RISK OF COMPLICATIONS USING LARYNGEAL MASK AIRWAY VERSUS ENDOTRACHEAL TUBE DURING GENERAL ANESTHESIA IN PEDIATRIC PATIENTS WITH UPPER RESPIRATORY INFECTIONS: A NARRATIVE REVIEW. CREATION OF THE UPPER RESPIRATORY INFECTION SCREENING TOOL© AND MANAGEMENT ALGORITHM FOR CHILDREN PRESENTING FOR GENERAL ANESTHESIA WITH UPPER RESPIRATORY INFECTION©

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pediatric, upper respiratory infection, anesthesia, laryngeal mask airway, endotracheal tube

Abstract

The inflammatory process that occurs in an upper respiratory infection poses an increased risk of complications for children undergoing general anesthesia for a surgical procedure. The anesthesia providers need to decide which airway device, laryngeal mask airways or endotracheal tubes, is most appropriate and has less risk of adverse respiratory complications. A literature search was completed using EMBASE, Cumulative Index to Nursing and Allied Health Literature, and the Cochrane Library. Ten articles were found comparing the use of laryngeal mask airways and endotracheal tubes in children with upper respiratory infections. Synthesis of the literature concluded that laryngeal mask airways have a decreased risk of complications compared to endotracheal tubes when used in children with recent or current upper respiratory infections. With this information, the use of a laryngeal mask airway should be considered in place of an

endotracheal tube. The Upper Respiratory Infection Screening Tool© and the Management Algorithm for Children Presenting for General Anesthesia© were designed for quick recognition of children at high risk for respiratory complications and provide management techniques for anesthesia providers to follow.

Introduction

Upper respiratory infections (URIs) are the most common illnesses among children, with most children developing 6-10 URIs a year.[1] These infections can be caused by more than 200 different viruses, the most common being the rhinovirus.[1] Children can contract any URI-causing virus through droplets in the air or from direct contact with someone who is ill.[1] Children are more susceptible to the illness due to their immature immune systems and close contact with other children in schools and daycares.[1] The most common symptoms of URIs are runny nose, cough, congestion, sore throat, and low grade fever. A complete list of symptoms can be found in Table 1. Upper respiratory infections are very common in children and may be present when the child is scheduled for surgery.

In 1979, McGill et al. were the first to conclude that there is an increased risk of respiratory complications in children with recent URIs who undergo general anesthesia.[2] The infection causes an acute inflammatory process that results in hyperreactivity of the airway smooth muscle that can last anywhere from 4 to 6 weeks.[3,4,5] Since this observation, anesthesia providers have disagreed on whether an elective surgical procedure should be postponed or even canceled to allow more time for the child to recover from a URI. However, by the time 4 to 6 weeks pass, a new URI may be acquired. The belief was that children with recent or current URIs were at an increased risk of peri- and postoperational complications including laryngospasm, bronchospasm, and/or oxygen desaturation[3,4,5,6,7,8,9,10] (see Table 2). In 1991, Cohen and Cameron published the largest prospective observational study involving 1283 children with URIs and

20876 without.[11] Their research found that children presenting with URIs were 2 to 7 times more likely to have respiratory complications peri- and postoperatively.[11]

Upper respiratory infections increase the risk for complications in children, as seen in Table 2. The infection causes an acute inflammatory process that results in hyperreactivity of the airway smooth muscle that can last anywhere from 4 to 6 weeks.[3,4,5] Anesthetic gases and airway manipulation can irritate the already hyperreactive smooth muscle, causing an increased risk of bronchoconstriction and laryngospasm in the child.[3,4,5] An important part of the anesthesia provider's tasks is to avoid stimulation of the larynx in the already sensitive airway, therefore decreasing the likeliness of laryngospasms and bronchospasms, which can hinder the ability to ventilate the patient.[3]

Different invasive airway devices

Several different types of airway devices can be used during a general anesthetic to provide the patient the ability to spontaneously breathe or to provide positive pressure ventilation either mechanically by the ventilator or manually by the provider. The airway device is directly connected to the breathing circuit on the anesthesia machine to deliver carrier gasses to the patient.

An endotracheal tube (ETT) is "a large-bore catheter inserted through the mouth or nose and into the trachea to a point above the bifurcation of the trachea. It is used for delivering oxygen and other gases at or above atmospheric pressure."[12] ETTs were the primary means of facilitating mechanical ventilation of patients for decades and are still the primary means of securing an airway.

Laryngeal mask airways (LMAs) were first approved by the U.S. Food and Drug Administration in 1991 and have since been used as a passive and positive-pressure ventilation device in surgeries.[13] They are a slightly less invasive way to provide

an airway in patients undergoing general anesthesia and have been gaining in popularity. Laryngeal mask airways are "inserted blindly into the pharynx, forming a low-pressure seal around the laryngeal inlet and permitting spontaneous or gentle positive-pressure ventilation."[13]

Debate has begun regarding what method of airway management has the least laryngeal stimulation and lowest risk of complications to the patient.[6] Current research is attempting to determine which airway device, an ETT or LMA, is better for use in children with a current or recent URI undergoing general anesthesia. The purpose of this study is to recognize and list the symptoms of a URI, describe the changes to a child's airway due to a URI which result in an increased risk for respiratory complications with general anesthesia, list potential complications when pediatrics with URIs undergo general anesthesia, and to determine whether an ETT or LMA is best to use in children with current or recent URIs undergoing general anesthesia.

Methodology

A literature search was conducted using EMBASE, Cumulative Index to Nursing and Allied Health Literature, and the Cochrane Library to find articles comparing the use of ETTs and LMAs in pediatric patients with recent or current URIs undergoing general anesthesia. The keywords used were *anesthes**, *surgery*, *pediatric**, *child**, *respiratory infection*, *upper respiratory infection*, *ETT*, *endotracheal tube*, *LMA*, and *laryngeal mask airway*. The "*" symbol was used as a truncation symbol to search all possible spellings of a root word. Keywords were combined using OR and AND to limit the results. The keywords were entered in the databases as (*anesthes** OR *surgery*) AND (*pediatric** OR *child*) AND (*respiratory infection* OR *upper respiratory infection*) AND (*ett* OR *endotracheal tube* OR *lma* OR l*aryngeal mask airway*). Abstracts were reviewed from 131 articles with 8 relevant articles found. The reference lists from the 8 studies were reviewed, finding an additional 2 articles meeting

inclusion criteria. This search was conducted in October 2010 and repeated in May 2011, September 2011, November 2011, February 2012, and March 2012, with the same articles found on each search.

In order to be included in this literature review, articles had to compare ETTs and LMAs used in pediatric patients undergoing general anesthesia with a recent or current URI. The studies had to compare ETTs and LMAs to determine which airway device had the higher incidence of complications. Editorial or opinion pieces were included, but the clinical guidelines provided in this synthesis were not made based on opinion pieces.

Studies including adults in the studied population were excluded in this literature review. Any study that excluded children with recent or current URIs was excluded. If only a single airway device (LMA or ETT) was studied, the article was excluded from the literature review.

Each article was compared to the Joanna Briggs Institute Levels of Evidence (LOE) rating system (Table 3).[14] This system is known worldwide and is used on all systematic reviews submitted to the Joanna Briggs Institute. After reading the articles, a score from 1 to 4 was given based on the characteristics of the article content. The LOE rating of each article can be seen in Table 4.

Review of Literature

Although there is a sufficient amount of research available on children with recent or current URIs undergoing anesthesia, there is not much research on what is the best airway device to use in those patients, an ETT or LMA. The only level 1 article in this literature review was the study by Tartari et al. This randomized control trial (RCT) consisted of 400 patients between the ages of 6 months and 12 years.[10] The subjects were assigned to either the LMA or ETT group, and within those groups, it was determined

whether or not the child had a URI.[10] This study determined that adverse respiratory events were more frequent in children with a URI when compared to children without a URI.[10] When an ETT was used compared to an LMA, children with URIs had more adverse respiratory events including laryngospasm, stridor, and excessive coughing. This study advocates the use of LMAs over the use of ETTs in children with URIs.[10]

In the RCT performed by Wakhloo et al, 40 patients with clear rhinorrhoea and mild cough only were included in the study.[4] There was random assignment to 2 different groups, the ETT or LMA group, based on what airway device was used during their surgical procedures.[4] This study found less oxygen desaturation, bronchospasm, and laryngeal stimulation in the LMA group as compared to the ETT group and an increased risk of postoperative complications when using an ETT.[4] In the 1998 study performed by Tait et al, 82 patients with URIs who were eligible to use either a LMA or ETT in their surgery were included in the study and were randomly assigned to one of these airway devices.[6] Both the studies by Wakhloo et al. and Tait et al. found that LMAs had more advantages and fewer respiratory related complications than ETTs.[4,6] The advantages of using an LMA are decreased incidences of laryngospasm, sore throat, and bronchospasm.[4,6] The complications seen with the ETT group were coughing, sore throat, laryngospasm, bronchospasms, arterial oxygen desaturation, and breath-holding.[4,6]

Tait and Malviya's 2005 study was a literature review that compared 9 different studies, all of which studied the complications caused by recent or current URIs in children undergoing anesthesia.[3] When comparing ETTs and LMAs, this study concluded that LMAs were associated with fewer adverse respiratory events than ETTs.[3] Another literature review written by Höhne et al. came to the conclusion that LMAs should be used in children with URIs undergoing anesthesia.[15] Höhne et al. recommend, if possible, waiting 4 weeks after a URI for elective

surgeries to allow healing.[15] If the surgery cannot be postponed, LMAs should be used in those children rather than ETTs due to the decreased risk of complications.[15]

The 2001 observational survey of practice study by Parnis et al. showed that LMAs provide a safe and non-irritating airway to patients with a decreased risk of adverse reactions when compared to ETTs.[8] The 2007 study by Homer et al. used data from several prospective observational and interventional studies to come up with their conclusion that LMAs have an increased amount of respiratory complications when compared to ETTs.[7]

The 2008 retrospective study by Flick et al. went through the medical records of 130 pediatric patients who had experienced a laryngospasm during anesthesia.[16] This study found that LMAs had an increased risk of laryngospasm when compared to ETTs in children with URIs.[16] It was not clear what caused the increased risk of laryngospasm with LMAs, but it was thought to be the accumulation of secretions in the airway during emergence.[16]

Eikermann and Cote wrote an editorial in response to a study by von Ungern-Sternberg where LMAs were used in children with and without current or recent URI symptoms.[5,9] The study by von Ungern-Sternberg found an increased risk of respiratory complications when LMAs were used in children who had URIs, and a lower risk of adverse respiratory complications in those without recent URIs.[5] Eikermann and Cote argued that children with recent URIs were more likely to have adverse respiratory reactions with ETTs rather than with LMAs.[9] Eikermann and Cote claimed that, in his experience, LMAs were a better choice of airway protection and had a lower risk of complications.[9] In reply to the editorial, von Ungern-Sternberg defended his claim by writing that LMAs being used in children with URIs have an increased risk of complications.[17] Both authors agreed that more RCTs need to be conducted to provide a clearer position

on what airway device has the decreased risk of complications.[9,17] Both von Ungern-Sternberg and Eikermann and Cote agreed that children without URI symptoms in the previous 2 weeks could be safely anesthetized without an increased risk of respiratory complications.[5,9]

Synthesis

Eight studies have explored whether LMAs or ETTs have an increased risk of adverse reactions when used in children with recent or current URIs. An additional 2 editorials discuss the use of LMAs and ETTs in children with recent or current URIs.

Three articles disagree with the statement that LMAs have a lower rate of respiratory adverse events than ETTs in children with URIs.[7,16,17] The 2 studies provided by Homer et al. and Flick et al. advocated the use of ETTs when comparing them to LMAs in children with recent or current URIs.[7,16] The studies by Homer et al. and Flick et al. did not clearly define the reason for the increased risk of complications in LMAs, but the authors thought it was related to the way the airway devices were removed and the secretions found on the vocal cords.[7,16] The study by von Ungern-Sternberg et al. expressed that the authors thought LMAs had a higher risk of complications when used in children with URIs.[17] This original study supported the use of ETTs in children with current URIs but did not compare the complication rates between LMAs and ETTs and was not included in this review for that reason.[5]

Of the 8 articles in which a study was performed, six articles have determined that LMAs have a decreased risk of complications when compared to ETTs when used in children with recent or current URIs.[3,4,6,8,10,15] LMAs have a decreased risk of complications due to the minimal manipulation and irritation to the already hyperreactive airway.[3,4,6,8,10,15] LMAs sit above the glottic opening so there is less stimulation to the laryngeal opening and vocal cords, limiting the risk of complications.[3,4,6,8,10,15] Eikermann

and Cote, in their editorial, agree from personal experience that LMAs have less risk of complications when compared to ETTs when caring for children with URIs.[9]

Limitations of Study

There were some limitations in the literature. In Tait and Malviya's 2005 study, all 9 studies included in the literature review looked at complications caused by recent or current URIs in children undergoing anesthesia.[3] However, not all 9 studies compared the different airway devices being used in the subjects.

Future Studies

An inconsistency with the literature is the amount of time after URI symptoms are resolved that surgery is still considered high risk for the child. Some of the literature suggests waiting 2-4 weeks for surgery,[3,5,9] when others suggest waiting 4-6 weeks.[4,7,8,15] A study should be performed to find the specific time after symptoms are resolved to consider airway manipulation at risk for complications or not. Most of the dispute is related to how long the smooth muscle of the airway is hyperreactive. Knowing the exact amount of time needed to completely recover from a URI will help anesthesia providers to plan accordingly for their patients. It may be extremely difficult or impossible to determine an exact time since all patients are different.

Intervention Overview

According to the literature, LMAs should be preferentially used instead of ETTs in children with recent or current URIs undergoing anesthesia.[3,4,6,8,9,10,15] LMAs have a decreased risk of peri- and postoperative complications compared to ETTs in the hyperreactive airway.[3,4,6,8,9,10,15] Endotracheal tube use in children with hyperreactive airways secondary to URIs results in a higher risk of respiratory complications including laryngospasm, bronchospasm, arterial oxygen desaturation, and breath-holding (a complete list is available in Table 2).[3,4,6,8,9,10,15]

The Upper Respiratory Infection Screening Tool© (Appendix 1) was created so parents/guardians can fill out a questionnaire regarding the child's recent health prior to surgery. On the Upper Respiratory Infection Screening Tool©, common signs and symptoms are listed, and the parent/guardian is to answer whether the patient currently has the symptom, has had the symptom within the past 4 weeks, or has not had the symptom. Using this screening tool, anesthesia providers will be able to see quickly if the patient is at a higher risk for complications due to their current or recent URI symptoms. Symptoms 1-5 on the screening tool: nasal congestion, sputum production, wheezing, productive cough, and fever greater than 100.4°F (38°C), are symptoms associated with a severe URI.[3] Two or more of those symptoms puts the child at higher risk for respiratory complications.[3,10]

The information found on the Upper Respiratory Infection Screening Tool© can then be used in the decision tree referred to as the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection© (Appendix 2). The decision tree was created as a clinical guidance algorithm for anesthesia providers to refer to when deciding the best option for the management of the child presenting for surgery. To use the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection©, the clinician starts at the top with the first question, and each answer will lead the clinician to another question. The result at the end of the tree is a recommendation of the safest way to provide anesthesia care for the child. If the end result recommends proceed with caution, the anesthesia provider needs to ensure the child is adequately hydrated through intravenous fluids, humidification on the patient breathing circuit, and that airway manipulation is only performed when the child is deeply anesthetized.[3,6] Medications such as sevoflurane, bronchodilators and anticholinergics can be used to help minimize the risk of respiratory complications but are not required to be routinely administered.[3,6]

Summary

The current literature supports the use of LMAs over ETTs when used in children with recent or current URIs.[3,4,6,8,9,10,15] There is a lower risk of respiratory complications when using a LMA in these children.[3,4,6,8,9,10,15] Anesthesia providers have the responsibility of selecting the right plan of care for each individual patient based on the type of procedure and the patient's health history. The Upper Respiratory Infection Screening Tool© and the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection© provide a quick reference for anesthesia providers to look to for guidance when taking care of the pediatric population.

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Table 1. Signs and symptoms of URIs in infants and older children[A]

Infants	Older Children
• unable to sleep	• stuffy, runny nose
• fussiness	• scratchy, tickly throat
• congestion in the nose	• watery eyes
• sometimes vomiting and diarrhea	• sneezing
• fever	• mild hacking cough
	• congestion
	• sore throat
	• achy muscles and bones
	• headaches
	• low grade fever
	• chills
	• watery discharge from nose and throat
	• mild fatigue

a. Data derived from Children's Hospital Boston.[1]

Table 2 – Possible anesthetic complications in children with URIs

• laryngospasm[4,5,6,7,9,10]	• stridor[3,7,10]	• secretions[3,4,8]
• bronchospasm[3,4,5,6,7,8]	• hypoxemia[5]	• airway obstruction[4,5,8]
• breath-holding[3,4,6,8]	• vomiting[8]	
• coughing[3,4,5,6,7,8,9,10]	• regurgitation[8]	• atelectasis[3,5,6]
• oxygen desaturation[3,5,6,7,8,9]	• hypotension[8]	• cardiac arrest[8]
• sore throat[6]	• arrhythmia[8]	• death[8]

Table 3 – The Joanna Briggs Institute Levels of Evidence[14]

Levels of Evidence	Feasibility F (1-4)	Appropriateness A (1-4)
1	Metasynthesis of research with unequivocal synthesized findings	Metasynthesis of research with unequivocal synthesized findings
2	Metasynthesis of research with credible synthesized findings	Metasynthesis of research with credible synthesized findings
3	a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality	a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality
4	Expert opinion	Expert opinion

Meaningfulness M (1-4)	Effectiveness E (1-4)	Economic Evidence
Metasynthesis of research with unequivocal synthesized findings	Meta-analysis (with homogeneity) of experimental studies (eg RCT with concealed randomization) OR One or more large experimental studies with narrow confidence intervals	Metasynthesis (with homogeneity) of evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
Metasynthesis of research with credible synthesized findings	One or more smaller RCTs with wider confidence intervals OR Quasi-experimental studies (without randomization)	Evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality	a. Cohort studies (with control group) b. Case-controlled c. Observational studies (without control group)	Evaluations of important alternative interventions comparing a limited number of appropriate cost measurement, without a clinically sensible sensitivity analysis
Expert opinion	Expert opinion, or physiology bench research, or consensus	Expert opinion, or based on economic theory

Table 4 – Levels of Evidence and Study Findings

Article	LOE	n	Study	Findings
Tartari,[10] 2000	1	400	RCT of LMA vs. ETT	LMAs had less adverse respiratory events than ETTs in children with URIs. LMAs are preferred over ETTs in children with URIs.
Tait,[6] 1998	2	82	RCT of LMA vs. ETT	Less coughing and oxygen desaturation in LMA, no bronchospasm in LMA. Total respiratory complications significantly greater in ETT than LMA. LMAs lack laryngeal stimulation. "LMA seems to offer several advantages over the ETT for airway management."
Wakhloo,[4] 2007	2	40	RCT of LMA vs. ETT	Less oxygen desaturation, no bronchospasm in LMA group compared to ETT. ETT use increases risk of postoperative complications. LMAs have decreased amount of laryngeal stimulation and decreased airway complications with URIs.
Tait,[3] 2005	2	-	Literature Review	More severe URI symptoms should wait 4 weeks for surgery. ETT should be avoided because of increased risk of respiratory complications. LMAs are a safe alternative for ETTs with significantly less complications.

Article	LOE	n	Study	Findings
Höhne,[15] 2006	2	-	Literature Review	LMA safe airway device, especially in children with URIs. Surgery should be delayed 4 weeks if possible, when not possible use LMA.
Homer,[7] 2007	3	335	Logistic regression model. Several prospective interventional and observational clinical studies.	In general, there was a higher percentage of adverse events with LMA as opposed to ETT. URI 2-4 weeks prior to surgery had the highest rate of respiratory complications.
Parnis,[8] 2001	3	2514	Logistic regression model. Observational survey of practice	Patients with ETTs had highest rate of adverse reactions. LMAs or FMs had the lowest. LMA provides clear, safe airway without irritating patient airway.
Flick,[16] 2008	3	130	Retrospective study of pediatric patients having experienced a laryngospasm during anesthesia	Chart reviews identified that LMAs have an increased risk of laryngospasm when compared to ETTs.
Eikermann,[9] 2008	4	-	Editorial responding to von Ungern-Sternberg's article	Clinical observation stating children without URI within the past few weeks may be safely anesthetized. Disagree with von Ungern-Sternberg's study that LMAs increase the risk of respiratory complications.
von Ungern-Sternberg,[17] 2008	4	-	In Reply to Eikermann and Cote's editorial	"Recent URI is a risk factor for the occurrence of perioperative respiratory complications with the use of an LMA."

Appendix 1

Upper Respiratory Infection Screening Tool©
Please check any symptoms currently present or present in the last 4 weeks.
Please answer as accurately as possible.

1. Runny Nose/Nasal Congestion

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

2. Sputum Production

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

3. Wheezing/Reactive Airway

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

4. Productive Cough

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

5. Fever (greater than 100.4°F)

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

6. Malaise (feeling unwell)

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

7. Muscular Pains

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

8. Sneezing

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

9. Hoarse Voice

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

10. Sore/Scratchy Throat

☐ Yes, Currently

☐ Yes, in last 4 weeks

☐ No

Comments: _____

_____

_____

_____

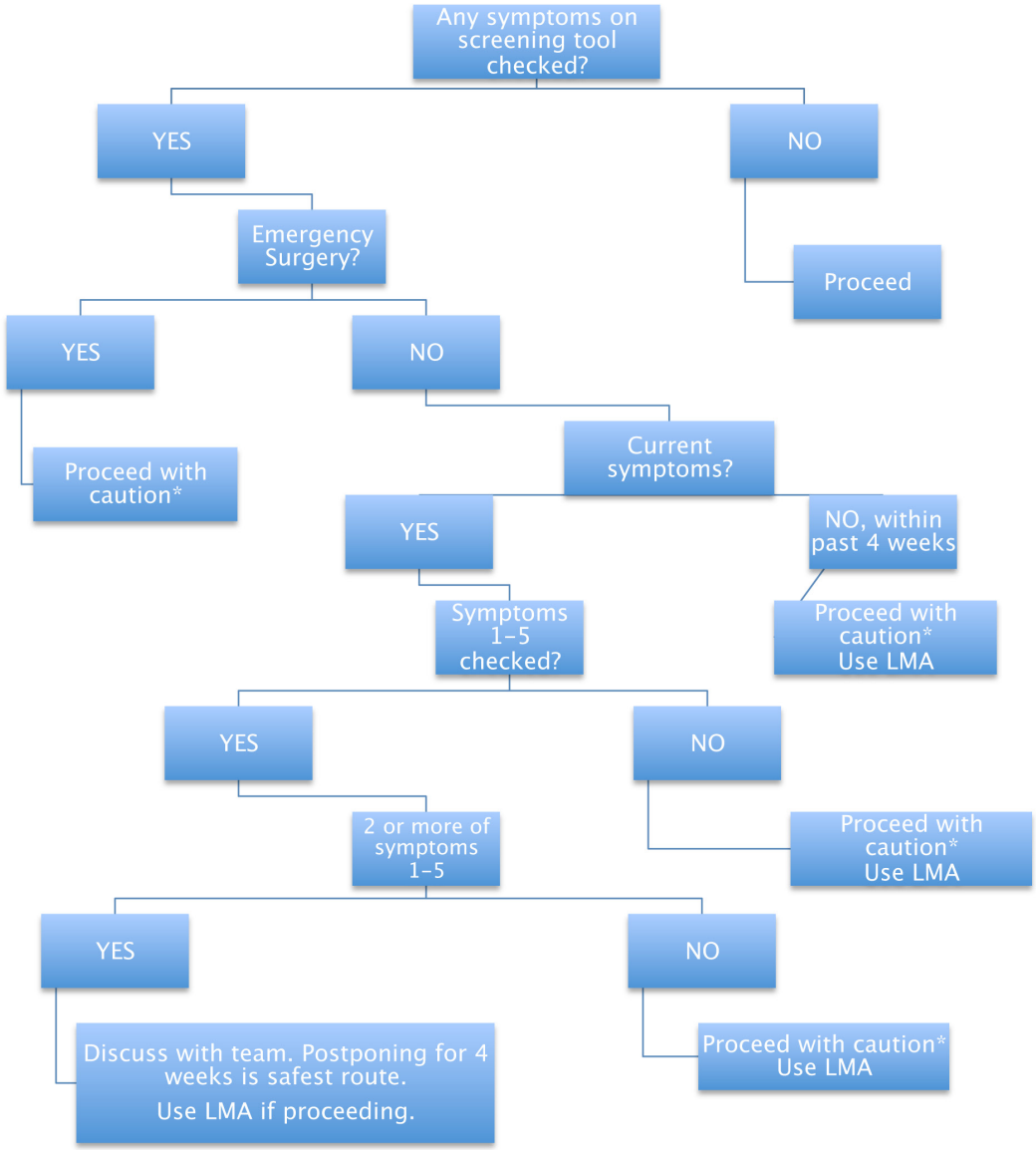
Information provided by: _____

Relationship: _____

Signature: _____ Date: _____

Appendix 2

Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection©



*When proceeding with caution, the following can help to reduce the risk of respiratory complications postoperatively: adequate IV hydration, humidification, bronchodilators, use of sevoflurane, anticholinergics, and ensuring adequate depth of anesthesia prior to airway manipulation.[3,6]

References

1 Children's Hospital Boston. Upper respiratory infection (common cold). Children's Hospital Boston website. http://www.childrenshospital.org/az/Site1719/mainpageS1719P0.html. Accessed February 25, 2012.

2 McGill WA, Coveler LA, Epstein BS. Subacute upper respiratory infection in small children. *Anesth Analg*. 1979;58(4):331-333.

3 Tait AR, Malviya S. Anesthesia for the child with an upper respiratory tract infection: still a dilemma? *Anesth Analg*. 2005;100(1):59-65.

4 Wakhloo R, Gupta SD, Gupta V, Ranbhushan. ETT vs. LMA in pediatric patients with URI: a comparison of adverse respiratory events. *Internet J of Anesthesiol*. 2007;14(2) http://find.galegroup.com.ezproxy.tcu.edu/gtx/infomark.do?&content Set=IAC-Documents&type=retrieve&tabID=T002&prodId=AONE&docId=A177102029&source=gale&srcprod=AONE&userGroupName=txshracd2573&version=1.0. Accessed February 25, 2012.

5 von Ungern-Sternberg BS, Boda K, Schwab C, Sims C, Johnson C, Habre W. Laryngeal mask airway is associated with an increased incidence of adverse respiratory events in children with recent upper respiratory tract infections. *Anesthesiol*. 2007;107(5):714-719.

6 Tait AR, Pandit UA, Voepel-Lewis T, Munro HM, Malviya S. Use of the laryngeal mask airway in children with upper respiratory tract infections: a comparison with endotracheal intubation. *Anesth Analg*. 1998;86(4):106-111.

7 Homer JR, Elwood T, Peterson D, Rampersad S. Risk factors for adverse events in children with colds emerging from anesthesia: a logistic regression. *Pediatric Anesth*. 2007;17(2):154-161.

8 Parnis SJ, Barker DS, Van Der Walt JH. Clinical predictors of anaesthetic complications in children with respiratory tract infections. *Paediatric Anaesth*. 2001;11(1):29-40.

9 Eikermann M, Cote CJ. Laryngeal mask airway and children's risk of perioperative respiratory complications: randomized controlled studies are required to discriminate cause and effect [Editorial]. *Anesth*. 2008;108(6):1154.
10 Tartari S, Fratantonio R, Bomben R, Paolazzi M, Gritti G, Alvisi R. Maschera laringea vs. tubo orotracheale in anestesia pediatrica nella flogosi felle prime vie aeree [English abstract]. *Minerva Anestesiol*. 2000;66(6):439-443.
11 Cohen MM, Cameron CB. Should you cancel the operation when a child has an upper respiratory infection? *Anesth Analg*. 1991;72(3):282-288.
12 *Mosby's Dictionary of Medicine, Nursing & Health Professions*. 7th ed. St. Louis, MO: Mosby Elsevier; 2006:648.
13 Pennant JH, White PF. The laryngeal mask airway. *Anesth*. 1993;79(1):144-163.
14 The Joanna Briggs Institute. Levels of evidence FAME. The Joanna Briggs Institute website Available at: http://www.joannabriggs.edu.au/Levels%20of%20Evidence%20%20FAME. Updated February 19, 2012. Accessed March 3, 2012.
15 Höhne C, Haack M, Machotta A, Kaisers U. Atemwegsmanagement in der kinderanasthesie [English translation]. *Anaesthesist*. 2006;55(7):809-820.
16 Flick RP, Wilder RT, Pieper SF, et al. Risk factors for laryngospasm in children during general anesthesia. *Pediatric Anesth*. 2008;18(4):289-296.
17 von Ungern-Sternberg BS, Johnson C, Habre W. Laryngeal mask airway and children's risk of perioperative respiratory complications: randomized controlled studies are required to discriminate cause and effect – in reply [Editorial]. *Anesthesiology.* 2008:108(6):115.