THE PREVALENCE OF POSTOPERATIVE RESPIRATORY COMPLICATIONS IN PAEDIATRIC PATIENTS UNDERGOING ELECTIVE ADENOTONSILLAR SURGERY AT THE KENYATTA NATIONAL HOSPITAL EAR NOSE AND THROAT SATELLITE THEATRE

BY

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SEPTEMBER, 2018
STUDENT’S DECLARATION

This dissertation is my original work and to my knowledge has not been presented for any award in any other university.

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DEDICATION

To my parents, Douglas Ndung’u Kariuki and Lucy Wanjiku Kariuki, whose support, guidance and unconditional love have brought me this far.

To my beloved wife, Teresia Njoki and my sons: Liam and Leo for their unwavering support.
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<th>Description</th>
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<tbody>
<tr>
<td>AAOHNS</td>
<td>American Academy of otolaryngology- Head and Neck Surgery</td>
</tr>
<tr>
<td>AHI</td>
<td>Apnoea Hypopnoea Index</td>
</tr>
<tr>
<td>ASA</td>
<td>American Society of Anaesthesiologists</td>
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<tr>
<td>CHAT</td>
<td>Childhood Adenotonsillectomy study</td>
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<td>CPAP</td>
<td>Continuous Positive Airway Pressure</td>
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<td>ECG</td>
<td>Electrocardiography</td>
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<td>ENT</td>
<td>Ear Nose and Throat</td>
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<td>HDU</td>
<td>High Dependency Unit</td>
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<tr>
<td>ICSD</td>
<td>International Centre for Sleep Disorders</td>
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<tr>
<td>IM</td>
<td>Intramuscular.</td>
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<tr>
<td>IV</td>
<td>Intravenous.</td>
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<tr>
<td>IVF</td>
<td>Intravenous fluids</td>
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<tr>
<td>KNH</td>
<td>Kenyatta national Hospital</td>
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<tr>
<td>MALT</td>
<td>Mucosa Associated Lymphoid tissue</td>
</tr>
<tr>
<td>OSA</td>
<td>Obstructive Sleep Apnoea</td>
</tr>
<tr>
<td>PICU</td>
<td>Paediatric Intensive Care Unit</td>
</tr>
<tr>
<td>PSG</td>
<td>Polysomnogram</td>
</tr>
<tr>
<td>PSQ</td>
<td>Paediatric sleep questionnaire</td>
</tr>
<tr>
<td>SBD</td>
<td>Sleep Related Breathing Disorder</td>
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<td>URTI</td>
<td>Upper respiratory tract infection</td>
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DEFINITION OF TERMS

**Laryngospasm:** Upper airway obstruction due to involuntary/uncontrolled muscular contractions of the vocal cords associated with complete or partial closure of the laryngeal opening. It can present with a silent chest.

**Bronchospasms:** Episodic, recurrent and reversible bronchiole airflow obstruction due to bronchiole smooth muscle spasms which can present as wheezing, auscultated rhonchi or a silent chest.

**Pulmonary oedema:** Transudative fluid in the lungs. It presents with crepitations on auscultation of the lungs.

**Apnoea:** Cessation of breathing of between 10 and 15 seconds.

**Desaturation:** In the context of pulse oximetry refers to exhibited low oxygen concentration of less than 90% from an initial reading of greater than 90% or a decrease from a baseline of less than 90% when a patient is on room air or oxygen supplementation.

**Shallow breathing:** Reduced rate and depth of breathing in relation to the age group.

**Stridor:** A high pitched breath sound resulting from partial obstruction of the airway at the level of the larynx or trachea.

**Deep extubation:** Removal of an endotracheal tube while the patient is fully anaesthetised.

**Awake extubation:** Removal of an endotracheal tube when the patient can fully obey commands, demonstrates recovery from neuromuscular blockade such as having sustained head lift and tongue protrusion. The patient also has to have adequate spontaneous breathing.
ABSTRACT

Background
Adenotonsillar surgery is one of the most common surgeries performed in the paediatric age group which is between birth and 16 years. It is associated with postoperative respiratory complications. The true picture of the problem in our centre has not been captured. Studies from other parts of the world have put the prevalence of postoperative respiratory complications following adenotonsillar surgery at between 1 and 27%. (1) (2)

I carried out a cross-sectional observational study on relatively healthy paediatric patients assigned ASA I and II classification presenting for adenotonsillar surgery to determine the prevalence of postoperative respiratory complications following adenotonsillar surgery in our centre KNH.

Broad objective
The study aimed at determining the prevalence of postoperative respiratory complications in paediatric patients undergoing adenotonsillar surgery at KNH Ear Nose and Throat ENT satellite theatre.

Study Design and Site
It was a crossectional observational study conducted on paediatric patients scheduled for elective adenotonsillar surgery in the ENT satellite theatre at KNH.

Materials and Methods
A total of 109 paediatric patients were recruited a day before surgery from KNH ward 5C. Information on presence of known risk factors associated with respiratory complications in the perioperative period were collected together with anthropometric measurements and entered into a data collection tool. On the day of surgery information on preoperative vitals, perioperative conduct of anaesthesia, postoperative respiratory complications and their interventions were collected using the data collection tool. The data collection tool was completed by the principal investigator.
Results

The study showed the prevalence of postoperative respiratory complications following adenotonsillar surgery at the KNH satellite ENT theatre is 41.2%. The most common complications were desaturation 37.6%, laryngospasms 11.1%, apnoea <1% and stridor < 1%. A diagnosis of adenoid hypertrophy, the intraoperative use of morphine and halothane was significantly associated with the postoperative respiratory complications. Oxygen supplementation was the most common intervention used for managing the postoperative respiratory complications.

Conclusions

The overall prevalence of postoperative respiratory complications in paediatric patients who underwent adenotonsillar surgery was much higher than what is observed in literature. A diagnosis of adenoid hypertrophy, the use of morphine and halothane were associated with postoperative respiratory complications. Desaturation was the most frequent complication while oxygen supplementation was the most common intervention used to manage the respiratory complications.
CHAPTER ONE

1.0 INTRODUCTION
Adenotonsillar surgery is one of the most common surgeries performed in the paediatric age group accounting for 30% of all surgeries done in this group.(3) Globally, postoperative respiratory complications following adenotonsillar surgery vary between 1 and 27%. (1)(4) These are from studies that concentrated on patients with serious co morbidities such as Down’s syndrome. In our centre KNH, 665 adenotonsillar surgeries were performed on relatively healthy paediatric patients in 2016. The prevalence of postoperative respiratory complications in paediatric patients who undergo adenotonsillar surgery in KNH is unknown. This study will aim to observe the postoperative respiratory complications and the associated risk factors for developing postoperative respiratory complications in paediatric patients undergoing adenotonsillar surgery in the satellite ENT theatre.

There are no set guidelines for the provision of anaesthesia in patients presenting for adenotonsillar surgery worldwide, as a result anaesthetic management is often left to the discretion of the anaesthesiologist. This study will also try to determine the association between the perioperative conduct of anaesthesia and the occurrence of postoperative respiratory complications. Studies have shown that patients with obstructive sleep apnoea, OSA, are more sensitive to the respiratory depressing effects of anaesthetic drugs such as opioids and benzodiazepines which can lead to respiratory compromise in the post anaesthetic care unit.

1.1 Research Question
What is the prevalence of postoperative respiratory complications in paediatric patients presenting for elective adenotonsillar surgery at the KNH satellite ENT theatre?

1.2 Objectives
1.2.1 Broad Objective
To determine the prevalence of postoperative respiratory complications in paediatric patients undergoing adenotonsillar surgery in KNH satellite ENT theatre
1.2.2 Specific Objectives

- To determine the prevalence of postoperative respiratory complications in paediatric patients who undergo adenotonsillar surgery in KNH satellite ENT theatre from the end of surgery to one hour in the postanaesthetic care unit.

- To determine patient risk factors associated with the development of postoperative respiratory complications in paediatric patients scheduled for elective adenotonsillar surgery at KNH satellite ENT theatre.

- To determine whether variations in anaesthesia provision are associated with postoperative respiratory complications in paediatric patients scheduled for elective adenotonsillar surgery at KNH satellite ENT theatre.

1.3 Study Justification

Previous studies done have concentrated on patients with serious comorbidities who are at a higher risk of suffering from postoperative respiratory complications for example those with cardiac disease, pulmonary disease and Down’s syndrome. This study will concentrate on otherwise healthy paediatric patients.

The practice of anaesthesia for adenotonsillar surgery varies amongst anaesthesia providers. This study will try to determine how this variation is associated with the occurrence of postoperative respiratory complications following adenotonsillar surgery.

There are no practice guidelines on anaesthesia provision for adenotonsillar surgery. The information from this study findings can be used to advise practice.

There is lack of local data in our population on the prevalence of postoperative respiratory complications in paediatric patients following adenotonsillar surgery.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

2.1.1 Anatomy and Physiology of the Tonsils

The term tonsils refers to all lymphoid tissue that form the Waldeyers ring, but for ease of differentiation the term “tonsils” is used to denote the lymphoid tissue in the faucal pillars of the palate. The Waldeyers ring consists of pharyngeal tonsils (adenoids), two tubal tonsils that bound the Eustachian tube, two palatine tonsils commonly called “the tonsils” and the lingual tonsils on the posterior part of the tongue (4).

The “tonsils” (palatine tonsils) are located on the lateral oropharynx where they derive their blood supply from the tonsillar branch of the facial artery, venous drainage is into the pharyngeal plexus. The external palatine vein is a large vein in the tonsillar bed which can be a source of postoperative venous bleeding. They are innervated by the glossopharyngeal and lesser palatine nerves. The presence of the lingual artery and the internal carotid artery deep to the inferior pole of the “tonsils” can be a source of arterial bleeding if they are inadvertently injured.

The adenoids are located in the midline on the posterior nasopharyngeal wall immediately below the rostrum of the sphenoid. The nasopharynx communicates with the posterior choanae. The arterial supply is from branches of the external carotid artery that include; the ascending pharyngeal, ascending palatine, sphenopalatine, pharyngeal branch of the maxillary artery and artery of the pterygoid canal. Its venous drainage is to the facial and internal jugular systems. Sensory innervation is by the glossopharyngeal (IX) and vagus (X) nerves.

The tonsils have an immune function as they form part of the MALT (Mucosa associated lymphoid tissue) which aid the production of immunoglobulins. The adenoids and tonsils are most active immunologically between 4 to 10 years of age regressing in activity by puberty.

2.1.2 Adenotonsillectomy

The earliest recording of adenotonsillar surgery was noted about 3000 years ago in Hindu writings. (5) In the 1st century AD Cornelius Celsus described the removal of a tonsil using his
finger. Paul Aeginus also documented the blunt removal of inflamed tonsils using a metal hook in 625 AD. In 1828 Philip Syng Physick described the tonsillotome which was the precursor of the current tonsillotome which was initially used for the surgical dissection of the uvula. In 1867 Wilhelm Meyer of Copenhagen witnessed the procedure on a 20-year-old lady as a remedy for treating reduced hearing and nasal obstruction. This was done with the aid of a ringed forceps passed through the nose. A report was written by Samuel J Crowe in 1917 on 1000 tonsillectomies; this popularized the use of the Crowe Davis mouth gag and sharp dissection as a surgical technique for removal of tonsils. This gradual increase in adenotonsillar surgery led to the need for improved surgical and anaesthetic safety.

2.1.3 Indications for Adenoidectomy
The recognized absolute indication for adenoidectomy is airway obstruction with cor-pulmonale. Relative indications include chronic nasal obstruction with rhinorrhea, obligate mouth breathing, failure to thrive, Eustachian tube obstruction with fluid effusion or conductive hearing loss, suspected malignant disease, abnormal speech and abnormal dento-facial development. (6)

2.1.4 Indications for Tonsillectomy
The accepted absolute indications for tonsillectomy are absolute dysphagia, clinically significant obstructive sleep apnoea OSA with cor pulmonale, suspected malignancy and failure to thrive. (6)
The relative indications include recurrent tonsillitis as per the American Academy of otolaryngology- Head and Neck Surgery AAOHNS guidelines, chronic tonsillitis resistant to antimicrobial therapy, tonsillolithiasis with halitosis and pain. (6)
A review on changing trends concerning adenotonsillar surgery by Ericksen et al observed whilst in 1970 adenotonsillectomy was done due to infectious causes attributing to 88% of surgeries done, there was a shift noted in 2005 whereby pharyngeal obstruction accounted for 77% of the surgeries done. (7)
These trends vary from region to region. According to The National Prospective Tonsillectomy Audit of practice in the United Kingdom 2003/ 2004 pharyngeal obstruction accounted for only 10% of the surgeries done in 25% of children less than 5 years of age. (7)
2.2 Risk Factors for Developing Postoperative Respiratory Complications Following Adenotonsillar Surgery

Known risk factors for developing respiratory complications include age less than 3 years, recent history of upper respiratory tract infection, severe OSA documented by polysomnogram, asthma, black race, neuromuscular disorders, craniofacial abnormalities, obesity, underweight, history of prematurity and sickle cell disease. (8)(9)(10)(11)

Children who are less than 3 years old are susceptible to respiratory complications due to their anatomical and physiological characteristics. The airway is narrowest at the level of the cricoid cartilage where the epithelium is loosely bound to the underlying tissues. Trauma at this level can lead to oedema. Oedema of about 1 mm can reduce the calibre of the airway by 60% leading to increased airway resistance and increased work of breathing. This is dictated by Hagen’s Poiseuille law. (12) This is avoided with the use of uncuffed endotracheal tubes. (13)

Respiratory muscle fatigue can occur in this age group due to the reduced percentage of Type I muscles in the diaphragm. The adult configurations of this muscles are achieved at 2 years of age. Increased work of breathing from different aetiology such as severe bronchospasms can lead to respiratory failure. Alveoli clusters develop to adult numbers by 8 years of age. As a result adequate oxygenation is achieved by having high ventilatory rates. Children have a low respiratory reserve leading to rapid desaturation associated with cessation of breathing. (14) Chest wall compliance is more in children in comparison to adults leading to low functional residual capacity FRC which can be reduced drastically by apnoea. (13) Minute ventilation is respiratory dependant with no other mechanism of increasing tidal volume. The horizontal configuration of the ribs in children negates the “bucket handle” effect seen in adults leading to less tidal volumes. The breathing in children is primarily diaphragmatic, this can be affected by splinting of the diaphragm by the abdominal contents due to gas inadvertently pumped into the stomach by poor bag and mask ventilation. This can cause respiratory failure during the postoperative period.

Sleep related breathing disorders (SBD) is a spectrum of nocturnal abnormalities ranging from habitual snoring, upper airway obstruction syndrome to outright obstructed sleep apnoea OSA. (9)(15) OSA is described as periodic episodes of nocturnal airflow restriction (hypopnoea) or obstruction (apnoea) in association with sleep disruption, arousals from sleep, oxygen desaturation, and possible hypercapnia. A daytime nap polysomnogram (PSG) also
known as a sleep study, is the gold standard used to definitively diagnose the disease. Nocturnal oximetry which assess the severity of OSA by quantifying the number and severity of oxygen desaturations has a positive predictive value of detecting OSA is a cheaper alternative (9) OSA is found in approximately 1 - 10% of school going children (9)(3) while primary snoring has a prevalence of about 20% to 27% .(9) This disparity arises from what different investigators used as yardsticks of defining OSA (16) Different sleep centres have different cut offs for defining the degree of SBD. (16) It is under diagnosed as little work has been done on investigating OSA in children. As a result, the diagnostic criteria used in adults has been found to be inappropriate as it underestimates the number of children with sleep disordered breathing. The symptoms of sleep deprived children are different from the symptoms of sleep deprived adults.(17) Children with severe OSA are increasingly sensitive to the residual effects of respiratory depressing drugs. As a result the use of drugs such as morphine can lead to an increased incidence of postoperative respiratory complications. It is hypothesised that intermittent periods of hypoxia during airway obstruction leads to the up regulation of MU receptors which results in increased sensitivity to opioids. Approximately half the dosage of opioids is what is required to achieve clinical effect.(9)(18)(7) Children with OSA also have a diminished ventilatory response to carbon dioxide leading to prolonged recovery of the respiratory drive in the postoperative period.(19)

There have been efforts to develop questionnaires to help detect children at risk of SBD but these tools are used for screening.(20) The paediatric Sleep Questionnaire PSQ developed by Chervin et al has undergone reliability and validity testing. It has been administered to parents of children between the ages of 2 to 18 years This tool hypothesizes the best clinical indicators to determine the presence of paediatric OSA are apnoea witnessed by the parent, loud snoring and difficulty in breathing during sleep (20)

The sensitivity of clinical and physical examination varies from 30 to 80%. Hoffstein and Szalai showed that even a skilled and experienced sleep physician cannot adequately diagnose the different spectrum of sleep disordered breathing clinically.(17) In the absence of PSG studies patient who are labelled low risk may have severe forms of sleep related breathing disorders and as a result may suffer from adverse postoperative respiratory complications.
Obesity, body mass index BMI greater than 95th percentile within an age group, increases the risk of postoperative respiratory complications due to the attendant collapse of the airway due to the presence of increased adipose tissues in the airway. This can lead to airway obstruction. Obesity is a risk factor for developing OSA, obese children have a higher propensity for developing upper respiratory tract infections and suffering from asthma. This leads to hyperactivity and obstruction of the airway due to laryngospasms and bronchospasms. Obese children are also at risk of inappropriate dosing of anaesthetics due to weight this can result in overdosing of drugs. Obesity impacts the pharmacokinetics of many anaesthetic drugs especially those drugs that concentrate in adipose tissues such as barbiturates. This can acts as a reservoir for these drugs promoting their respiratory depressing effects into the postoperative period.(19)(9)

Asthma is a chronic pulmonary disease characterized by airway inflammation and hyper responsiveness resulting in episodic wheezing, coughing, breathlessness, chest tightness and reversible airway obstruction. Bronchospasms occurring during the perioperative period are a major concern to the anaesthesia provider. Morbidity and mortality due to asthma has gradually reduced due to availability of drugs and awareness on the management of the disease. Contributing factors can be multifactorial from genetics, environmental triggers such as pollen, atopy and anxiety. The level of control should be ascertained during a preoperative review. This is assessed by the number of drugs the patient is receiving. A patient on a single agent such as a β agonist is well controlled when compared to a patient on numerous medications. A history on the frequency and (21) severity of previous asthmatic attacks can also act as a guide on the severity of the disease. Known allergies should also be ascertained. Asthmatics should continue with their medication on the day of surgery(22)

Upper respiratory tract infection URTI is a risk factor for the development of perioperative respiratory complications. 85 % of URTIs are viral in origin and they present with cough, nasal congestion and discharge, sneezing, sore throat. Airway hyper reactivity leading to bronchoconstriction has been hypothesized to occur via 2 mechanisms; release of chemical mediators and neurological reflexes. Damaging of the epithelium by the virus causes the release of inflammatory chemical mediators such as bradykinnin, histamine and prostaglandins which can cause bronchoconstriction. Alternatively Muscarinic receptors M2 can be inhibited by viral neuramidases leading to acetylcholine release and subsequent bronchoconstriction.(23) The risk of perioperative respiratory complications is highest during
an acute infection and can persist for a period of 2 to 6 weeks. Reducing the secretions with
gentle suctioning and avoiding irritation of the airway in a child with a history of a URTI is
an important anaesthetic goal. Intravenous induction of anaesthesia is preferable to
inhalational induction as a means of avoiding the irritation of the airway.(23)

Underweight which is defined as weight less than the 5th percentile is a consequence of
untreated OSA. This arises from the erratic release of growth hormone due to disturbance of
sleep and high metabolism associated with sustained sympathetic activity. It is a marker of
the severity of OSA.(21)

A history of pre-term birth has been shown to be a risk factor for developing postoperative
respiratory complications. This has been postulated to be due to presence of apnoea of
prematurity at birth and the need for endotracheal intubation in the neonatal intensive care
unit NICU which can change the morphology of the airway.(11)

Black race has been identified as a risk factor for developing postoperative respiratory
complications following adenotonsillar surgery.(9)(24) Some studies have shown than the
cross-sectional area of the airway is smaller in African Americans than in white children
making them more susceptible to airway obstruction due to oedema. There is a higher
incidence of sickle cell disease in blacks than in whites. The attendant risk of sickle cell
disease is the presence of chronic pulmonary hypertension which can lead to postoperative
pulmonary oedema following the relief of chronic upper airway obstruction. A subset of
blacks have been found to be ultra-fast metabolisers of codeine due to gene polymorphism of
the CYP2D6 enzyme.(18)(24) This leads to high levels of morphine in the blood stream
causing postoperative respiratory depression. An intricate interplay of socio economic factors
such as poverty and environmental factors such as in utero and household smoke exposure
has been attributed to low birth weights and subsequent reduced lung functions in African
American children as compared to children of Caucasian descent.

Cranial facial disorders such as Pierre Robin’s sequence, Down’s syndrome and neurological
disorders such as cerebral palsy are known risk factors for developing upper airway
obstruction and respiratory failure. Patients with Down’s syndrome have been found to have
multiple levels of upper airway obstruction, increased salivation which cannot be treated with
surgery. Patients with macroglossia have the increased risk of the tongue falling back during
recovery period. (25) These group of patients are not usually operated on in the satellite ENT theatre.

Sickle cell disease is a spectrum of inherited haemoglobinopathies. The pathophysiology involves not only the abnormalities of red blood cells but also the vascular endothelium, white blood cell function, coagulation and inflammatory response. One important sequelae of sickle cell disease is chronic pulmonary hypertension.(26) Other pulmonary complications include asthma, pulmonary fibrosis and acute chest syndrome. All these can lead to postoperative respiratory complications.

2.3 Respiratory Complications Following Adenotonsillectomy

The incidence of postoperative respiratory complications following adenotonsillar surgery varies from 1- 30% (8) while postoperative bleeding has been shown to occur at a lower rate of between 1 and 8%. (27) Trends in morbidity and mortality following adenotonsillar surgery have reduced. This reduction has been attributed to improved monitoring modalities such as pulse oximetry, capnography and improved surgical techniques. The current incidence of mortality is 1:16,000-35,000 of tonsillectomies done.(28)

The most common postoperative complications following adenotonsillar surgery are postoperative nausea and vomiting and respiratory complications. (29)(30) Children < 2 years have the highest incidence of postoperative respiratory complications.(31)(29) Upper airway obstruction in children is the leading cause of respiratory compromise in the postanaesthetic care unit. In the Australian incident monitoring study AIMS, airway obstruction due to laryngospasm accounted for 43% of all respiratory complications in the PACU.(32) (33) (30)

There are numerous reasons for this. Loss of pharyngeal tone is one of the most common causes of upper airway obstruction in a sedated or obtunded patient. Secondly, the residual effects of inhaled and intravenous anaesthetics, residual neuromuscular blockade and opioids can have these effect. In a conscious patient, opening of the upper airway is facilitated by the contraction of the pharyngeal muscles and at the same time the negative inspiratory pressure that is generated by the diaphragm. As a result, the tongue and soft palate are pulled forward, tenting the airway open during inspiration. This pharyngeal muscle activity is depressed during sedation leading to airway obstruction.(30) Obstruction secondary to loss of pharyngeal tone can be relieved by simply opening the airway with the “jaw thrust manoeuvre” or continuous positive airway pressure CPAP applied via a facemask (or both).
Laryngospasm is sudden spasm of the vocal cords leading to the complete occlusion of the laryngeal opening causing upper airway obstruction. It is the commonest cause of upper airway obstruction in the paediatric age group.(33) It commonly occurs in the operating room immediately following tracheal extubation and in addition it can occur in a sedated patient in PACU.(30) Other known causes that can stimulate laryngospasms are increased secretions in the airway such as saliva and blood. Jaw thrust with CPAP (up to 40 cm H\textsubscript{2}O) is often sufficient stimulation to “break” the laryngospasm. If jaw thrust and CPAP manoeuvres fail, immediate skeletal muscle relaxation can be achieved with succinylcholine (0.1 to 1.0 mg/kg intravascular IV or 4 mg/kg intramuscular IM). There have been controversies on deep versus awake extubation as a means of countering laryngospasms. Deep extubation exposes the patient to the risk of reduced pharyngeal tone. This can cause the tongue to fall back causing airway obstruction. Some studies have shown that there is no difference in morbidity between awake and deep extubation.(34) A recent episode of a URTI and a history of asthma increases the risk of laryngospasms by 2 to 7 fold.(33) A history of intraoperative laryngospasm increases the incidence of laryngospasms in the postoperative period.(9) Post extubation stridor can arise from the use of a tight fitting endotracheal tube or a cuffed endotracheal tube. This can lead to oedema of the airway causing airway obstruction. This can be managed by nebulisation using racemic adrenaline to cause vasoconstriction and reduction of tissue oedema.(33)

Post-obstructive pulmonary oedema is non cardiogenic in nature. It can arise from the relief of upper airway obstruction that may follow tracheal extubation at the conclusion of anaesthesia and surgery. Post-obstructive pulmonary oedema is a transudative oedema produced by the exaggerated negative intrathoracic pressure generated by an inspiratory effort against a closed glottis. The resulting negative intrathoracic pressure and increased venous return increases the hydrostatic pressure gradient across the pulmonary vascular bed promoting the transudation of fluid. The removal of adenoids which can be a source of chronic obstruction has been shown to precipitate post-obstructive pulmonary oedema.(30)(33) Once obstruction is relieved it can be managed by giving high flow oxygen using CPAP of 5-10 cm of water, diuretics and fluid restriction. In the case of persistent hypoxia endotracheal intubation and positive pressure ventilation is encouraged. The most common cause of post-obstructive pulmonary oedema in PACU is laryngospasm(30)

Respiratory insufficiency following adenotonsillar surgery can be due to apnoea. The candidates for adenotonsillar surgery are known to have OSA. These patients are increasingly
Sensitive to opioids especially to long acting drugs such as morphine which can depress the respiratory centre. This can be reversed with the use of naloxone at a dose of 0.01mg/kg titrated for effect. (33)

Bronchospasms can occur in asthmatics and can be exacerbated if there is presence of a URTI. They can be precipitated by anaesthetic drugs causing anaphylaxis such as morphine. It can be managed with nebulized salbutamol or adrenaline. The use of intravenous lignocaine has been shown to reduce airway irritability. (22)

A retrospective study by Renato Oliviera Martins et al showed that abnormal preoperative PSG parameters, prolonged orotracheal intubation (P=0.0011) and upper respiratory tract infection URTI (P=0.0426) were independent predictors of respiratory complications. This study was a cross-sectional retrospective observational study of 53 subjects who had a predetermined criteria for admission into PICU. The criteria were both clinical and/or polysomnographic determinants. The clinical criteria were: age < 3 years, obesity, underweight, asthma, rhinitis, history of an upper airway respiratory tract infection, adenoid size, tonsillar size. PSG determinants were Apnoea/Hypopnoea Index, AHI > 10 events/hr., Spo2 nadir < 80%. The surgical and anaesthetic technique were standardized for all the patients. This study concluded that significant preoperative PSG parameters (Apnoea/Hypopnoea Index AHI and Spo2 nadir) studies coupled with URTI were significant risk factors for developing postoperative respiratory complications. A drawback of this study was the relatively small sample size. The other clinical parameters were not statistically significant. The most common complication was apnoea followed by laryngospasms, acute pulmonary oedema and bronchospasms in that order (8).

A study conducted by Thongyam et al detected a postoperative respiratory complication rate of 28%. It was an adequate sample sized study apart from the aforementioned risk factors there was an addition of black race as an independent risk factor for respiratory complications. The strongest risk factor with statistical significance was severe OSA as documented by PSG. Age less than 3 years of age, failure to thrive and black race increased the risk of postoperative respiratory complications but they were not statistically significant (10). A drawback of this study was the oversampling of patients with craniofacial abnormalities.
The childhood adenotonsillectomy (CHAT) study by Sofia et al studied 229 children was multi centred. Children with suspected OSA using PSG parameters and American Academy of otolaryngology- Head and Neck Surgery AAOHNS guidelines were used to select generally healthy school going children. Obesity was the strongest independent risk factor associated with respiratory complications. The respiratory complication rate was at 1.4 % with a majority suffering from pulmonary oedema. Other complications noted were bronchospasms and hypoxaemia. (35) The demographics of this study were children between the ages of 5 and 9 years it therefore lacked information on children less than 3 years of age who have increased risk of postoperative respiratory complications.

A retrospective study by Kieran et al on postoperative desaturations looked at the records of 4092 patients who had undergone adenotonsillar surgery over a 2 year period. The respiratory complication rate was at 7.4 %. Age less than 3 years, obesity, failure to thrive and a clinical diagnosis of OSA had P < 0.0001 and hence were statistically significant risk factors for developing postoperative respiratory complications. The drawback of this study was that there was a high number of patients with medical comorbidities such as cardiac disease, Down’s syndrome and pulmonary disease. This group represented 68% of the patients who desaturated during the postoperative period. (28)

A retrospective cohort study done by Linda Horwood et al to investigate postoperative respiratory complications following adenotonsillar surgery detected a complication rate of 29.5 %. Age less than 2 years (P < .001), low weight for age (P=.04), comorbidities (P<.001) were significant risk factors for developing postoperative respiratory complications. When controlling for all these variables with multivariate analysis, children of African American descent were found to be at a higher risk of major postoperative respiratory complications (adjusted odds ratio 1.82 [95% CI 1.05- 3.14] ) (P=0.003). For all analysis statistical significance was placed at P < 0.05. It had a sample size of 594 patients studied over a four year period. A drawback of this study was the lumping together of all comorbidities such as craniofacial malformations, neurological diseases, cardiac abnormalities, asthma and history of prematurity into one group as a risk factor. They could not be independently analysed as risk factors. In the analysis of outcomes, respiratory complications were interpreted as major and minor depending on whether the intervention was done by an anaesthesiologist or a nurse respectively. It did not specify on the type of complications. (24)
2.4 Anaesthesia for Adenotonsillar Surgery

Currently there are no standardized guidelines concerning provision of anaesthesia for adenotonsillectomy. This is left to the discretion of the anaesthesia provider.

2.5 Preoperative Assessment

The preoperative assessment is an opportunity for the anaesthesia provider to determine whether the patient is fit for general anaesthesia. A detailed history with the aim of determining comorbidities and risk factors for postoperative respiratory complications such as a known history of asthma and the level of control, recent history of URTI, history of any known allergies. A clinical history with the aim of detecting any form of SDB is also important. The physical exam should include weight, height a systemic exam with particular attention to the respiratory system.

2.6 Peri-operative considerations

Proper airway management during induction, reversal and recovery from anaesthesia is important as some of the patients presenting for adenotonsillar surgery are at risk of developing respiratory complications during these periods. Adequate and safe analgesia provision is important.

An endotracheal tube or a laryngeal mask airway can be used for adenoidectomy(3) The endotracheal tube use requires deeper planes of anaesthesia or the use of short acting muscle relaxant. Residual neuromuscular blockade can be a cause of upper airway obstruction in the PACU.(33) The actions of inhaled anaesthetics, long acting opioids and some intravenous anaesthetics can lead to respiratory compromise in the PACU due to their residual effects on inhibiting pharyngeal muscle tone and respiratory drive(3) Prevention of respiratory tract soiling with blood in the intraoperative period is managed with the use of throat packs. These packs can cause airway obstruction if they are inadvertently left in the airway. Gentle suctioning of the nasopharynx and pharynx for secretions at the end of surgery reduces the incidence of laryngospasms(9)

In a postal survey conducted in the UK the most common induction method involved the use of the intravenous induction agent propofol with concomitant use of succinylcholine and tracheal intubation. The use laryngeal mask airway LMA has been used in adenoidectomy procedures though this has been limited. The main drawback has been ease of dislodging and
kinking of the tube by the mouth gag. (3)(36) Maintenance of anaesthesia was mostly with isoflurane and spontaneous ventilation. (3) Inhalational induction is an accepted method of induction using halothane or sevoflurane. Desflurane and Isoflurane should be avoided in the presence of a URTI. These agents are known to have airway irritating properties. Sodium thiopental is also avoided due to its airway irritating activity (36)

Pain control in paediatric patients who have undergone tonsillectomy with or without adenoidectomy requires balancing. The exclusion of an opioid during anaesthesia leads to higher pain scores postoperatively or the need for early rescue analgesia in the postoperative period. The inclusion of an opioid can lead to postoperative nausea and vomiting (37). Patients with severe OSA are inherently sensitive to opioids therefore there is need to reduce the dose of morphine for example. On the other hand patients with severe OSA have high circulating levels of inflammatory cytokines due to sleep disruption, this makes them have increased sensitivity to pain (38). An alternative method of analgesia provision would be the use of a short acting opioid such as remifentanil or the use of a non-steroidal anti-inflammatory drug NSAID and acetaminophen for opioid sparing effect. Other adjuncts that can be used are dexamethasone, ketamine and dexmedetomidine (9).

2.7 Post-anaesthesia Care Unit

The Postanaesthesia care unit PACU is a specialised unit that is designed for monitoring patients who are recovering from the physiological effects of general anaesthesia or regional anaesthesia (30). The size and number of beds should reflect the number of cases done and duration of stay of patients in the PACU. An appropriate standard of monitoring is required. The bare minimum should include pulse oximetry, non-invasive blood pressure monitoring, electrocardiogram ECG, and capnography for the patient who is intubated. Equipment that should be easily available include difficult airway equipment, a nerve stimulator, a thermometer and warming devices. All drugs, fluids, algorithms, equipment needed for resuscitation and management of both anaesthetic and surgical complications should be easily available (39).

The patient should ideally be monitored on a one on one basis by the anaesthesiologist and a PACU trained nurse until he or she has achieved good airway control, respiratory and cardiovascular stability. The recording of vitals should be continuous. The patient should be monitored based on their medical condition. Oxygenation, ventilation, circulation, level of
consciousness and temperature are areas of keen importance. There are no set guidelines for monitoring patients who have undergone adenotonsillar surgery. An area of being vigilant is respiratory stability. Respiratory rates should be taken manually. Adequacy of ventilation should be monitored using pulse oximetry. Novel ways of monitoring ventilation in a non-intubated child in PACU such as transthoracic impedance and nasal capnography are still nascent and have their own inherent weaknesses. These patients should also be monitored for postoperative bleeding and adequate analgesia.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study Design

It was a cross-sectional observational study on paediatric patients undergoing adenotonsillar surgery in the KNH satellite ENT theatre and postanaesthetic care unit. The patients were followed up from the end of surgery to a period of one hour in the postanaesthetic unit of the theatre.

3.2 Study Site

The study was conducted in the Kenyatta National Hospital from ward 5C to the satellite ENT theatre and postanaesthetic care unit. This theatre is within the KNH ENT clinic and separate from the KNH main theatre. Majority of adenoid and tonsillar surgery are carried out at the KNH ENT satellite theatres, patients with severe co-morbidities such as cardiac disease requiring adenoid and /tonsillar surgery are operated on in the main operating theatre. This accounts for less than 5% of all adenoid and or tonsillar surgeries. The Postanaesthesia care unit was manned by qualified medical personnel and had monitors for measuring different physiological parameters such as blood pressure, heart rate and oxygen saturation. It also had an emergency cart for handling various emergencies.

3.3 Study Population

Paediatric patients undergoing adenotonsillar surgery at the Kenyatta National Hospital satellite ENT theatre fulfilling the inclusion criteria.

3.4 Eligibility Criteria

3.4.1 Inclusion Criteria

Paediatric patients who were scheduled for elective adenotonsillar surgery under general anaesthesia at Kenyatta National Hospital satellite ENT theatre with informed consent from the parents/ guardian. ASA I and ASA II patients

3.4.2 Exclusion Criteria

Patients who were excluded from the study were adult patients, emergency patients and patients who have been labelled as ASA III and IV classification.
3.5 Operational Definitions

3.5.1 Paediatric Patient
In this study a paediatric patient was between birth and 16 years.

3.5.2 Demographic Variables
The demographic variables that were collected were the patient’s age and sex.

3.5.3 Anthropometric Variables
The anthropometric measurements that were collected were weight and height.

3.5.4 Preoperative Variables
Preoperative variables that were included were history of upper respiratory tract infection, history of asthma, apnoea witnessed by the parent, ASA status, blood pressure, heart rate, saturation of oxygen at room air, respiratory rate, indication for surgery.

3.5.5 Intraoperative Variables
Intraoperative variables included were heart rate, respiratory rate, oxygen saturation, blood pressure, end tidal carbon dioxide, type of surgery, induction method, estimated blood loss, intravenous fluid volume infused, pharmacological agents used perioperatively, induction time and reversal of anaesthesia, start and end time of surgery.

3.5.6 Postoperative variables
Postoperative variables included were: laryngospasms, bronchospasms, pulmonary oedema, desaturations, apnoea and stridor. Physiological parameters included blood pressure, heart rate, respiratory rate, oxygen saturation.

The interventional strategies that were recorded included need for oxygen supplementation, reintubation, continuous positive airway pressure, repeat reversal, reversal of opioid, use of Guedels airway, jaw thrust, nursing in the left lateral position, use of furosemide, use of propofol or succinylcholine to overcome laryngospasms, use of salbutamol, use of adrenaline.
3.6 Sample Size Calculation

There was a finite number of paediatric patients undergoing adenotonsillar surgery at the KNH satellite ENT theatre, the Cochran’s formulae for estimating sample size was used with a finite population correction as suggested by Daniels WW .(40)

\[
    n = \frac{NZ^2P(1-P)}{d^2(N^2+1) + Z^2P(1-P)}
\]

Where:

N = the population of paediatric patients with adenoid and tonsillar hypertrophy undergoing adenotonsillar surgery at the KNH satellite ENT theatre over a 3 month period .(corresponding to the study period)

Z = Z statistic for a level of confidence at 95% (standard value of 1.96)

P = expected prevalence or proportion using the prevalence of 29.5 % from the study by Linda Horwood.(24)

d = Margin of error at 5 % (standard value of 0.05)

\[
    n = \frac{166 \times 1.96^2 \times 0.295(1 - 0.295)}{0.05^2 (166 - 1) + 1.96^2 \times 0.295(1 - 0.295)}
\]

Sample size = 109 subjects

3.7 Conduct of the Study

The principal investigator received approval from the University of Nairobi / Kenyatta National Hospital Ethics and research committee KNH/UON ERC. The investigator recruited paediatric patients scheduled for elective adenotonsillar surgery from ward 5C using a theatre list that had been prepared by the ENT surgical team for the planned surgeries scheduled for the next day. The eligible patients’ parent(s)/guardian were requested to give informed consent by completing a consent form before being involved in the study. The consenting process involved explaining to the parent(s)/guardian the aim of the study, confidentiality and the use of the results. This took approximately ten minutes to ensure the parent(s)/guardian understood the content of the informed consent form. The consent was administered on the day before surgery. One copy of the consent was placed in the patients file and one copy was retained by the primary investigator. The data collection tool was administered by the principal investigator on patients whose parents or guardians had consented to take part in the study. Biodata, weight, height, known risk factors for respiratory complications present in the patient were taken a day prior to the surgery.
On the day of surgery the diagnosis and planned surgery, vital signs which included heart rate, respiratory rate, blood pressure and level of oxygen saturation in room air were noted in the satellite ENT theatre receiving area. The intraoperative conduct of anaesthesia which included drugs used for induction and maintenance of anaesthesia, mode of ventilation the method of extubation and vital signs which were monitored continuously and recorded every 5 minutes into the data collection tool by the principal investigator.

In the postoperative period monitoring began from the time the surgery ended. Patients were carefully monitored from the operation table to the postanaesthetic care unit. The vital signs were monitored continuously for a period of 60 minutes and recorded at 10 minute intervals. In the event a postoperative respiratory complication occurred, it was noted together with the interventions done by the anaesthesia provider or the PACU nurse. All this information was captured by the principal investigator using the data collection tool.

3.8 Outcome
The primary outcome was the occurrence of postoperative respiratory complications. The secondary endpoint was the interventions used to manage the respiratory complications.

3.9 Ethical considerations
- The study was conducted following approval from Kenyatta National Hospital-University of Nairobi Ethics and Research Committee.
- Permission was sought from KNH administration before carrying out the study.
- The nature of the study was explained to the parent or guardian of the patient, before the consent was sought.
- Precautions were put in place to protect the patients from harm during the period of the study.
- There was no additional cost incurred by the participants.
- The participants’ initials were used to maintain anonymity.
- The participants were allowed to exit from the study at any time at their own request.

3.10 Data collection, storage and analysis
Data was recorded by the principal investigator using a data collection tool. The data was collected from the patients’ files, anaesthetic charts and direct observations noted by the
principal investigator during the preoperative, intraoperative and postoperative period. This data was backed up for preservation. The data was entered into a computer data sheet and analysed using the SPSS (statistical package for social scientists) 22.0 and presented as narratives, tables, pie charts and histograms as appropriate. Descriptive analysis was used to summarise sample characteristics. Continuous data was analysed using means and standard deviations. Categorical variables was summarized using frequency counts and percentages to show relative frequencies.

The main outcome variable was the prevalence of complications calculated as percentage of patients with any events during the post-operative period. After determining prevalence, bivariable analysis was conducted through cross tabulating the prevalence variable and the potential risk factors. Comparison for categorical variables and prevalence of complications was done using chi square test. For continuous risk factors, comparison between the groups with and without complications was based on Student’s T-test. Factors that showed significant association with complications in the bivariable analysis based on p value cut off of <0.05 were used in the multivariable analysis.
CHAPTER FOUR

4.0 RESULTS

4.1 Characteristics of patients undergoing adenotonsillar surgery

The study enrolled a total of 109 paediatric patients undergoing adenotonsillar surgery in KNH. Males accounted for 50.5% (55) of paediatric adenotonsillar patients, Table 1. The mean age of the participants was 4.3 years (SD 2.5), with an age range between 1 and 13 years. Table 1. Of the 109 participants, 57 (52.3%) had a history of apnoea witnessed by the parents, 7 (6.4%) had a history of prematurity and 12 (11%) had recent history of URTI (table 2). 6 of the patients were obese. (Table 3)

Table 1: Demographics of children undergoing adenotonsillar surgery in KNH

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency (n)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 years</td>
<td>59</td>
<td>54.1</td>
</tr>
<tr>
<td>4 - 5 years</td>
<td>29</td>
<td>26.6</td>
</tr>
<tr>
<td>6 - 13 years</td>
<td>21</td>
<td>19.3</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>55</td>
<td>50.5</td>
</tr>
<tr>
<td>Female</td>
<td>54</td>
<td>49.5</td>
</tr>
</tbody>
</table>

Table 2: Risk factors associated with respiratory complications in children undergoing adenotonsillar surgery in KNH

Of the 109 participants, 57 (52.3%) had an apnoeic episode witnessed by the parent, 7 (6.4%) had history of prematurity and 12 (11%) had recent history of URTI. Table 2

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Frequency (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>URTI in the last 2 weeks</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Apnoea witnessed by parent</td>
<td>57</td>
<td>52.3</td>
</tr>
<tr>
<td>History of Prematurity</td>
<td>7</td>
<td>6.4</td>
</tr>
</tbody>
</table>
Table 3: BMI of children undergoing adenotonsillar surgery in KNH (n = 109)

6 of the patients were obese, 26 patients had severe thinness. (Table 3)

<table>
<thead>
<tr>
<th>BMI range</th>
<th>Frequency (n)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe thinness</td>
<td>&lt; 16</td>
<td>26</td>
</tr>
<tr>
<td>Moderate thinness</td>
<td>16 to &lt;17</td>
<td>6</td>
</tr>
<tr>
<td>Mild thinness</td>
<td>17 to &lt;18.5</td>
<td>10</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5 to &lt;25</td>
<td>48</td>
</tr>
<tr>
<td>Overweight</td>
<td>25 to &lt;30</td>
<td>13</td>
</tr>
<tr>
<td>Obese</td>
<td>30+</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>109</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Types of surgeries

Figure 1: Types of adenotonsillar surgeries

Out of the 109 participants undergoing adenotonsillar surgery, 73 (67%) underwent adenotonsillectomy, 22 (20%) underwent adenoidectomy and 14 (13%) underwent tonsillectomy. (figure 1).
4.2 Perioperative Anaesthetic Drug use in Paediatric Adenotonsillar Surgery

Propofol and halothane as a combination were the most commonly used induction agents. 91 of the patients received this combination. Only 1 patient was induced with propofol only.

Table 4: Induction anaesthetic agents used in paediatric elective adenotonsillar surgery

<table>
<thead>
<tr>
<th>Induction agent</th>
<th>Received drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol + Halothane</td>
<td>91</td>
</tr>
<tr>
<td>Ketamine+ propofol+ Halothane</td>
<td>17</td>
</tr>
<tr>
<td>Propofol</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 5: Muscle relaxants used in adenotonsillar surgery

<table>
<thead>
<tr>
<th>Muscle relaxants</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td>12(11)</td>
</tr>
<tr>
<td>Atracurium</td>
<td>22(20.2)</td>
</tr>
</tbody>
</table>

12 and 22 patients received Suxamethonium and atracurium respectively. Table 5
Table 6: Inhalational agents used for maintenance in paediatric elective adenotonsillar surgery

<table>
<thead>
<tr>
<th>Received drug</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhalational agents</strong></td>
<td></td>
</tr>
<tr>
<td>Halothane</td>
<td>6(5.5)</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>103(94.5)</td>
</tr>
</tbody>
</table>

Isoflurane was used as a maintenance agent in 103 (94.5%) patients. The maintenance inhalational agents were administered with nitrous oxide in 95 (87.2%) of the cases. (table 6)

4.3 Analgesics administered intraoperatively

Table 7: Analgesics administered during paediatric adenotonsillar surgery

<table>
<thead>
<tr>
<th>Analgesic</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paracetamol + Morphine</td>
<td>87</td>
</tr>
<tr>
<td>Tramadol + Paracetamol</td>
<td>12</td>
</tr>
<tr>
<td>Diclofenac + Paracetamol</td>
<td>10</td>
</tr>
</tbody>
</table>

Paracetamol and morphine were the most commonly used analgesics in 87 children respectively. Most of the patients received multi modal analgesia. All the 109 patients received fentanyl during induction. Table 7

Table 8: Other drugs used during adenotonsillar surgery

<table>
<thead>
<tr>
<th>Drug</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ondansetron + Dexamethasone</td>
<td>79</td>
</tr>
<tr>
<td>Metoclopramide + Dexamethasone</td>
<td>30</td>
</tr>
</tbody>
</table>
Ventilation modes:

Figure 2: Ventilation modes used during adenotonsillar surgery

85 out of 109 patients were put on spontaneous ventilation during the surgery. Figure 2

Duration of Surgery:

Figure 3: Duration of anaesthesia

The mean duration between induction and reversal was 45 minutes (SD 15.2), range 20 to 100 minutes. Figure 3
Figure 4: Level of consciousness at extubation
89 out of the 109 patients were extubated when fully conscious. Figure 4

4.4 Prevalence of postoperative respiratory complications

Figure 5: Prevalence of postoperative respiratory complications
There were 45 paediatric patients who developed postoperative respiratory complication following adenotonsillar surgery giving a prevalence of 41.2%. Figure 5.

**Table 9: The frequency of the specific postoperative respiratory complications**

<table>
<thead>
<tr>
<th>Single Complication</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desaturation</td>
<td>31</td>
<td>68.8</td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>3</td>
<td>6.6</td>
</tr>
</tbody>
</table>

**Combined complications**

<table>
<thead>
<tr>
<th>Combined complications</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desaturation &amp; Laryngospasm</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>Desaturation &amp; apnoea</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Desaturation, Laryngospasm &amp; stridor</td>
<td>1</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Desaturation was the most common postoperative complication, however it did not occur in isolation in some cases. Some the patients suffered from desaturation and other complications such as laryngospasms. Out of the 109 paediatric patients 34 (31%) had a single respiratory complication, 10 (9%) had two complications and 1 (<1%) had three complications as tabulated above. (Table 9)

**4.5 Patient risk factors for postoperative respiratory complications**

None of the patient demographic factors and risk factors obtained from clinical history were significantly associated with the development of postoperative respiratory complications in paediatric patients scheduled for elective adenotonsillar surgery at KNH satellite ENT theatre.
Table 10: Patient risk factors associated with the development of postoperative respiratory complications

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>(%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3 years</td>
<td>29</td>
<td>64</td>
<td>0.11</td>
</tr>
<tr>
<td>4 - 5 years</td>
<td>11</td>
<td>24</td>
<td>0.587</td>
</tr>
<tr>
<td>6 - 13 years</td>
<td>5</td>
<td>11</td>
<td>0.159</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>n</th>
<th>(%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>21</td>
<td>46</td>
<td>0.639</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>53</td>
<td>0.639</td>
</tr>
</tbody>
</table>

Table 11: Clinical risk factors associated with the development of postoperative respiratory complications

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>n</th>
<th>(%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>URTI in the last 2/52</td>
<td>4</td>
<td>8.7</td>
<td>0.51</td>
</tr>
<tr>
<td>Apnoea witnessed by parent</td>
<td>27</td>
<td>58.7</td>
<td>0.253</td>
</tr>
<tr>
<td>History of prematurity</td>
<td>4</td>
<td>8.7</td>
<td>0.408</td>
</tr>
</tbody>
</table>
There was no significant association between the BMI of the patients and the development of respiratory complications. Table 12.

4.6 Surgical indications and postoperative respiratory complications

The development of any respiratory complication was significantly associated with adenoid hypertrophy and obstructive sleep apnoea as an indication for surgery (p = 0.025). Table 13
4.7 Anaesthetic Agents and Postoperative Complications

4.7.1 Variations in anaesthesia provision and postoperative complications

45 patients who received propofol developed postoperative respiratory complications. It should be noted that it was not the sole agent used for induction of anaesthesia.

Table 14: Induction agents and postoperative respiratory complications

<table>
<thead>
<tr>
<th>Induction agent</th>
<th>Respiratory complications (n)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine + Propofol</td>
<td>10</td>
<td>0.131</td>
</tr>
<tr>
<td>Halothane + propofol</td>
<td>35</td>
<td>0.391</td>
</tr>
</tbody>
</table>

None of the IV anaesthetic induction agents nor the inhalational induction agent used were significantly associated with postoperative respiratory complications. Table 14

Table 15: Muscle relaxants and postoperative respiratory complications

<table>
<thead>
<tr>
<th>Muscle relaxants</th>
<th>Respiratory complications(n)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td>7</td>
<td>0.23</td>
</tr>
<tr>
<td>Atracurium</td>
<td>9</td>
<td>0.891</td>
</tr>
</tbody>
</table>

None of the muscle relaxants used were significantly associated with postoperative respiratory complications. Table 15
Table 16: Inhalational agents used for maintenance and postoperative respiratory complications

<table>
<thead>
<tr>
<th>Agent</th>
<th>Respiratory complications n</th>
<th>%</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halothane</td>
<td>5</td>
<td>11.11</td>
<td>0.036</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>40</td>
<td>88.88</td>
<td>0.212</td>
</tr>
</tbody>
</table>

Where halothane was used as a maintenance agent it was significantly associated with respiratory complications. (p=0.036)

Only one participant who received halothane as a maintenance agent participant did not develop any of respiratory complications. These patients received other drugs during the maintenance of anaesthesia which may contribute to postoperative respiratory complications. There was no significant association between isoflurane administration as a maintenance agent and development of respiratory complications (p= 0.212) (Table 16).

4.7.2 Morphine

There was a significant association between morphine administration and respiratory complications. (Table 17). 31 children who received morphine. (68%) developed respiratory complications during the postoperative period. (p=0.028)

Table 17: Respiratory complication in adenotonsillar surgery with morphine administration

<table>
<thead>
<tr>
<th>Drug</th>
<th>Respiratory complications n (%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>31(68%)</td>
<td>0.028</td>
</tr>
</tbody>
</table>
Table 18: Ventilation modes and respiratory complications

<table>
<thead>
<tr>
<th>Ventilation Mode</th>
<th>Respiratory complications n</th>
<th>%</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>37</td>
<td>80.4</td>
<td>0.304</td>
</tr>
<tr>
<td>IPPV</td>
<td>8</td>
<td>17.7</td>
<td>0.709</td>
</tr>
</tbody>
</table>

There was no significant association between the ventilation modes and respiratory complications. (p=0.304) Table 18

Table 19: Level of consciousness and respiratory complications

<table>
<thead>
<tr>
<th>Level of consciousness</th>
<th>Respiratory complications n</th>
<th>%</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>6</td>
<td>13.4</td>
<td>0.447</td>
</tr>
<tr>
<td>Awake</td>
<td>39</td>
<td>86.6</td>
<td>0.335</td>
</tr>
</tbody>
</table>

There was no statistical difference between deep or awake extubation and the occurrence of respiratory complications. Table 19
4.8 Duration of Anaesthesia and Complications

There was no evidence of a significant association between duration from induction to reversal and postoperative complications ($p = 0.484$). The median duration between induction and reversal in patients with complications was 40 minutes compared to 41 minutes in those without complications, Figure 6.

**Figure 6: Duration of anaesthesia and complications in paediatric elective adenotonsillar surgery**

![Graph showing duration of anaesthesia and complications](image)

4.9 Management of postoperative respiratory complications

Oxygen supplementation was the most commonly implemented intervention among patients developing respiratory complications during adenotonsillar surgery. All of the 45 patients with respiratory complications received oxygen supplementation, 7 were started on continuous positive airway pressure (CPAP), 3 had a Guedel airway inserted and 1 was reintubated. The management for each of the specific complications is presented in table 20. It included oxygen supplementation in 100% of desaturations and 61.5% of laryngospasms and CPAP in 58.3% of laryngospasms. Only one patient required reintubation.
Table 20: Management of respiratory complications in paediatric adenotonsillar surgery

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. of patients with complications</th>
<th>Oxygen supplementation</th>
<th>CPAP</th>
<th>Reintubation</th>
<th>Insertion of Guedel airway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desaturation</td>
<td>31</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Combined complications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desaturation &amp; Laryngospasm</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Desaturation &amp; apnoea</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Desaturation, Laryngospasm &amp; stridor</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

5.0 DISCUSSION

Adenotonsillar surgery is a relatively safe surgery however vigilance is required during the postoperative period as morbidity and mortality can occur during the first 24 hours. This study had 109 patients between the ages of 1 and 13 years. There were 55 (50.5%) males and 54 (49.5%) females. (table 1) There were 12 patients who had a recent history of URTI, 27 patients with a known history of apnoea witnessed by the parent, 7 patients with a known history of prematurity (table 2) and 6 obese children.(table 3) The prevalence of postoperative respiratory complications in paediatric patients undergoing adenotonsillar surgery at the KNH satellite ENT theatre during the period of the study was at 41.2%. (figure 5) This is relatively higher compared to what is found in other studies. The study by Linda Horwood et al detected a prevalence of 29.5%(24) while a study by Thongyam et al had a prevalence of 28% (10). The study by Sofia et al had a prevalence of 1.4%(1) and a study by Renato et al had a complication rate of 2.6%(8)The complications in this study were as follows; desaturation 31%, laryngospasms 6.6%, stridor 2% and apnoea 2%. (table 9) This was different from the other studies; The study by Linda Horwood et al quoted laryngospasms as the most common complication(8) this mirrored the study by Tay et al (29). The study by Sofia et al detected pulmonary oedema as the most common postoperative respiratory complication. (32). 45 patients out of the 109 paediatric patients developed postoperative respiratory complications. 34 had a single respiratory complication, 10 had two complications and 1 had three complications. (Table 9) It should be noted that the high frequency of postoperative desaturation can be associated with the high rate poor oxygen mask acceptability by paediatric patients in the PACU as most of the cases of desaturations were adequately managed with oxygen supplementation alone.

5.1 Patient Risk Factors and Respiratory Complications

A diagnosis of adenoid hypertrophy and obstructive sleep apnoea was associated with the occurrence of postoperative respiratory complications (P= 0.025). (Table 13) Adenoid hypertrophy accounted for 68% of the surgeries. These subsets of patients usually have upper airway obstruction and obstructive sleep apnoea. The airway dynamics of these patients persist over a period of 6 months despite the surgery, as a result they are still susceptible to upper airway obstruction in the immediate postoperative period. The other diagnoses such as recurrent tonsillitis and chronic tonsillitis were not significantly associated with the
occurrence of postoperative respiratory complications. The other risk factors that were assessed included: sex, age, obesity, history of prematurity, history of upper respiratory tract infection and apnoea witnessed by the parent. They were not statistically significantly associated with the occurrence of postoperative respiratory complications. This findings were similar to the study by Sofia et al which showed that there were no statistically significant demographic or clinical features that were associated with postoperative respiratory complications following adenotonsillar surgery (1).

5.2 Variations in anaesthesia provision and postoperative respiratory complications

There was a significant association between the intraoperative administration of morphine and postoperative respiratory complications/ (p=0.028) (Table 17) 31 (68.8%) patients who received morphine during the intraoperative period developed postoperative respiratory complications. Obstructive sleep apnoea accounted for a large number of the surgical diagnosis. These patients are increasingly sensitive to opioids as this can cause respiratory depression in the postoperative period. There have been many theories that have been postulated as the inherent causes of this sensitivity. In literature it has been found that these patients require half of the dose of morphine required to achieve clinical effect. (38) There can also be a role of gene polymorphism in relation to the cytochrome enzymes CYP 2D6 which is responsible for the metabolism of morphine. The patients at risk of suffering from postoperative respiratory depression are the ultrafast metabolizers. They will have increased amounts of pharmacologically active metabolites of morphine. The desaturation was as low as 88%. This can point towards postoperative respiratory depression. Most patients received multimodal analgesia which involved the use of Paracetamol, morphine, diclofenac and tramadol. (Table 7) There was very little use of NSAIDs. Most literature advocates for opioid sparing analgesic techniques that are multimodal in nature this is according to Patino and et al (9) It must be noted that the study was not adequately powered to determine if the postoperative desaturation was attributed to morphine alone. Some of these patients received atracurium and halothane which can also increase the risk of postoperative desaturation.

The use of halothane as a maintenance agent during the surgery was associated with the occurrence of postoperative respiratory complications. Of the 6 patients who received halothane as the maintenance agent 5 developed postoperative respiratory complications. (table 14) These can be due to the depressive respiratory effects of halothane.
persisting into the postoperative period. The other aspects of anaesthesia provision were not associated with the occurrence of postoperative respiratory complications. It should be noted that the patients also received other drugs such as morphine which may have had a contribution to the occurrence of postoperative respiratory complications.

Most of the patients in the study were induced with propofol, inhalation induction using halothane and intubated with an endotracheal tube. Suxamethonium was used in some of the patients. (Table 4) Most of the patients were maintained on isoflurane and spontaneous ventilation. This findings were similar to the postal survey conducted in the UK quoted by Ravi et al (3) This had no significant association with postoperative respiratory complications.

The duration of anaesthesia was not significantly associated with the postoperative respiratory complications. This findings were different from the findings by Renato et al which found that prolonged intubation during adenotonsillar surgery was significantly associated with postoperative complications(8). (figure 6)

In this study there was no difference between deep and awake extubation in relation to postoperative laryngospasms. (Table 19) This was similar to the findings by Budi et al (34) Other risk factors associated with laryngospasm such a recent history of URTI were not significantly associated with postoperative laryngospasms.

5.3 Management of Postoperative Respiratory Complications

The most common method of managing the respiratory complications was oxygen supplementation this was due to the occurrence of postoperative desaturation. Desaturation was the most common postoperative respiratory complication. Laryngospasms were managed using positive pressure ventilation, oxygen supplementation. Other methods such as jaw thrust were not employed for managing laryngospasm. The patient who suffered from apnoea was administered for oxygen, and reintubated. Stridor was managed by oxygen supplementation and insertion of a Guedel airway. (Table 20)
5.4 Conclusions

From the above findings it has been established that: The postoperative respiratory complication rate following adenotonsillar surgery at the KNH satellite ENT theatre is higher than what is in the literature.

a) Desaturation is the most common postoperative respiratory complication following adenotonsillar surgery.

b) Postoperative respiratory complications were significantly associated with adenoid hypertrophy with obstructive sleep apnoea, intraoperative use of morphine and the use of halothane as a maintenance agent.

c) Oxygen supplementation was the most common intervention used in managing the postoperative respiratory complications.

5.5 Recommendations

a) Vigilance for postoperative respiratory complications is required during the immediate postoperative period.

b) A high index of suspicion for the presence of sleep related breathing disorder is required when managing patients presenting with adenoid hypertrophy for adenotonsillar surgery. These patients are likely to suffer from postoperative respiratory complications.

c) There should be a development of a protocol or guidelines for the conduct of anaesthesia and analgesia for patients scheduled for adenotonsillar surgery with the aim of reducing respiratory complications.

d) There is need for use of opioid sparing analgesics for these subset of patients as the majority of the patients who received morphine suffered from desaturation.

e) It would be favourable to have volatile agents such as sevoflurane in this theatre to avoid the use of halothane as an agent during adenotonsillar surgery.

f) Oxygen supplementation is required during the postoperative period.
REFERENCES


25. Capdevila OS, Kheirandish-Gozal L, Dayyat E, Gozal D. Pediatric Obstructive Sleep


41. American Heart Association Accredited Paediatric Advanced Life Support PALS study guide 2012:2-4
APPENDICES

Appendix I: Data Collection Tool

Instructions:
1. This questionnaire is to be filled by the principal investigator.
2. The demographic data will be filled as indicated.
3. The history of risk factors, type of surgery and indication for surgery will be filled as indicated a day before surgery.
4. The preoperative vital signs will be filled as indicated on the day of surgery.
5. The intraoperative conduct of anaesthesia which will include the drugs used and the anaesthetic technique will be filled as indicated during the intraoperative period.
6. The intraoperative vital signs will be recorded as filled as indicated every 5 minutes from the beginning to the end of surgery.
7. The postoperative period will begin from the end of surgery and will last for 1 hour. The vital signs will be filled as indicated every 10 minutes.
8. The time and occurrence of postoperative respiratory complications will be filled as indicated.
9. The intervention done by the anaesthesia provider will be filled as indicated

THE PREVALENCE OF POSTOPERATIVE RESPIRATORY COMPLICATIONS IN PAEDIATRIC PATIENTS UNDERGOING ELECTIVE ADENOTONSILLAR SURGERY AT KENYATTA NATIONAL HOSPITAL SATELLITE EAR NOSE AND THROAT THEATRE

Fill in appropriately
Serial number.................. Date..................

1. Age ................. Years ...........

2. Sex ............... (tick appropriately)
   i. Male     ii. Female

Fill in appropriately
3. Weight......... Kg
4. Height ........ cm
5. History of Risk factors (tick appropriately)
   i History of upper respiratory tract infection in the last 2/52
   ii Apnoea witnessed by the parent
   iii History of Prematurity

6. Type of surgery (tick appropriately)
   i. Adenoidectomy
   ii. Tonsillectomy
   iii. Adenotonsillectomy

7. Indication for surgery (tick appropriately)
   i. Recurrent tonsillitis
   ii. Adenoid hypertrophy
   iii. Chronic tonsillitis
   iv. Tonsillitis with effusion
   v. Failure to thrive
   vi. Obstructive sleep Apnoea
   vii. Other

8. Preoperative Vitals (fill in appropriately)
   Heart rate ............. bpm
   Blood pressure ..........mmHg
   Respiratory rate ..........bpm
   Oxygen saturation ..........%

9. Premedication (tick and fill appropriately) Yes/ No
   Drug, dosage, route and time ............................................

10. Induction time ...........Am/ Pm

11. Perioperative drugs used and their dosage
    Induction (fill appropriately)
    a. Intravenous induction agents indicate dose and route.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
b. Muscle relaxants indicate dose and time

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atracurium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cisatracurium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocuronium</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c. Inhalational agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>%</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halothane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sevoflurane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isoflurane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nitrous oxide Yes/ No

d. Maintenance:

<table>
<thead>
<tr>
<th>Inhalational agent</th>
<th>%</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halothane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isoflurane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sevoflurane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nitrous oxide Yes/ No

e. Total intravenous anaesthesia

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Others………………………………………

f. Analgesics indicate dose and route

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paracetamol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diclofenac</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tramadol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Others…………………
g. Others drugs indicate dose route and time

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ondansetron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metoclopramide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexamethasone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lignocaine</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. Ventilation mode: (tick appropriately)
   - Intermittent positive pressure ventilation IPPV
   - Spontaneous ventilation

13. **Intraoperative vitals chart every 5 minutes (fill appropriately)**

<table>
<thead>
<tr>
<th>TIME</th>
<th>BP</th>
<th>HR</th>
<th>SPO2</th>
<th>RR</th>
<th>ETCO2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Estimated blood loss…………….mls

15. Fluids (tick and fill appropriately)
   - Crystalloid / Type………………………mls
   - Colloid / Type……………………………mls

16. Reversal time ………..AM/ PM
   Reversal indicate dose and route (fill appropriately)

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Route</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neostigmine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycopyrrolate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

17. Surgical time (fill appropriately)
   - Start……… Am/Pm
   - Stop …….. Am/Pm
18. Extubation (tick where appropriate)
   Deep
   Awake

19. Laryngospasms at extubation (tick appropriately)
   Yes/ No

POSTOPERATIVE PERIOD (fill in appropriately)

20. Postoperative vital signs

<table>
<thead>
<tr>
<th>TIME</th>
<th>BP</th>
<th>HR</th>
<th>SPO2</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 mins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

21. Tick and fill appropriately

<table>
<thead>
<tr>
<th>Respiratory Complication</th>
<th>Time in mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laryngospasm</td>
<td></td>
</tr>
<tr>
<td>Pulmonary oedema</td>
<td></td>
</tr>
<tr>
<td>Bronchospasm</td>
<td></td>
</tr>
<tr>
<td>Desaturation</td>
<td></td>
</tr>
<tr>
<td>Apnoea</td>
<td></td>
</tr>
<tr>
<td>Stridor</td>
<td></td>
</tr>
<tr>
<td>Shallow breathing</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
22. Interventions tick and fill appropriately.

a) Drugs used

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenaline</td>
<td></td>
<td></td>
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<tr>
<td>Naloxone</td>
<td></td>
<td></td>
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<tr>
<td>Salbutamol</td>
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<td></td>
</tr>
<tr>
<td>Furosemide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neostigmine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atropine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Technique used tick and fill appropriately

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive pressure ventilation</td>
<td></td>
</tr>
<tr>
<td>Oxygen supplementation</td>
<td></td>
</tr>
<tr>
<td>Reintubation</td>
<td></td>
</tr>
<tr>
<td>Guedel airway insertion</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
Appendix II: Consent for Participation

Study title: The prevalence of postoperative respiratory complications in paediatric patients undergoing elective adenotonsillar surgery at the satellite Ear Nose and Throat theatre at Kenyatta National Hospital.

Study site: Kenyatta National Hospital satellite Ear Nose and Throat theatre.

Background

My name is Dr. Ndung’u Christopher Kariuki, a postgraduate student in Anaesthesia at the University of Nairobi. As part of my course work I am required to perform clinical research. I am conducting a study at the Kenyatta National Hospital on the prevalence of postoperative respiratory complications in paediatric patients undergoing elective adenotonsillar surgery at the KNH satellite ENT theatre. The purpose of this consent form is to give you the information you will need to help you decide whether or not your child should participate in the study. For children below 18 years old we will give information about the study to parents or guardians. We will go over this information with you and you need to give permission in order for your child to participate in this study. If your child is at eight years and above and he/she can appreciate what is being done then he/she will also be required to agree to participate in the study after being fully informed.

Purpose of the study

The aim of this study is to help anaesthetists improve the care given to patients. To do this I will monitor the patient from the intraoperative period to the postoperative period for the occurrence of respiratory complications. Any complications that occur during this period will be noted and appropriate action taken to manage them. Thereafter I will do statistical calculations on this information. This information will be published in a book that will be in the custody of the University of Nairobi.

Study participation

Participation in this study will be voluntary. As a consequence I shall need your consent for your child to be included in the study.

Benefits of participation

The benefits are that management will be optimized should a shortcoming be encountered. Any information obtained in the course of the study is beneficial in the management of the patient.

Risks of participation

There are no risks involved in participating in this study.

Confidentiality

All information gathered will be treated with utmost confidentiality. No names or other identifiers will be used in the study.

Right of withdrawal

The consenting adult has the right to withdraw from the study at any given time.

Cost and compensation

There shall be no extra cost incurred by participating in the study other than the standard cost of care at Kenyatta National Hospital.

For further information and clarification you may contact:
Principal investigator
Dr Christopher Kariuki Ndung’u; Mobile 0720900608, Email: drkariuki2013@gmail.com
1st supervisor
Dr. Caroline Mwangi Mobile: 0721546600 Email: carlomwa@yahoo.com

2nd Supervisor
Dr. Jane Gwaro Mobile: 0722749667 Email: gwaroj@yahoo.com

3rd supervisor
Dr. Charles Kabetu Mobile: 0722512205 Email: ckabetu@gmail.com

Secretary,
KNH/UON ERC,
P.O Box 20723-00202,Nairobi.
Tel 020 2726300 Ext 44355
Email:KNHplan@Ken.Healthnet.org

Statement by the researcher:
I confirm that the parent(s)/guardian was given an opportunity to ask questions about the study, and all the questions asked have been answered. I confirm the parent(s)/guardian has not been coerced to let their child participate in the study and the consent has been given freely and voluntarily.

Name:___________________________
Signature:________________________
Date:___________________________
Appendix III: Consent Form
I _________________ have been explained to the purpose and conditions of my child’s involvement in the study by Dr. Ndung’u C.K. I have had my questions answered in a language that I understand. The risks and benefits have been explained to me. I understand that my participation and that of my child in this study is voluntary and that I may choose to withdraw it any time.
I agree to the above and do give consent for __________________ to be included in the study who is my child.

Name: ______________________
Signature: ___________________
Thumb print: _________________
Date:______________________

Idhini ya kushiriki katika utafiti
The prevalence of postoperative respiratory complications in paediatric patients undergoing elective adenotonsillar surgery at the satellite Ear Nose and Throat theatre at Kenyatta National Hospital
Maelezo.
Kitambulizi
Jina langu ni Daktari Ndung’u Christopher Kariuki, mwanafunzi wa shahada ya pili katika chuo kikuu cha Nairobi. Kama sehemu ya masomo yangu ninastahili kufanya utafiti wa kitabibu. Lengo langu ni kufanya utafiti katika Hospitali ya Taifa ya Kenyatta juu ya kiwango ya shida ya kupumua kwa watoto baada ya kufanyiwa upasuaji wa tezi za koo. Kwa watoto waliopatikana chini ya miaka kumi na nane wazazi au wachungaji wao ndio hutía sahihi. Kama mtoto walio chini ya miaka kumi na nane wazazi au wachungaji wao ndio hutía sahihi kuonyesha amekubali kuwa katika utafiti huu.
Lengo la utafiti huu ni kusaidia madaktari kuboresha huduma unaotolewa kwa wagonjwa. Kwa kufanya hivyo, nitafuatilia mgonjwa kutoka mwanzo wa operesheni hadi wakati wa ziada. Tatizo lolote likitokea, mgonjwa atashughulikiwa inavyofaa kuepuka madhara. Baada ya hapa nitafanya mahesabu ya takwimu na taarifa hii na kutangaza habari hiyo katika kitabu ambacho kitakuwa chini ya ulinzi wa Chuo Kikuu cha Nairobi. Taarifa zote zilizokusanywa zitashughulikiwa na usiri.
Ushiriki wake katika utafiti huu ni kwa hiari yako.
Utafiti huu utasaidia madaktari kuweza kuhudumia wagonjwa vizuri katika chumba cha upasuaji. Mwanawe hatapata madhara yoyote.

Hakuna majina au vitambulisho vingine zitakavyotumika katika utafiti.

Utaweza kujiondoa katika utafiti huu wakati wowote.

Kwa hiyo nitahitaji idhini yakwa kura kuhusisha mwanawe kuwa mshiriki katika utafiti huu. Kwa maelezo zaidi na ufafanuzi, unaweza kuwasiliana na:

Daktari Ndung’u Christopher Kariuki, Nambari ya simu- 0720900608, drkariuki2013@gmail.com
Daktari Caroline Mwangi, Nambari ya Simu 0721546600, carlomwa@yahoo.com
Daktari Jane Gwaro, Nambari ya simu 0722749667, gwaroj@yahoo.com
Daktari Charles Kabetu, Nambari ya simu 0722512205, ckabetu@gmail.com

KNH / UON - Kitengo cha Maadili na Kamati ya Utafiti. Nambari ya simu 020 2726300

**Idhini**

Mimi _________________ nimelezewa madhumuni na masharti ya ushiriki wa mwanangu katika utafiti na Daktari Ndung’u Christopher kariuki. Nakubaliana na maelezo hayo na nimemruhusu daktari kufanya utafiti huo kwa mwanangu ________________.

Jina: ______________________
Sahihi: ______________________
Finyo kidole cha gumba: _______
Tarehe: ______________________

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Appendix IV: Assent Form

ASSENT FORM FOR CHILDREN AGED 8-12 YEARS

Study Title: The prevalence of postoperative respiratory complications in paediatric patients undergoing elective adenotonsillar surgery at the satellite Ear Nose and Throat theatre at Kenyatta National Hospital

My name is Dr. Ndung’u Christopher Kariuki and I am doing a research on the above topic. A research study is a way to learn more about people. I am doing a study on the prevalence of postoperative respiratory complications on children who have undergone adenotonsillar surgery. You will be monitored from the beginning of surgery up to the end of surgery and in the recovery room. Any respiratory complications will be noted and managed promptly and appropriately. You do not have to be in this study if you do not want to be. This study will help anaesthesia providers to give better care to children who come to theatre for surgery. You will not be harmed during this study. When we are finished with this study we will write a report about what was learned. This report will not include your name or that you were in the study. If you decide to stop after we begin, that’s okay too. Your parents know about the study too.

If you decide you want to be in this study, please sign your name.

I, ________________________________, want to be in this research study.

Sign your name here--------------------------------- Date..........................................

For further information or clarification you can contact

Principal investigator
Dr. Christopher Kariuki Ndung’u; Mobile 0720900608, Email: drkariuki2013@gmail.com

1st supervisor
Dr. Caroline Mwangi Mobile: 0721546600 Email: carlomwa@yahoo.com

2nd Supervisor
Dr. Jane Gwaro Mobile: 0722749667 Email: gwaroj@yahoo.com

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Secretary,
KNH/UON ERC,
P.O Box 20723-00202, Nairobi.
Tel 020 2726300 Ext 44355
Email: KNHplan@Ken.Healthnet.org
IDHINI YA WATOTO WENYE UMRI YA MIAKA 8 -12.


Mimi, _________________________________, nataka kushiriki katika utafiti huu.

Sahihi yako hapa __________________________ Tarehe________________________

Kwa maelezo za ufanuzi, unaweza kuwasiliana na:
Daktari Ndung’u Christopher Kariuki, Nambari ya simu- 0720900608,
drkariuki2013@gmail.com Daktari Caroline Mwangi, Nambari ya Simu
0721546600 Email: carlomwa@yahoo.com Daktari Jane Gwaro,
Nambari ya simu : 0722749667 Email: gwaroj@yahoo.com
Daktari Charles Kabetu, Nambari ya simu, : 0722512205 Email: ckabetu@gmail.com
KNH / UON - Kitengo cha Maadili na Kamati ya Utafiti. P.O Box 20723-00202, Nairobi.
Tel 020 2726300 Ext 44355
Appendix V: Paediatric advanced life support PALS guide for respiratory rate (41)

<table>
<thead>
<tr>
<th>Age</th>
<th>Breaths / minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddler (1 to 3 yrs.)</td>
<td>24 to 40</td>
</tr>
<tr>
<td>Preschooler (4 to 5 yrs.)</td>
<td>22 to 34</td>
</tr>
<tr>
<td>School age (6 to 12 yrs.)</td>
<td>18 to 30</td>
</tr>
<tr>
<td>Adolescent (13 to 18 yrs.)</td>
<td>12 to 16</td>
</tr>
</tbody>
</table>