicated that the magnitude of laryngospasm in pediatric population was slightly higher especially during emergence phase. Therefore, appropriate measures should be taken by anesthetists to reduce the magnitude of laryngospasm.

Acknowledgement

First of all, I would like to honestly express my deepest heartfelt gratefulness towards my advisor Mr. Wosenyeleh Admasu for his support and encouragement to develop this research thesis.

Then, I would like to express my great gratefulness towards those authors and researchers of articles, and on-line information for the valuable works, I had read and cited in my thesis. I wouldn't have been able to achieve my goal if I hadn't gotten wonderful help from those relevant literatures.

Lastly, but not the least, I would like to thanks AAU for financial support.

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List of acronyms

AAU Addis Ababa University COR-crudes odds ratio

AIMS Australian Incident Monitoring Study

AOR Adjusted Odds Ratio

ASA American Society of Anesthesiologist

TASH Tikur Anbesa Specialized Hospital

BSc Bachelor of Science

COR Crudes Odds Ratio

ETT Endo Tracheal Tube

FMOH Federal Ministry of Health

GERD Gastro EsophagealReflux Disease

LMA Laryngeal Mask Airway

MSc Master of Science

NPPE Negative Pressure Pulmonary Edema

OR Operation Room

ORIF Open Reduction and Internal Fixation

PS Physical Status

SPSS Statistical Package for the Social Sciences

SRS Systematic Random Sampling

URTI Upper Respiratory Tract Infection

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Chapter one: Introduction

1.1 Background

Pediatric anesthesia practiceis not simply adjusting drug doses and equipment for smaller patients. Neonates (0–1 months), infants (1–12 months), toddlers(12–24 months), and young children (2–12 years of age) have differing anesthetic requirements. For safe anesthetic management, full appreciation of the physiological, anatomical, and pharmacological characteristics of each group is very important. Indeed infants are at much greater risk of anesthetic morbidity and mortality than older children; risk is generally inversely proportional to age.In addition, pediatric patients are prone to illnesses that require unique surgical and anesthetic strategies(1).

Pediatric airway management remains the most daunting task for anesthesia providers (2).Because airway related problems constitute amajor risk factor for intraoperative respiratory adverse events (3, 4). Laryngospasm, bronchospasm, airway obstruction,oxygen desaturation and difficult tracheal intubation are the most common problems (3,5).

There for, attention is needed especially during induction of anesthesia and emergence period, when laryngeal spasm is more common. The anesthesiologist should know pharyngeal-laryngeal physiology and the risk factors for airways obstruction, since this is a potentially sever complication with a multi factorial etiology that can develop during anesthesia and whose consequences can be seriously catastrophic (6).

Laryngospasm is a reflex closure of the upper airway as a result of the glottis musculature spasm.It is essentially a protective reflex that acts to prevent foreign material entering the tracheobronchial tree. The exaggeration of this reflex may result in complete glottis closure and consequently impeding respiration(7). There are two types of laryngospasm: expiratory stridor, which is an active closure of the glottis secondary to adductor spasm and inspiratory stridor which is a passive closure of the glottis secondary to a ball–valve mechanism (8).

Laryngospasm is commonly perceived to be a significant problem by anesthesiologists, with varying magnitude depending on surgical type, preexisting condition and anesthetic technique(12).

1.2 Statement of problem

Respiratory events are one of the greatest causes of morbidity and mortality during anesthetic-surgical procedures, especially in pediatric anesthesia because children are more susceptible to hypoxemia due to the smaller residual functional capacity and greater tendency to develop collapse of the airways. Besides, children have a high vagal tonus and can rapidly evolve to apnea and laryngospasm after vagal stimulation due to irritation of receptors in the airways by secretion, tracheal intubation, or aspiration. Hypoxia and laryngospasm represent approximately 30% of respiratory events during pediatric anesthesia;difficult intubation represents 13%, and bronchospasm 7%(13).

So,the magnitudeoflaryngospasm was higher generally in children and particularly in infants.According to one study the overall magnitude of laryngospasm was 0.87%. Themagnitude in children in the first 9 years of age was1.74% with a higher magnitude of 2.82% in infantsbetween 1 and 3 months (9). Similarly another study said children were especially associated; from 0 to 9 years of age the magnitude of laryngospasm is approximately 17 in 1,000 cases. However, in children ages 1 month to 3 months the magnitude could be up to three times greater and laryngospasm is even more severe because their airways are narrow and the parasympathetic tonus is increased. In this group, laryngospasm could be fatal because desaturation develops very rapidly and tracheal intubation is more difficult(18).A study conducted in Ethiopia, at Jimma University, a year before had shown from pediatrics under 14 years, the majority of laryngospasm occurred in children <10 years of age (35% <5 years of age), 28.3% <10 years of age)(10).

Various factors have been associatedto intraoperative laryngospasm in pediatrics.It can be classified into three categories: patient-related, surgery-related and anesthesia-related factors(11).

The common inciting factors are hyperactive airway like in case of upper respiratory tract infection. Other common triggering factors are painful stimulation, primary vagal hyper tonicity, insufficient depth of anesthesia on endotracheal intubation, light anesthesia on tracheal extubation or combination of either preceding with or without some irritant such as blood, mucus, laryngoscope blade,suction catheter,surgical debris or other foreign body (12).

Inexperience of anesthetists can be associated with increased magnitude of laryngospasm (5, 12, 27). Multiple endotracheal intubations and laryngeal mask airway (LMA) insertion attempts increase the occurrence of laryngospasm(25).

According to some authors, barbiturate induced parasympathetic activity resultedlaryngealspasm (14). From the inhalational agents isoflurane showed greater magnitude of laryngospasm than enflurane,sevoflurane and halothane (15).
In addition to this there is a close association between laryngospasm and the type of surgery (4, 8). Tonsillectomy and adenoidectomy have the highest magnitude of laryngospasm (21–26%) (1, 20, 37–42). Other types of surgery such as appendectomy, cervical dilation, hypospadias surgery and skin transplant in children are highly associated with laryngospasm (4).Thyroid surgery has been associated with laryngospasm secondary to superior laryngeal nerve injury or to iatrogenic removal of parathyroid glands causing hypocalcemia that predisposes to laryngospasm(43,44). Esophageal procedures may cause laryngospasm secondary to stimulation of distal afferent esophageal nerves (9).

Even though,laryngospasm is essentially a protective reflex that acts to prevent entrance of foreign material in to the tracheobronchial tree. If it persists, it may cause hypoxia and hypercapnea. Most of the time, the resulting hypoxia abolishes the reflex and the spasm tends to be self-limited (8, 9, 16).However, in rare occasions, serious morbidity such as cardiac arrest, arrhythmia, pulmonary edema, bronchospasm or aspiration may occur (9, 17, 18, 19). So every effort should be made to rapidly relieve the airway obstruction caused by laryngospasm (20).Patients with laryngospasm can deteriorate rapidly and intervention should be sought early; three incidents were reported in which the patient suffered morbidity because of a lack of skilled assistance. It is well recognized from the AIMS database that not only does a lack of skilled anesthetic assistance contribute to adverse events, but that inadequately trained assistants may actually make an adverse event worse (21).

Outside our country, many studies done on magnitude and associated factors of intraoperative laryngealspasm in pediatrics. However, researches have rarely been reported in the literature in Ethiopia.Thus, this study is aimed to know the magnitude and associated risk factors of intra operative laryngospasm for appropriate prevention strategies and treatments.

1.3 Justification of the study

Even if the quality of anesthesia get improved through time, magnitude of intraoperative laryngospasm especially in pediatrics needs a great concern and several identified factors are associated with intraoperativelaryngospasm that may be preventable and better treated. These aspects should be achievable, despite the current era of cost containment as easily visible from a wealth of literatures especially outside our country.

It is generally agreed that data on magnitude of laryngospasm and associated factors play significant role in providing good quality of anesthesia. In addition, identifying associated factors increasingly playing a pivotal role for anesthesiaproviders. It is also viewed as an established indicator of quality of anesthesia especially in Ethiopia where scarcity of literature on this topic has greatly seen.

Most studies about intraoperative laryngospasm have focused only specific associated factors. But this research was includedmultipleassociated factors that related to patient, anesthesia and surgery and prioritized thesefactors in this specific site.

The study done in Ethiopia was only in elective ASA I and ASA II patients. Also it included all patients during the study period without any sampling technique. Rather this study was on both elective and emergency patients of all ASA classes by using systemic random sampling. In addition the study at TASH may be more representative than Jimma University study, because this hospital accepts many patients from all directions of Ethiopia.

The findings of the study may in general help all OR staffs and in particular for anesthetists to understand the extent of the problem in pediatrics. The study will also enhance the capacity to look for possible alternative solutions to intra operative laryngospasm in addition to contributing to increase in the knowledge and awareness of the problem areas by concerned bodies especially anesthetists.

In addition, hopefully, this research is used as a baseline data and a footstep for next studies to be done on similar problems.

Chapter two: Literature review

Different studies suggested that pediatric anesthesia requires special skills because of physiological, anatomical and pharmacological differences from adult patients.

From these studies which done on intraoperative laryngospasm, an 11 year prospective study indicated the overall magnitude of laryngospasm in the largest (of 136929) patients was 7.9/1000 anesthetics or 8.7/1000 patients (2) .The magnitude in children being higher especially in infants 1-3 months of age(9). Other studies showed the magnitude of laryngospasm in pediatric population ranges from 0.04 to 14% (17,22–25).Similarlyother two investigators reported 0.43/1000 and 1/1000 magnitudes of laryngospasm in children respectively(22,24).

Across sectional study done in our country, at Jimma University showed from 147 cases, the majority of laryngospasm occurred in children <10 years of age (35% <5 years of age), 28.3% <10 years of age).But this study said there was no correlation between age and the laryngospasm incident (P-value is 0.83764)(10).This study also indicated that laryngospasm could occur at any time of periopeative period by showing the data from 53 laryngospasm events identified as cases, 30 (56.6%) occurred during induction, 4 (7.6%) during maintenance and 19(35.8%) during emergence(10).Another study also supported this result which saidlaryngospasm tends to occur after extubation, while anesthesia by spontaneous breathing using a face or laryngeal mask may result in laryngospasm duringinduction or maintenance(12,26,27).

Associated factors for laryngospasm in pediatrics are under investigation throughout the world. Thus far, several validated studies in different ethnicities have been performed regarding associated factors and its assessment requires multiple measure of process combined with measure of outcome.

Most literatures classifiedassociated factors of laryngospasm into three categories: patient-related, surgery-related and anesthesia-related factors.

Based on different studies from patient-related associated factors, pediatric population was more susceptible(28),especially those with upper respiratory tract infection or asthma having an irritable airway(29-31). But few studies (32,33) failed to show the increment of laryngospasm in children with URI.Studies done on tobacco smoke also proved to be associated factor for pediatric laryngospasm(34,35).

Othersindicated patients withhistory of gastro esophageal refluxdisease had more chances of developing laryngospasm under general anesthesia (36). Upper airway anomalies was a significant associated factor as seen in one study(32).This data was supported by American Society of Anesthesiologists (ASA)(37).

On the other hand from anesthesia-related factors,some studies showed that inadequate depth of anesthesia during induction and emergence, while holding a mask on spontaneous breathing (12, 26), Mucus, secretions, blood, laryngoscope, suction catheter or any other foreign body in the laryngopharynx may trigger laryngospasm especially in light plane of anesthesia. Similarly in the above Jimma University's study the main triggering factors were repetitive airway manipulations and light plain of anesthesia accounting about 43.4% and 22.6% respectively(10).

There is controversy in the literature regarding the use of the airway device and associated risk of laryngospasm (40,41). ETT was shown to be associated with increased magnitude of laryngospasm (9). The use of facemask in URI was suggested to be associated with low magnitude of laryngospasm (30). However, in three recent prospective studies (42–44), there was no statistical difference of the magnitude of laryngospasm among facemask, LMA and ETT. On the contrary, in two retrospective studies(22, 37),LMA was shown to increase magnitude of Laryngospasm. Some investigators suggested that the use of cuffed tracheal tubes in younger than 4-year-old children may predispose to laryngotracheal injury and laryngospasm(45, 46).

A study conducted on the effect of anesthetic agents on laryngospasm showed among the intravenous induction agents barbiturates like thiopentone have shown to increase laryngospasm (18,23,47,48). Ketamine although not usually associated with laryngospasm, produces secretions which can play a trigger by irritating the vocal cords (17, 49).But a study conducted on recurrent episodes of intractable laryngospasm during dissociative sedation with intramuscular ketamine showedketamine is frequently mentioned as a cause of laryngospasm, (50). Laryngospasm have seen more with sevoflurane than propofol induction (26, 41) and amongst the inhalational agents maximum with desflurane. In reducing order of association with laryngospasm inhalational agents were isoflurane, enflurane, halothane and sevoflurane (15, 51, 52).In contrast one book says there is no difference in the incidence of laryngospasm between sevoflurane and halothane(53).

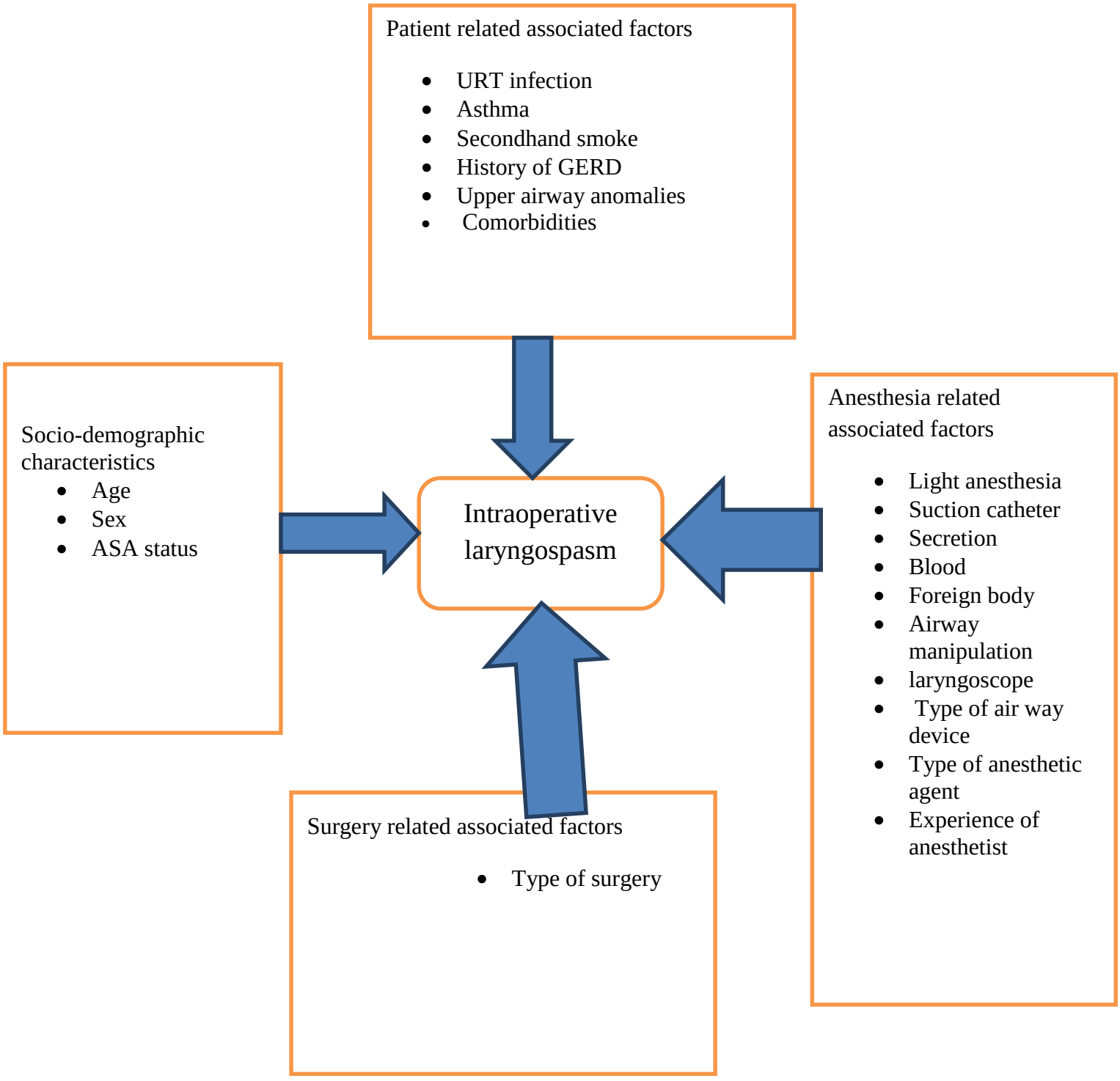
In addition a relatively less experienced anesthesia provider also encounters more number of laryngospasms (23).

Similar studies on risk factors of laryngospasm states that from surgery-related factors: upper airway surgeries were associated with a larger magnitude (21-26%) of laryngospasms that was tonsillectomy and adenoidectomy(57–63). Other surgeries like appendectomy, dilatation of anal sphincter or cervix, mediastinoscopy, hypospadias surgery and skin transplant in children were also highly associated with laryngospasm (9, 26).Some studies showed that damage to the superior laryngeal nerve after a thyroid surgery or iatrogenic removal of the parathyroid glands cause hypocalcemia that has predisposed to laryngospasm (53, 64, 65). Others indicated stimulation of the distal afferent nerves in esophageal procedures caused reflex laryngospasm (65).

A review of the AIMS reports of laryngospasm in 2005 revealed significant morbidity associated with laryngospasm in pediatric and adult anesthetic practice(26).Another study indicated the magnitude of morbidity resulting from laryngospasm can vary as follows: cardiac arrest 0.5%,postobstructive negative pressure pulmonary edema 4%, pulmonary aspiration 3%, bradycardia 6% and oxygen desaturation 61% (66).Similar study done on Jimma also showed Overall Perioperative complications identified, the percentage of desaturation, bradycardia, pulmonary aspiration and negative pressure pulmonary edema, cardiac arrest and death were 42 (79.2%), 37(69.8%), 11 (20.8%), 5 (9.4%), 3 (5.7%) and 1 (1.9%) respectively.(10)

Having adequate information about both magnitude and associated factors in the hospitals is relevant in order to prevent and treat intraoprative laryngospasm in pediatrics and to improve the quality of anesthesia.

Conceptual frame work



Chapter Three: Objective

3.1 General Objective

To assess magnitude and associated factors of intraoperative laryngospasm among pediatric patients who undergo surgery under general anesthesia from December 5, 2016 to April 13, 2017 at Tikur Anbesa Specialized Hospital.

3.2 Specific Objectives

1. To assess magnitudeof intraoperative laryngospasm.

2. To determine associated factors of intraoperative laryngospasm.

Chapter Four: Method and Materials

4.1 Study area and period

The study was conducted at Tikur Anbesa specialized Hospital which is located in capital city of Ethiopia, Addis Ababa. Ethiopia is a landlocked East African nation with an estimated land area of 1.1 million square kilometers. It is the third most populous country in Africa with a population of 79 million of whom 80 percent live in rural areas; while 86% of the population is reported to have access to basic health services.Addis Ababa is the capital city of Ethiopia and the African Union and is often called the "African Capital" due to its historical, diplomatic and political significance for the continent. Located in the foothills of the Entoto Mountains and standing 7,726 feet (2,355 meters) above sea level.It is the third highest capital in the world. It is located in the geographic center of the country.Tikur Anbesa Specialized Hospital is now the main teaching hospital for both clinical and preclinical training of most disciplines. It is also an institution where specialized clinical services that are not available in other public or private institutions are rendered to the whole nation. The study was conducted from December 5, 2016 to April 13, 2017.

4.2 Study design

Institutional based cross sectional study was employed fromDecember 5, 2016 to April 13, 2017 at TASH.

4.3 Population

4.3.1 Source population

All pediatric patients who undergo surgery under general anesthesia at Tikur Anbesa Specialized Hospital.

4.3.2 Study population

All selected pediatric patients who undergo surgery under general anesthesia at Tikur Anbesa Specialized Hospital from December 5, 2016 to April 13, 2017.

4.3.3 Inclusion Criteria

Being pediatric surgical patient under general anesthesia was used as inclusion criteria.

4.4 Sample size determination

The sample size was calculated by using single population proportion formula.

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

Where:

n = sample size

P = percentage

q = 1-p

d = desired degree of precision

$Z_{\frac{\alpha}{2}}$ = is the standard normal value at the level of confidence desired, usually at 95% confidence level

According to previous studies p value is 36% (10).

Therefore, $n = \frac{[1.96]^2(0.36)(0.64)}{(0.05)^2} = 354$

But the sample is to be taken from a relatively small population (N = 240), the required minimum sample was obtained from the above estimate by making some adjustment (if the population is less than 10,000 then a smaller sample size may be required).

Therefore, $n_{final} = \frac{n}{1+\frac{n}{N}}$

$$= \frac{354}{1+\frac{354}{240}}$$

$$= \underline{143}$$

So, the final sample size was **143** pediatric patients.

4, 5 Sampling technique

Systematic random sampling (SRS) technique was used to select study participants.Depending upon average values of the previous pediatric surgery per month and our sample size, the value for sampling interval K^{th} was calculated by using the following Formula. $K^{th} = \frac{N}{n} = \frac{240}{143} \sim 2$ where n is calculated sample size and N is population size and then based on the time taken to complete the study, a random number 2was chosen by lottery method. Then every subsequent 2^{nd} patient was included until the final sample size was achieved.

4.6 Study variables

4.6.1 Dependent variable

Laryngospasm

4.6.2 Independent variables

Socio-demographic characteristics –Age, sex,ASA status,

Patient related – URT infection, asthma, second hand smoke, history of GERD, upper airway anomalies.

Anesthesia related- light anesthesia, suction catheter,secretion, blood, foreign body, airway manipulation, laryngoscope, type of air way device, type of anesthetic agent , experience of anesthetist,

Surgery related-type of surgery

4.7 Data collection tools and procedure

Data was collected using pretested structured questionnaire after reviewing relevant literature. It was prepared in English and data was collected by four BSc holders' anesthetists and supervised by one MSc holder anesthetist. The questionnaire was designed to obtain information on socio demographic characteristics of respondents, magnitude, associated factors,signs, symptoms and complications of intraoperative laryngospasm.Informed consent of patients from their parents was taken on arrival in the pre induction room.

4.8 Data Quality Assurance

Pretest was done on 5% of the sample size at Empress Zewditu Memorial Hospital, in the area different from the study area before actual data collection. Data collectors and supervisors were trained on each items included in the study tools, objective, relevant of study, confidentiality of information obtained, about pretest and technique of diagnosis. During data collection, regular supervision and follow up were made. Investigator cross checked for completeness and consistency of data on daily basis. Once the data had been collected and checked for completeness, consistency and accuracy, it was sorted, categorized and summarized. Then, we were entered the data into the computer using developed data entry, format, coded for each category of variables and again cross check for errors.

4.9 Data Analyzing and processing

Data was checked manually for completeness and then coded and entered in to Epi info version 7 computer software by investigators and was transported to SPSS version 20 computer program for cleaning and analysis. Descriptive statistics was used to summarize data, tables and figures. Shapiro Wilk test was used to test for distributions of data and described in terms of median and interquartile range for asymmetric numeric data. Bivariate and multivariate analysis was used to identify associated factors of intraoperativelaryngospasm and the strength of association were measured by 95% confidence interval and P- value of 0.05 was used as a cut of point. Finally, the result was compared with other results, discussed, concluded, and recommendation was forwarded.

4.10 Ethical Consideration

Ethical clearance and approval was obtained from Institutional Review Board, college of health science, Addis Ababa University. Permission to conduct and Consent was obtained from Hospitals and Addis Ababa University. Informed Verbal consent was also be secured from every parent of study participants before the start of the study after telling them about the objective of the study. Confidentiality and anonymity was ensured. They were asked for their willingness to participate in the study.

4.11 Dissemination plan

The copies of final result will be disseminated to department of anesthesia, college of health science and medicine and Federal Ministry of Health. It will be published in local as well as multi national and international languages. It will be presented on workshop and different seminars.

4.12 Operational Definition

Laryngospasm is the sustained closure of thevocal cords resulting in the partial or complete loss of the patient's airway.

NPPE is a form of noncardiogenic pulmonary edema that results from the generation of high negative intra thoracic pressure needed to overcome upper airway obstruction.

Aspiration is inhalation of material into the airway below the level of the true vocal cords.

Pediatrics refers to children less than 12 years of age.

Age: Age of pediatric patient who undergo surgery under general anesthesia.

ASA physical status classification

ASA Physical Status classification is a grading system simply to assess the degree of a patient's "sickness" or "physical state" prior to selecting the anesthetic or prior to performing surgery.

ASA 1 Normal healthy patient

ASA 2 Patients with mild systemic disease

ASA 3 Patients with severe systemic disease

ASA 4 Patients with severe systemic disease that is a constant threat to life

ASA 5 Moribund patients who are not expected to survive without theoperation

ASA 6 A declared brain-dead patient whose organs are being removed for donor purposes

ASA E Emergency patient

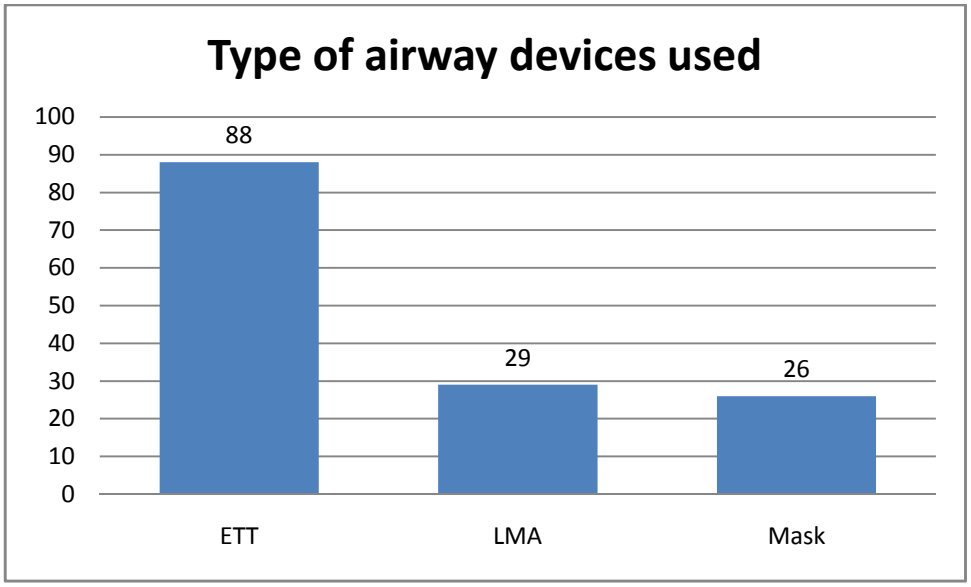
Chapter Five: Result

5.1 Socio demographic and personal characteristics

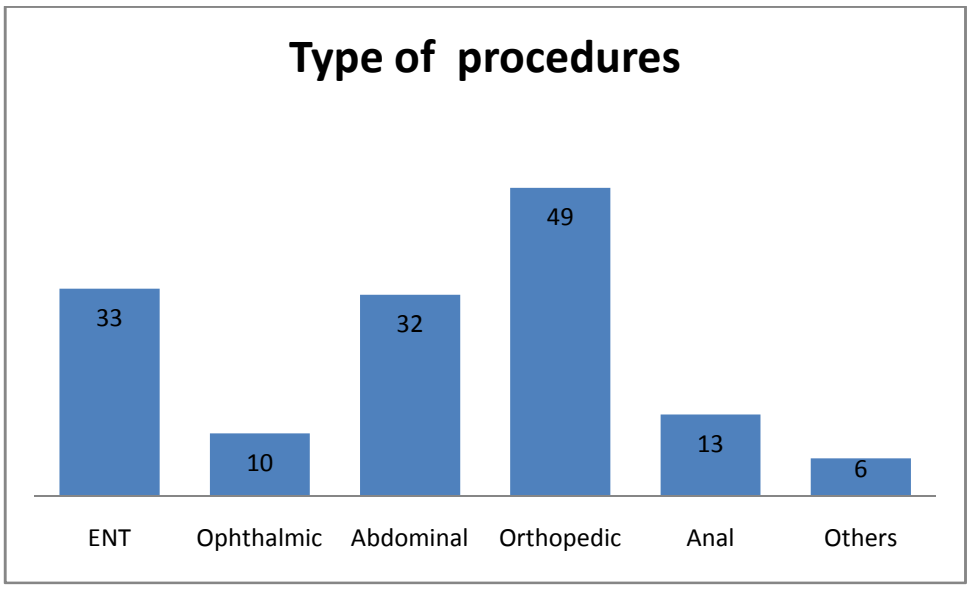
A total of 143 patients with age range from birth to 11 years included in the study to determine the magnitude and associated factors of laryngospasm. The highest number of age group was found between 2 to 11 years and followed by the age group between 1-11 months of age.The median age of respondents was 4and theinterquartile range was 2.Regarding the sex composition of the sampled respondents, more than half of them were males. Pertaining to ASA classification most of patients were electives.Majority of cases had done by degree anesthetists. (See table 1)

Table 1.Sociodemographic characteristics ofpediatrics whoundergo surgery under general anesthesia and anesthesia providers for them from December 5, 2016 to April 13, 2017 at TASH.

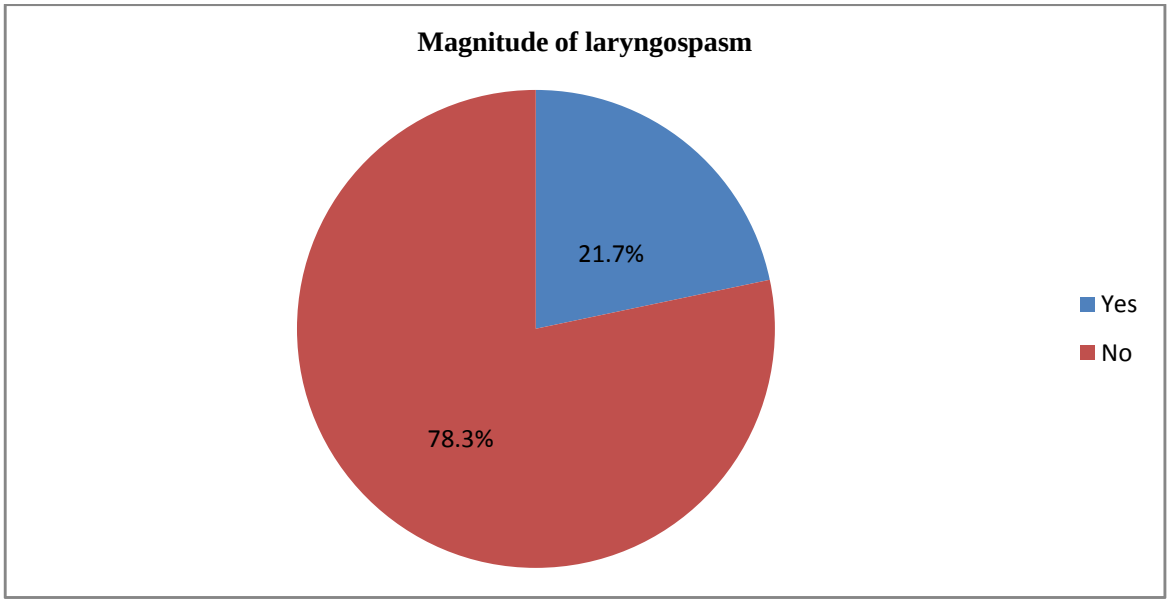
Variables	Category	Frequency	Percentage
Age	0 to 29 days	21	14.7
	1 month to11 months	27	18.9
	12months to 23months	14	9.8
	2 to 11 years	81	56.6
Sex	Male	77	53.8
	Female	66	46.2
ASA status	I	95	66.4
	II	20	14.0
	III	6	4.2
	IV	4	2.8
	E	18	12.6
Status of anesthesia providers	Degree	70	49.0
	Masters	35	24.5
	Physician anesthetist	38	26.6


Type of airway devices used
100
90
80
70
60
50
40
30
20
10
0
88
29
26
ETT
LMA
Mask

Variables	Category	Frequency	Percentage
Induction agents	Ketamine	18	12.6
	Thiopental	12	9.1
	Propofol	67	46.9
	Halothane	45	31.5
Maintenance agents	Halothane	95	66.4
	Isoflurane	48	33.6



Variables	Category	Frequency	Percentage
Comorbidities	Asthma	5	3.5
	GERD	7	4.9
	Down syndrome	4	2.8
	Other	3	2.1
	None	124	86.7
Recent URTI(<2weeks)	Yes	14	9.8
	No	129	90.2



5.3 Complications of laryngospasm

Fromalllaryngospasm cases, further complications were identified. 48.3% of complications were desaturation. Others werebradycard ia, pulmonary aspiration, NPPE and cardiac arrest (see table 4). All pulmonary aspiration, two third of desaturation and NPPE occurred at emergence time. Whereas cardiac arrest occurred during maintenance period.All of pulmonary aspiration ,NPPE and cardiac arrest were occurred in patients with ETT .

Table 4: Complications of laryngospasm among pediatrics patients who undergo surgery under general anesthesia from December 5, 2016 to April 13, 2017 at TASH.

Variables	Category	Frequency	Percentage
Complication of laryngospasm	Desaturation	15	48.3
	Bradycardia	8	25.9
	Pulmonary aspiration	4	12.9
	NPPE	3	9.7
	Cardiac arrest	1	3.2
	Total	31	100.0

5.4 Associated factors of laryngospasm

Among all determinants of laryngospasm :sex, ASA physical status,exposure to second hand smoke,type of airway device,type of laryngoscope,size of laryngoscope ,duration of anesthesia , comorbiditiesand type of surgical procedures were not associated on bivariate analysis at p-value less than 0.2, therefore excluded from multivariate analysis. It was observed from a data of multivariate analysis that neonates,infants,ketamine and light anesthesia were associated with laryngospasm at p-value less than 0.05 (see table 5).

Table 5:Associated factors of laryngospasm for pediatric patients who undergo surgery under general anesthesia from December 5, 2016 to April 13, 2017 at TASH.

Variable	Laryngospasm		COR (95% C.I.)	AOR (95% C.I.)	Sig.
	Yes	No			
Age					
0 to 29 days	9(42.9%)	12(57.1%)	0.146(0.047-0.453)	2.180(1.223-3.885)	.027*
1 to11 months	11(40.7%)	16(59.3%)	0.159(0.055-0.460)	1.090(1.009-2.917)	.042*
12 to 23months	3(21.4%)	11(78.6%)	0.402(0.092-1.749)	.222(.038-1.310)	.097
2 to 11 years	8(9.9%)	73(90.1%)	1	1	1
Preexisting airway anomalies					
Yes	11(50.0%)	11(50.0%)	.198(.076-0.519)	.205(.035-1.217)	.081
No	20(16.5%)	101(83.5%)	1	1	1
Recent URTI					
Yes	8(57.1%)	6(42.9%)	.163(.052-.514)	.533(.039-7.302)	.637
No	23(17.8%)	106(82.2%)	1	1	1
Oropharyngeal airway device used					
Yes	14(43.8%)	18(56.2%)	.233(.098-.554)	.700(.095-5.129)	.725
No	17(15.3%)	94(84.7%)	1	1	1
Type of induction					
Intravenous	27(27.8%)	70(72.2%)	.247(.081-.755)	.251(.033-1.888)	.179
Inhalational	4(8.7%)	42(91.3%)	1	1	1
Induction agents					
Ketamine	9(50.0%)	9(50.0%)	.095(.024-.379)	.066(.006-.731)	.027*
Thiopental	6(50.0%)	6(50.0%)	.095(.021-.439)	.917(.063-13.369)	.949
Propofol	12(17.9%)	55(82.1%)	.437(.131-1.450)	.300(.135-.500)	.305
Halothane	4(8.7%)	42(91.3%)	1	1	1
Inhalational agent for maintenance					

Halothane	27(28.4%)	68(71.6%)	1	1	1
Isoflurane	4(8.3%)	44(91.7%)	.229(.075-.699)	.218(.027-1.784)	.155
light anesthesia					
Yes	18(60.0%)	12(40.0%)	.087(.034-.220)	2.756(.867-8.754)	.000*
No	13(11.5%)	100(88.5%)	1	1	1
Secretions in the oropharynx					
Yes	22(38.6%)	35(61.4%)	.186(.078-.445)	.346(.068-1.773)	.203
No	9(10.5%)	77(89.5%)	1	1	1
Aspiration of gastric contents					
Yes	8(44.4%)	10(55.6%)	.282(.100-.793)	1.543(.128-18.575)	.733
No	23(18.4%)	102(81.6%)	1	1	1
Suction device used					
Yes	29(26.6%)	80(73.4%)	5.800(1.307-25.745)	.026(.000-1.655)	.085
No	2(5.9%)	32(94.1%)	1	1	1

Hint: 1-reference group *- statistically significant

COR-crudes odds ratio sig.-significant

AOR- adjusted odds ratio

Chapter six: Discussion

In the practice of Anesthesia airway management is one of the most important task. Pediatric airway management is always challenging. Laryngospasm occurs more commonly in pediatric anesthetic practice than in adults. In this study, it was attempted to assess magnitude and associated factors of intraoperative laryngospasm among pediatric patients who undergo surgery under general anesthesia.

The highest number of age group was found between 2 to11 years and followed by the age group between 1-11 months of age.The median age of respondents was 4 and interquartile range was 2.

The magnitudeof laryngospasm was 21.70% .Which was slightly lower than the review conducted in Jimma University teaching hospital 28.30% (10). In contrast to this study, the magnitudeof laryngospasm outside our country was low.From these studies which done on intraoperative laryngospasm, a five-year review of upper airway obstruction inNigeriashown the magnitude of laryngospasm was 5.6%(67).An eleven years prospective study indicated the overall magnitude of laryngospasm in the largest (of 136929 patients) was7.9/1000anesthetics or 8.7/1000 patients(2).Other studies showed the magnitude of laryngospasm in pediatric population ranges from 0.04 to 14% (17,22–25).Similarly some investigators reported 0.43/1000 and 1/1000 magnitude of laryngospasm in children respectively(22,24) . The higher magnitude of laryngospasm in our country could be attributed to difference of the setup and the quality of anesthesia providers.

In this study, it was foundthatthe majority of laryngospasm cases occurred in children <24 months of age (29% <1month of age, 64.5%<12months of age,74.2%<24months of age). It is also found that children whose agebetween 0 to 29 days and 1 to 11 monthswere statistically significant for occurrence of laryngospasm(P value of 0.027 and 0.042 respectively). It is consistent with other similar studies which said the magnitudeof laryngospasm in children being higher especially in infants 1-3 months of age(9).The reason for the inverse relationship between age and laryngospasm may be due toto the result of their narrow airway and the increment of parasympathetic tone.

This is in contrast with the finding ofJimma University study whichreported as no statistically significant association between laryngospasm and age(P-value is 0.83764).However,it indicatedthe majority of laryngospasm cases occurred in children <10 years of age (35% <5 years of age), 28.3% <10 years of age)(10).

In the current study there were statistical association between ketamine and laryngospasm. According to our data patients induced by ketamine had less chance to develop laryngospasm.Similarly different studies which conducted on the effect of anesthetic agents on laryngospasm showed among the intravenous induction agents barbiturates have shown to increase laryngospasm (18,23,47,48).This may be due to upper airway obstructionand airway instrumentation secondary to barbiturates. In contrast a study conducted on recurrent episodes of intractable laryngospasm during dissociative sedation with intramuscular ketamine showed ketamine was frequently mentioned as a cause of laryngospasm(50).The reason for this may be other associated factors like light anesthesia during sedation.

On the other hand, evidences showed there wasassociation between inhalational agents and laryngospasm.From these studies, one study indicated, amongst the inhalational agents laryngospasm was maximum with desflurane(41). Others also showed in reducing order of association with laryngospasm inhalational agents were isoflurane, enflurane, halothane and sevoflurane (15, 51,52).In contrast one book says there was no difference in the incidence of laryngospasm between sevoflurane and halothane (53).In this study there was no statistically significant difference between isoflurane and halothane. But this research failed to compare other inhalational agents due to their availability.

In line with other studies (12, 26) light anesthesia was found to be associated with laryngospasm. A data from multivariate analysis also showed that pediatrics with light anesthesia was three times more likely to have laryngospasm than pediatrics whose anesthesia was deep. This study also found that,from all cases with light anesthesia ,60% of patientswere developed laryngospasm.Which is almost consistent with other study (10)which showed light plain of anesthesia wasone of the two the main triggering factors of intraoperative laryngospasm.

According to the result of the present study there was no statistical difference of the magnitude of laryngospasm among facemask, LMA and ETT. This data was supported by one local study(10) and three recent prospective foreign studies (42–44). On the contrary, in two retrospective studies (22,37) LMA was shown to increase magnitude of Laryngospasm.Others indicated ETT was shown to be associated with increased magnitude of laryngospasm (9). One study also suggested that use of facemask in URI associated with low magnitude of laryngospasm (30).

A review of different literatures (57–63) indicated thatupper airway surgeries are associated with a larger incidence (21-26%) of laryngospasms that was tonsillectomy and adenoidectomy. Other surgeries like appendectomy, dilatation of anal sphincter or cervix, mediastinoscopy, hypospadias surgery and skin transplant in children were also highly associated with laryngospasm (9,26). But in the current study there was no statistical association between type of procedure and incidence of laryngospasm (P value was 0.463).

This study also revealedthere was significant morbidity associated with laryngospasm in pediatric anesthetic practice. Of all laryngospasm cases,15 (48.3%)complicationswere desaturation. 8(25.9%), 4(12.9%) and 3(9.7%) were bradycardia, pulmonary aspiration, negative pressure pulmonary edema respectively.There was one cardiac arrest,but it was resuscitated and resolved. The present study also nearly consistent with the review of the AIMSreports of laryngospasmin 2005 (24).Another study indicated the magnitude of morbidity resulting from laryngospasm can vary as follows:cardiac arrest 0.5%, post obstructive negative pressure pulmonary edema 4%, pulmonary aspiration 3%, bradycardia 6% and oxygen desaturation 61% (67).

Similar study done on Jimma also showed almost the same complication.But there wasone death, who underwent abdominal procedure induced with ketamine and intubated withendotracheal tube developed laryngospasm went to cardiac arrest immediately at emergence phase despite adequate resuscitation the patient was died(10).

Chapter Seven: Conclusion and Recommendation

7.1 Conclusion

The result of the study indicated that the magnitude of laryngospasm in pediatric population was slightly higher especially during emergence phase.

Neonates, infants and light anesthesia wererisk factors for laryngospasm. Whereas ketamine was a protective for laryngospasm.

7.2 Recommendation

Based on the finding of the study the following recommendations were drawn.

- FMOH, hospital administrative and anesthesia providers should give attention for this high magnitude of laryngospasm in pediatric population.
- Anesthetists should avoid light anesthesia and make sure that the patient is in a depth of anesthesia before insertion of airway devices.
- Researcher should conduct further researches including different intervention and management strategies of laryngospasm.

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Annexes

Annex I: Information sheet to get permission for the research

Introduction

This information sheet is prepared to explain the research project that you are asked to join by a group of research investigators.

The research team includes the investigator, one senior advisor from AAU ,four data collectors and one supervisor.

Name of Principal investigator: - Salih Mohamed (2nd year MSc Student)

Advisor's name: - Mr.:- Wosenyelleh Admasu

Name of sponsor: - AAU

Name of organization: - AAU, Health science college, anesthesia department

This information sheet is prepared by the above mentioned investigator.

Risk

There is no any risk or harm that you will face by participating in this research. Any personal information recorded will not be copied and transferred to other bodies. No need of writing participants' name but by a code. Every piece of information will be kept confidentially.

Benefits

There is no incentive or payment to be gained by taking part in this project. The information collected from this research project will be kept confidential and only accessed the researcher and research assistant only. This research project will be reviewed and approved by ethical committee of the AAU. If you want to know more information, you can contact the committee through the address below.

Tel: +251914336823

E-mail:yasinferuz@yahoo.com

Annex II: Consent form

Dear participant:

This is a research designed to assess the magnitude and associated factors of intraoperative laryngospasm among pediatric patients who undergo surgery under general anesthesia.As a chance your child was included in the study. So, we kindly request his/her involvement in the study and honest response to achieve the objective of the study. Your response completely confidential and you have full right either to refuse a single question or leave the study. However, your honest response to those question will help us .So, we are requesting you to give honest response and keep participation.

Would you willing to participate in the study please? YES/NO

Thanks for taking part in the study!!!!

For further question ask investigator

Tel: +251914336823

E-mail:yasinferuz@yahoo.com

Annex III: የመጠይቅፈቃድ

አድስአበባዩኒቨርሲቲጤናሳይንስኮሌጅ፣ህክምናትምህርትቤት፣የአንስቴዥያትምህርትክፍል

የመጠይቅፈቃደኛነትቅጽ

ስሜ _____

ይባላል፡፡እኔበአዲስአበባዩኒቨርሲቲበአንስቴዝያትምህርትክፍልየምርምርቡድንዉስጥአንድአባልነኝ፡፡የዚህመጠይቅአላማህ ጻናትቀዶጥገናበሚደርጉበትጊዜላሪንነስፓዝምየሚባልየጉሮሮውስጥህመምመጠንእናተያያዥምክንያቶችንለማዎቅለሚደረገ ውምርምር/ጥናት /መረጃለመሰብሰብነው፡፡

የእርስዎልጅአንድየጥናቱክፍልአድርጌስመርጥአስፈላጊየሆኑመረጃዎችንእንደሚሰጡኝበማሰብነዉ፡፡በጥናቱለመሳተፍፈቃ ደኛከሆኑከእርስዎየሚገኘውማንኛውምመረጃበሚስጥርይጠበቃል፡፡ለዚህምሲባልየእርስዎምሆነየልጅዎሥምናአድራሻአይ ገለጽም፡፡እንድሁምከጥናቱበኋላአፕራሲዎንለሚደረግላቸዉህጻናትቀዶጥገናበሚደርጉበትጊዜላሪንነስፓዝምየሚባልየጉሮ ሮውስጥህመምመጠንእናተያያዥምክንያቶችንለማዎቅእናተገቢየሆኑእርምጃዎችንለመዉሰድይረዳል፡፡

የቃልሥምምነት

የዚህጥናትዓላማውንብቶኝበጥናቱለመሣተፍ

ሀ. ፈቃደኛሆኛለሁለ. ፈቃደኛአይደለሁም

በጥናቱለመሳተፍፈቃደኛከሆኑቃለመጠይቁንመቀጠልይቻላል፡፡

ፈቃደኛከሆኑየመጠይቁመለያቁጥር_____ መጠይቁየተካሄደበትቀን _____

የጠያቂውሥምናፊርማ _____

የሱፐርቫይዘርስምናፈርማ _____

ጥናቱንበተመለከተማንኛዉምአይነትጥያቄካላችሁየሚከተለዉንአድራሻተጠቀሙ::

በዋናነትምርምሩንየሚያካሂዉሰዉስም፡

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Annex IV:Questionnaire

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

Sociodemographic factors

No.	Factor	Response	Skip pattern
101	Age (years)	_____	
102	Sex	A. Male B. Female	
103	Anesthetist qualification	A. Degree B. Masters C. Physician anesthetist	

Preoperative period

No.	Factor	Response	Skip pattern
201	ASA status	A. I D. IV B. II E. V C. III F. E	
202	Preexisting airway anomalies	A. Yes B. No	
203	Diagnosis	_____	
204	Planned surgery	_____	
205	Co morbidity	A. Asthma B. Gastroesophageal reflux disease C. Down syndrome D. Other? E.None	
206	Patient exposed to second hand smoke	A. Yes B. No	
207	Recent upper respiratory infection (<2 weeks)	A. Yes B. No	
208	Preoperative saturation (%)	_____	

Intraoperative period

No.	Intraoperative factors	Response	Skip pattern
301	Type of anesthesia	A. General anesthesia with ETT B. General anesthesia withLMA C. General anesthesia with mask D. Other	
302	Oropharyngeal airway device used	A. Yes B. No	
303	Type of induction method used	A. Intravenous B. Inhalational	
304	Intravenous induction agent used	A. Ketamine B. Thiopental C. Propofol	
305	Type of inhalational used for maintenance	A. Halothane B. Isoflurane C. Other_____	
306	Type of laryngoscope used	A. Macintosh B. Miller C. Not used	
307	Size of laryngoscope used	A. 1 C. 3 B. 2 D. 4	
308	Number of attempts during airway device insertion		
309	Light Anesthesia	A. yes B. No	
400	Secretions in the oropharynx	A. Yes B. No	
401	Aspiration of gastric contents	A. Yes B. No	
402	Suction device used	A. Yes B. No	
403	Duration of anesthesia (minutes)	_____	

Questions about the presence of laryngospasm

No.	Laryngospasm questions	Response	Skip pattern
501	Inspiratory stridor	A. Yes B. No	
502	Decreased air entry via stethoscope	A. Yes B. No	
503	Increased inspiratory effort/tracheal tug	A. Yes B. No	
504	Paradoxical breathing	A. Yes B. No	
505	Desaturation with or without bradycardia	A. Yes B. No	
506	Cyanosis	A. Yes B. No	
507	Laryngospasm	A. Yes B. No	
508	Complication of laryngospasm if any?	A.Desaturation B.Bradycardia C.Pulumonary aspiration D.Negative pressure pulumonary edema E.Cardiac arrest F.Death G.Others(…….	

Name of data collector----------signature----------date----------

Name of supervisor----------signature----------date----------

Declaration

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

Name: _____

Signature: _____

Submission to MSc Tutor, Dept. of Anesthesia, Addis Ababa University.

Date of Submission: _____

This thesis work has been submitted for examination with my/our approval as Advisors and Tutors on the MSc in Advanced Clinical Anesthesia course

Name Signature

1. Chairperson _____ _____

2. Advisor_____ _____

3. Examiner_____ _____