

MANAGEMENT OF PEDIATRIC AIRWAY ISSUES

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DISCLOSURE

I have NO financial disclosure or conflict of interest.



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LEARNING OBJECTIVES

- Discuss the incidence of common pediatric airway related issues.
- Identify various perioperative airway complications.
- Describe the etiology and pathophysiology for early identification.
- Elaborate the management and prevention of airway problems.

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AIRWAY RELATED PROBLEMS

- Most common peri-operative complication
- Serious adverse events recorded
 - Out of 10,000 anesthetics, 297 - Serious events
 - 75% involve the respiratory system
 - 36% related to laryngospasm



Kurth, C.D., Tyler, D., Heitmiller, E., Tosone, S.R., Martin, L., Deshpande, J.K. National pediatric anesthesia safety quality improvement program in the United States. *Anesth. Analg.* 2014. 119: 112-121.

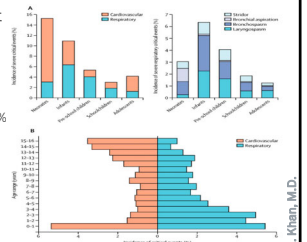
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AIRWAY RELATED PROBLEMS

- Distribution of severe critical events throughout the age groups:

- Relative incidence and of respiratory and CV events (%)
- Relative distribution of respiratory critical events (%)
- Age distribution of CV (orange) and respiratory (blue) critical events



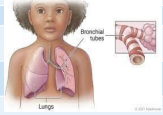
Egbuta C, Mason KP. Recognizing Risks and Optimizing Perioperative Care to Reduce Respiratory Complications in the Pediatric Patient. *Journal of Clinical Medicine*. 2020; 9(6):1942. <https://doi.org/10.3390/jcm9061942>

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PREDISPOSING FACTORS

Patient Related	Surgery Related	Anesthesia Related
Age	Surgery Type	Experience level
Lung Disease of Prematurity	Surgical Approach	
Inflammatory Lung Disease	Surgery Timing	
Airway manipulation	Operation Location	
Obesity		
Upper respiratory tract infection		
Sleep disordered breathing		
Congenital Abnormalities		



Hi L, Templeton TW, Sommerfeld D, Sommerfield A, Matava CT, von Ungern-Sternberg BS. Risk assessment and optimization strategies to reduce perioperative respiratory adverse events in pediatric anesthesia-Part 1 patient and surgical factors. Paediatr Anaesth. 2022 Feb;32(2):209-216. doi: 10.1111/pan.14377. Epub 2021 Dec 20. PMID: 34907906.

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PEDIATRIC AIRWAY ANATOMY


ANATOMY	RISKS
Neonates: Obligate nose breather	Nasal obstruction: airway obstruction and respiratory distress
Occiput: Large and round	When supine, occiput flexes head forward, obstructing airway
Tongue: Large relative to mouth	Obstructs larynx
Laryngeal and tracheal cartilage: soft and compressible	External pressure on the larynx: obstruct the airway
Larynx higher in the neck: near C2, C3 vs adult C4, C5	Tongue and soft tissue can obstruct the larynx easily
Cricoid ring is narrower than glottic opening	Narrow cricoid creates a funnel-shaped larynx=>risk for obstruction from subglottic edema
Laryngeal and tracheal diameter: very narrow	Minimal edema => significant obstruction
Trachea: Short	Inadvertent extubation and mainstem intubation can occur with head position changes
Adenoids and tonsils fill posterior pharynx	Hypertrophic tonsils and adenoids cause obstructive sleep apnea
Baby teeth become loose	Accidental aspiration of loose teeth during airway handling can occur

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THE COLDS SCORE

- Preoperative screening tool in < 6 years of age
- Quantify the risk of peri-operative respiratory complications
- Predictive of cancellation of a surgical procedure for anesthesia-related concerns
- Be cautious: Higher COLDS Score => More perioperative risk
- Score of 19/25 indicates significant risk => Postpone



Eghuta C, Mason KP. Recognizing Risks and Optimizing Perioperative Care to Reduce Respiratory Complications in the Pediatric Patient. Journal of Clinical Medicine. 2020; 9(6):1942. <https://doi.org/10.3390/jcm9061942>

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THE COLDS SCORE

	1	2	5
Current signs and symptoms (C)	None	Mild: URI and/or congestion, runny nose, sore throat, low grade fever, dry cough	1. Mod/Severe: wet cough, abnormal lung sounds, toxic appearance, high fever
Onset of symptoms (O)	>4 weeks ago	2-4 weeks ago	<2 weeks ago
Presence of Lung Disease (L)	None	Mild: Hx of RSV, intermittent asthma, BPD>1 yr, snoring, passive smoker	Moderate/Severe (mod/persistent asthma, BPD>1 yo, OSA)
Airway Device (D)	None or facemask	LMA/Supraglottic Airway	ETT
Surgery (S)	Non-airway (inc. PE Tubes)	Minor airway(T&A), Dental, Flex.Bronch)	Major airway (Cleft Palate, Rigid Bronch)


Lee LK, Bernardo MKL, Grogan TR, Elashoff DA, Ren WHP. Perioperative respiratory adverse event risk assessment in children with upper respiratory tract infection: Validation of the COLDS score. Paediatr Anaesth. 2018 Nov;28(11):1007-1014. doi: 10.1111/pan.13491. Epub 2018 Oct 3. PMID: 30281195.

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AIRWAY EMERGENCIES

- Laryngospasm
- Bronchospasm
- Post-Intubation Croup
- Foreign Body
- Aspiration
- Epiglottitis



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CASE ONE

A 2 year old, 16 kg is undergoing bilateral ear tubes for recurrent ear infections. Healthy otherwise playing actively in mom's lap. Vital signs unremarkable. Last strep infection was 4 weeks ago and finished antibiotic course. Clear nasal congestion which mom attributes to ear infection.

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Next step? Choose the most likely answer.

- A. Cancel the surgery
- B. Perform a physical exam and decide accordingly
- C. Administer albuterol treatment in anticipation of bronchospasm and proceed
- D. Proceed

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CASE ONE

- After SASAMA, mask induction with sevoflurane
- No IV or airway instrumentation
- Right ear tube is placed uneventfully
- Head turned to the right for left ear tube
- You replace the mask and notice no waveform on the ventilator

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What do you think is going on? Choose the most likely answer.


- A. Inadequate mask seal
- B. Circuit disconnect
- C. Laryngospasm
- D. Bronchospasm
- E. Kinked EtCO₂ line
- F. Any of the above

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CASE ONE

- You ruled out differentials quickly and all clues direct towards laryngospasm.



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What steps would you take in chronological order?

- A. Call for help; Positive Pressure Ventilation; Establish PIV; Propofol
- B. Positive Pressure Ventilation; Call for help; Establish PIV; Propofol
- C. Establish PIV; Call for help; Positive Pressure Ventilation; Propofol
- D. IM Succinylcholine; Call for help; Positive Pressure Ventilation; Establish PIV

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CASE ONE

- You called for help and initiate PPV. It took a long time to establish a PIV. Administered IV propofol.
- Patient's vital signs are as below:
 - SpO₂: 84%; Not responding to positive pressure ventilation.
 - Heart rate: 113 => 86

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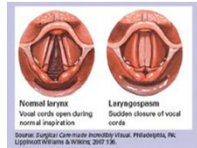
How do you proceed?

- Administer another bolus of propofol.
- Administer a small dose of succinylcholine.
- Administer epinephrine.
- Start chest compressions.

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LARYNGOSPASM

- Glottic closure due to reflex constriction of intrinsic laryngeal muscles.
- Exaggeration of a protective reflex that prevents aspiration:
 - ⇒ impedance of airflow to the trachea and lungs (hypoxia)
 - ⇒ pulmonary edema
 - ⇒ cardiac dysrhythmias; cardiac arrest
 - ⇒ death



Normal larynx: Vocal cords open during normal inspiration.

Laryngospasm: Sudden closure of vocal cords.

Source: Sumner E, Hatch D, (eds), Paediatric Anaesthesia, 2nd edn, London: Arnold, 1999


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LARYNGOSPASM - RISK FACTORS

- Lack of inhibition of glottic reflexes.
- Inappropriate depth of anesthesia.
- Increased stimuli:
 - Vocal cord irritation (inhalation anesthetics, secretions, blood).
 - Airway manipulation.
 - Young age (infants - highest risk).
 - Recent or current upper respiratory infection.
 - Passive smoke exposure.
 - Obstructive sleep apnea.



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LARYNGOSPASM-INNervation

VAGUS NERVE

- SUPERIOR LARYNGEAL NERVE:**
 - Internal branch (sensory): Area above the glottis
 - External branch (motor and sensory):
 - Motor: Cricothyroid muscle
 - Sensory: Anterior Infraglottic larynx at level of cricothyroid membrane
- INFERIOR OR RECURRENT LARYNGEAL NERVE:**
 - Motor: All intrinsic laryngeal muscles of SAME side except cricothyroid. Interarytenoid muscles of BOTH sides.
 - Sensory: Areas below the glottis.



INNervation

- Superior laryngeal nerve (CN X):
 - Internal branch: Cricothyroid
 - External branch: Mucosa above the rim
- Superior laryngeal artery: Branch of the subclavian
- Inferior laryngeal artery: Branch of the aortic arch
- Inferior laryngeal nerve (CN X):
 - All intrinsic muscles
 - Mucosa below the rim


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LARYNGOSPASM - SIGNS & SYMPTOMS

- Inspiratory Stridor
- Accessory Muscle use
- Sternal Retractions
- Paradoxical chest Movement
- Airway Obstruction
- Decrease Oxygen Saturations
- Decrease Heart rate
- Loss of EtCO2



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LARYNGOSPASM - PREVENTION

Postpone surgery (2-3 weeks) after an URTI if surgery is not urgent episode

Induction phase	Maintenance phase	Emergence
<ul style="list-style-type: none"> Seek supervision by an experienced pediatric anesthesiologist Avoid manipulation of the airway at an insufficient depth of anesthesia Choose noninvasive airway management Choose intravenous induction and muscle relaxant if tracheal intubation is necessary 	<ul style="list-style-type: none"> Provide adequate level of anesthesia and analgesia 	<ul style="list-style-type: none"> Oropharyngeal and tracheal suction of blood and secretions Discontinuation of inhaled or intravenous anesthetics Check for residual paralysis Limited stimulus until the patient opens the eyes spontaneously Extubation of the trachea of a fully awake patient, using the "artificial cough technique"

Orliaguet GA, Gail O, Savatelli GL, Coubrigner V. Case scenario: perianesthetic management of laryngospasm in children. *Anesthesiology*. 2012 Feb;116(2):458-71. doi: 10.1097/ALN.0b013e318242aa69. PMID: 22222477

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LARYNGOSPASM – MANAGEMENT

1) Call for help.	5) Deepen anesthesia with IV propofol (1-3 mg/kg)
2) Give 100% Oxygen.	6) Give succinylcholine 0.1-2 mg/kg (if no IV: 2-4 mg/kg IM)
3) Apply Positive pressure.	7) If bradycardia, atropine 0.02 mg/kg IV (if no IV: 0.04 mg/kg IM)
4) Establish adequate IV access.	8) Suction.


<https://pedsanesthesia.org/wp-content/uploads/2020/11/SPAPediCrisisChecklistsNov2020.pdf>

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LARSON'S MANEUVER (LARYNGOSPASM NOTCH)

- Found behind the lobule to the pinna
- Bounded:
 - Anteriorly: Ascending ramus of the mandible
 - Posteriorly: Mastoid process
 - Cephaloid: Base of the skull.
- Involves firm pressure at this point that causes pain over the styloid process. The afferent input is thought to cause relaxation of the cords by a poorly defined mechanism.




Pediatric laryngospasm: HAMPSON EVANS, DARRYL; MORGAN, PATRICK; FARRAR, MARKISSN: 1155-5645, 1460-9592; DOI: 10.1111/j.1460-9592.2008.02446.xPaediatric anaesthesia, 2008, Vol.18(4), p.303-307

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LARYNGOSPASM - DISPOSITION

- Patients with normal oxygen saturation (SpO₂) on room air:
 - Discharge home with instructions to return to the ER if symptoms recur.
- Patients not able to maintain oxygen saturations:
 - Observe in the hospital for at least three to four hours
 - Monitor for negative pressure pulmonary edema.
 - If present, consider ETT, PPV, PEEP, ICU




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CASE TWO

A 3 year old, 10 kg, former 23 week premie, is undergoing hypospadias repair. History significant for BPD and TEF s/p repair. Induction was uneventful. Soon after surgery start, patient moved. Simultaneously, ventilator starts alarming. Saturations dropped. Tidal Volumes less than 3 ml/kg.



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What would be your first step in management?

- A. Increase FiO₂
- B. Auscultate the chest
- C. Check ETT
- D. Deepen anesthetic
- E. Albuterol

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You auscultate wheezing all over the lung fields. What EtCO₂ would you notice on your ventilator?

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BRONCHOSPASM

- Bronchial smooth muscle constriction due to a stimulus.
 - Mechanical: Endotracheal Tube
 - Chemical: Asthmatic (exacerbation), Anaphylactic (allergen)
- Hypoventilation, hypoxemia, and metabolic acidosis.



BRONCHOSPASM


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BRONCHOSPASM – SIGNS & SYMPTOMS

- Increased Peak airway pressures
- Decreased tidal volumes
- Oxygen desaturation
- Expiratory wheeze or silent chest
- Change in capnograph waveform



SEVERE BRONCHOSPASM DURING ANAESTHESIA

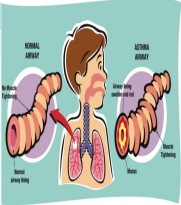
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BRONCHOSPASM

RISK FACTORS	PREVENTION
Underlying reactive airway disease	Preemptive Albuterol treatment
Stimulation from an airway device	Consider Lidocaine topicalization. Supraglottic airway
Aspiration of gastric contents	Appropriate NPO status
Anaphylaxis	Avoid Allergens known to patient

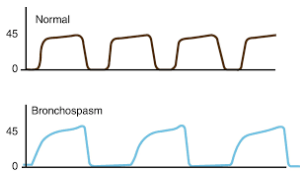



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BRONCHOSPASM – END-TIDAL CO₂ WAVEFORM

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BRONCHOSPASM - MANAGEMENT

Intubated Patient	Non-Intubated Patient
<ul style="list-style-type: none"> ○ Increase FIO₂ to 100% ○ Auscultate the chest ○ Check ETT ○ Albuterol 2-10 puffs, repeat as needed ○ Consider deepening anesthetic ○ If needed, give ketamine 1-2 mg/kg IV ○ If severe, epinephrine 1-2 micrograms/kg IV (max 1 mg) ○ Consider IV steroids: methylprednisolone 2 mg/kg IV (MAX 60 mg) or dexamethasone 0.15-0.25 mg/kg (MAX 16 mg) ○ Consider chest radiograph ○ For refractory bronchospasm, consider magnesium sulfate 50-75 mg/kg (max 2 grams) bolus over 20 minutes. (Caution: may cause hypotension) 	<ul style="list-style-type: none"> ○ Administer supplemental oxygen ○ Auscultate the chest, differentiate from stridor/extrathoracic airway obstruction ○ Consider inhaled albuterol (with spacer) 2.5-5 mg. If severe, 5-20 mg/hr inhaled ○ Consider chest radiograph ○ Consider IV steroids: methylprednisolone 1 mg/kg IV (max 60 mg) or dexamethasone 0.15-0.25 mg/kg (max 16 mg) ○ If severe, epinephrine 1-2 micrograms/kg IV (max 1 mg) or 10 micrograms/kg SC/IM (max 0.5 mg) ○ If severe, consider ICU and/or advanced airway management.

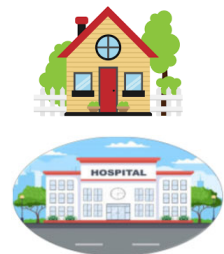
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BRONCHOSPASM - DISPOSITION

- Patients with no wheezing:
 - If breathing comfortably, without wheezing, and have normal oxygen saturation (SpO₂) on room air: discharge home with instructions to return to the emergency department if symptoms recur.
- Patients with continued wheezing:
 - Observe in the hospital for at least three to four hours
 - If no change or not able to maintain saturations, admit to the hospital for monitoring and treatment.



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LARYNGOSPASM VERSUS BRONCHOSPASM

LARYNGOSPASM	BRONCHOSPASM
Inspiratory, usually stridor	Expiratory, usually wheeze
Expiration: Not prolonged	Expiration: Prolonged
Rapid onset	Slow onset
Indrawing of intercostal. Suprasternal notch	Use of accessory muscles

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CASE THREE

10-month-old girl, ex-26 week premie underwent endoscopic foreign body removal under anesthesia. She was intubated successfully with 3.5 cuffed ETT on first attempt. Removal took approximately 30 minutes due to the coin being stuck in mid esophagus.

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What is your peri-operative concern most consistent with patient history?

- A. Laryngospasm
- B. Bronchospasm
- C. Croup
- D. Epiglottitis
- E. Failure to extubate

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CASE THREE

She developed stridor right after emergence from anesthesia. Severe croup develops, with cyanosis of the lips after the end of the procedure. You provide oxygen which resolves the cyanosis but barking cough persists.



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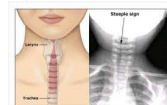
What is your next step?

- A. IV dexamethasone and IV propofol.
- B. IV dexamethasone, and racemic epinephrine therapy.
- C. IV propofol and IV epinephrine.
- D. Racemic epinephrine and albuterol.

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POST-INTUBATION CROUP

- Local inflammation caused by endotracheal tube (ETT) pressure on laryngeal/subglottic structures.
- Small amount of edema => significant increase in airway resistance
- Symptoms:** Barking cough, hoarseness, inspiratory stridor, suprasternal or subcostal retractions, respiratory distress, cyanosis
- X-Ray findings:**
 - AP: Steeple sign
 - Lateral: Subglottic swelling



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POST-INTUBATION CROUP - FACTORS

Intubation:


- History of difficult intubation
- Several attempts
- Large tube size

Post-intubation:

- Prolonged endotracheal intubation
- High cuff pressures
- Agitation while intubated

Patient, setting, and surgery-related:

- Type and length of surgery
- Prone positioning
- Inhalational injuries
- Gastro-esophageal reflux
- Post Intubation Laryngeal Edema



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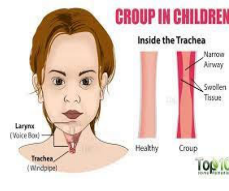
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POST-INTUBATION CROUP

Prevention: Appropriately-sized ETT. If cuffed, use manometer to check leak.

Treatment:

- Mild:** Humidified cold mist, mild sedation
- Moderate-Severe:**
 - Racemic epinephrine (5-10 minutes) => vasoconstriction and minimize tissue edema.
 - Dexamethasone 0.6 mg/kg; max 10 mg; Not effective in immediate post-operative period.



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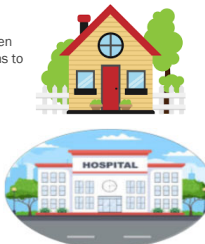
POST-INTUBATION CROUP - DISPOSITION

Patients who receive epinephrine:

- Observe in the hospital for at least three to four hours
- If breathing comfortably, without stridor, and have normal oxygen saturation (SpO2) on room air: discharge home with instructions to return to the emergency department if symptoms recur

Patients who require repeated doses of epinephrine:

- Admit to the hospital or intensive care unit, as indicated, for monitoring and treatment



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FOREIGN BODY

Most common cause of death in children with acute asphyxia.

Age 3 and less.

Intraoperative considerations:

- Shared airway
- Laryngospasm
- Bronchospasm



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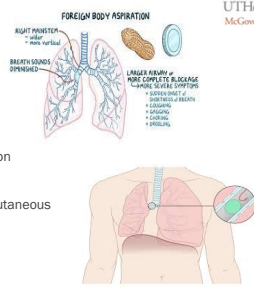
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FOREIGN BODY

History & Physical:

- Age and weight
- NPO Status
- Size and type of foreign body
- Location and degree of foreign body obstruction
- Degree of hypoxia
- Presence of pneumothorax, mediastinal subcutaneous emphysema and other complications.



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FOREIGN BODY - MANAGEMENT

Rigid Bronchoscopy – Procedure of choice

- Prepare rescue drugs, equipment, emergency airway cart.
- Maintain spontaneous respiration (whether respiratory distress or not).
- Be aware of insufficient anesthesia depth: Consider Lidocaine 4% LTA.
- Observe SpO2 and chest movement during the procedure.
- High risk of airway complications despite removal.



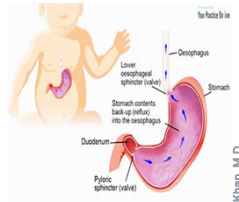
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ASPIRATION

- Rare complication of pediatric airway management.
- Reported incidence ranging from 0.02 to 0.1 percent of all pediatric anesthetics.



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ASPIRATION - RISK FACTORS

- American Society of Anesthesiologists (ASA) physical status of III or IV
- Emergency procedures
- Inappropriate NPO status
- Light anesthesia
- High intra-abdominal pressure (lithotomy position) during maintenance with a supraglottic airway (SGA) in place



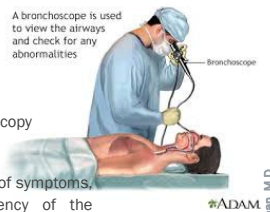
Aspiration events during maintenance: more common in patients managed with an SGA, mask anesthetic, or natural airway.

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ASPIRATION - MANAGEMENT

- Turn head to the side
- Remove SGA, if used
- Suction the mouth and pharynx
- Administer 100 percent oxygen by face mask
- Evaluate airway with flexible fiberoptic bronchoscopy
- For large particle, possible rigid bronchoscopy
- Subsequent management depends on severity of symptoms, timing and cause of aspiration, and urgency of the procedure

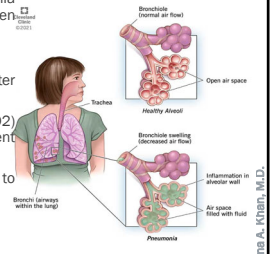


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ASPIRATION - DISPOSITION

- Morbidity: No observable sequelae to severe hypoxemia and ARDS. Death due to aspiration in healthy children is extremely rare.
- ✓ Children with no symptoms: Discharge two hours after suspected aspiration.
- ✓ Children with mild symptoms [oxygen saturation (SpO₂) >90 percent on nasal cannula]: Observe on a patient ward.
- ✓ Children who require mechanical ventilation: Admit to the intensive care unit.
- Recovery in severe cases may take days to weeks.

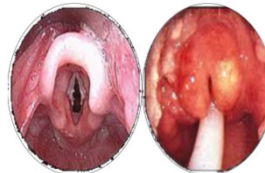


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EPIGLOTTITIS

- Extremely rare due to vaccination.
- Infectious:
 - Group A, beta hemolytic streptococci
 - Hemophilus influenza type B
- Non-Infectious:
 - Trauma from foreign objects, inhalational and chemical burns



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EPIGLOTTITIS - SIGNS & SYMPTOMS

- Life threatening airway emergency
- Acute onset of symptoms
- Generalized toxemia: high fever, severe sore throat, difficulty swallowing
- Inspiratory stridor=> late finding
- Classic Presentation:
 - Sitting up, leaning forward in sniffing position; Drooling
- X-ray findings: Enlarged, "thumbprint like" epiglottitis with edematous epiglottic folds



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EPIGLOTTITIS

NEED FOR AIRWAY INTERVENTION	NO NEED FOR AIRWAY INTERVENTION
Stridor	Voice change
Respiratory distress	Secretions
Tachycardia	Odynophagia/Dysphagia
Tachypnea	Fever
Rapid onset of symptoms	Age, sex
Shortness of breath	Major medical comorbidities

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EPIGLOTTITIS - MANAGEMENT

Minimize distress => No awake IV. Slow inhalational induction. Parental presence	ENT presence is mandatory
DO NOT force the child to lay supine for induction.	Use propofol or dexmedetomidine to maintain spontaneous ventilation Consider glycopyrrolate to minimize secretions.
No airway or radiologic exam if signs of impending respiratory obstruction	Obtain IV access and intubate
If patient is able to maintain airway => Airway manipulation in the OR	Intubation can be extremely challenging. After intubation=>ICU
Video laryngoscope, difficult airway cart, needle cricothyroidotomy, Tracheostomy kit.	NO racemic epinephrine



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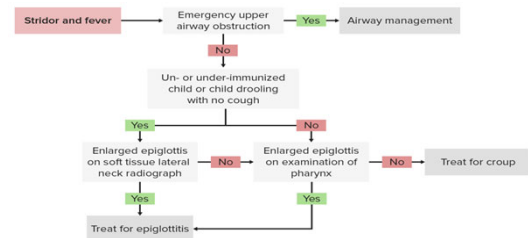
PERIOPERATIVE RISK FACTOR MANAGEMENT

Preoperative	Intraoperative	Postoperative
Preoperative Risk stratification	Propofol induction; Consider lidocaine	Deep or awake and timing of extubation
Experienced provider in medically complex patients	Minimizing NMBD use; Use of reversal agent if used	Appropriate respiratory monitoring
α2 adrenergic agonists>benzodiazepine	Face mask >LMA >ETT: risk-benefit assessment	PACU staff education
Albuterol for those at risk	Maintenance TIVA but if inhalational-sevo	Standardized handover protocols
	Lung-protective ventilation strategies	
	Careful titration of opioids; Use of opioid-sparing techniques	

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EPIGLOTTITIS VERSUS CROUP



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REFERENCES

- Egbuta C, Mason KP. Recognizing Risks and Optimizing Perioperative Care to Reduce Respiratory Complications in the Pediatric Patient. *Journal of Clinical Medicine*. 2020; 9(6):1942. <https://doi.org/10.3390/jcm9061942>
- Cui Y, Shao J, Sun H, Wang X, Zhu Z. Risk factor analysis of bronchospasm after tracheobronchial foreign body removal: Cases report and literature review (STROBE). *Medicine (Baltimore)*. 2020 Dec 24;99(52):e23170. doi: 10.1097/MD.00000000000023170. PMID: 33350722; PMCID: PMC7769373.
- Complications of pediatric airway management for anesthesia. (uptodate) Authors: Narasimhan Jagannathan, MD, MBANicholas Burjek, MD Section Editors:Carin A Hagberg, MD, FASALena S Sun, MDDeputy Editor:Marianna Crowley, MD
- Lichter JL, Roche Rodriguez M, Aaronson NL, Spock T, Goodman TR, Baum ED. Epiglottitis: It Hasn't Gone Away. *Anesthesiology*. 2016 Jun;124(6):1404-7. doi: 10.1097/ALN.0000000000001125. PMID: 27031010
- Hill J, Templeton TW, Sommerfield D, Sommerfield A, Matava CT, von Ungem-Sternberg BS. Risk assessment and optimization strategies to reduce perioperative respiratory adverse events in pediatric anesthesia-Part 1: patient and surgical factors. *Pediatric Anesthesia*. 2022 Feb;32(2):209-216. doi: 10.1111/pan.14977. Epub 2021 Dec 20. PMID: 34697906.

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