Difficult Airway for Pediatric Basics

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Learner Outcomes

1. Address components of the basic airway examination for the pediatric patient

2. Examine specific considerations of the pediatric airway and congenital conditions that alert the team to anticipate a difficult airway

3. Understand how traumatic injuries affect airway management

4. Identify critical elements for room set up (or other applicable environment), including medications and equipment, when preparing for a difficult airway

5. Inspect the *Difficult Airway Algorithm*

Disclaimer

- This presentation contains graphic photos of traumatic airways. Please notify someone, or excuse yourself if something is disturbing

- This is not the 100% complete lecture on difficult airways

Dogs can't operate MRI machines

But Catscan

Background

- Different numbers for each population of difficult airways
- Trauma patients: aspiration, cervical spine injuries, facial fractures and altered mental status
- Pediatric patients (specifically): Infection or genetic condition

Difficult airway

- Definition: A difficult airway is a clinical situation in which a healthcare provider who is skilled at airway management encounters difficulty with one or more standard methods of airway management.

- Expected

- Unexpected

- Anesthesiology definition

- More than 3 attempts

- More than 10 minutes

Be positive

- I like to think of a "Difficult Airway" as an "I know you can do it airway"!

Learner Outcome 1

Address components of the basic airway examination for the pediatric patient

Airway examination: Mallampati classification

The modified Mallampati classification for difficult laryngoscopy and intubation

Hard palate   Soft palate   Uvula   Pillar

Class I   Class II   Class III   Class IV
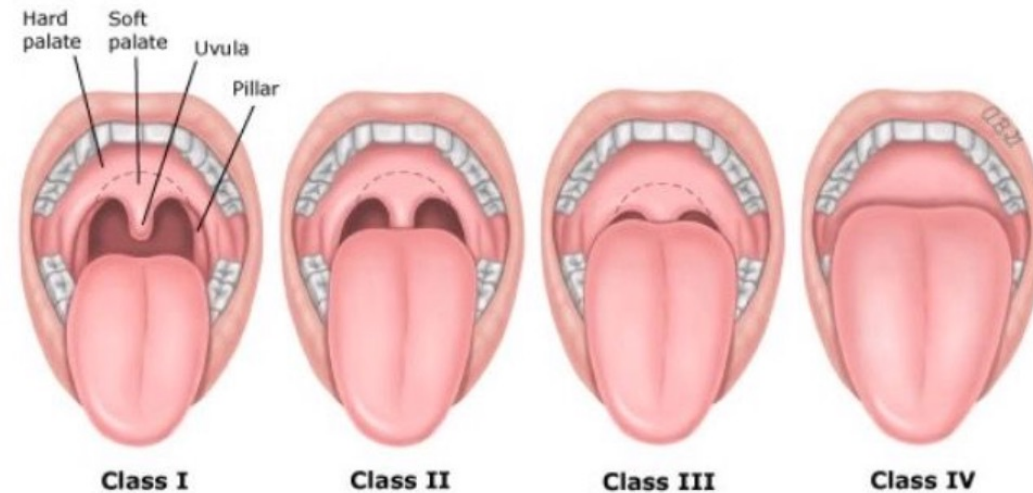
The modified Mallampati classification[1] is a simple scoring system that relates the amount of mouth opening to the size of the tongue, and provides an estimate of space available for oral intubation by direct laryngoscopy. According to the Mallampati scale, class I is present when the soft palate, uvula, and pillars are visible; class II when the soft palate and base of the uvula are visible; class III when only the soft palate is visible; and class IV when only the hard palate is visible.

Reference:
1. Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. Anaesthesia 1987; 42:487.

Airway Examination: Anthropometric lengths
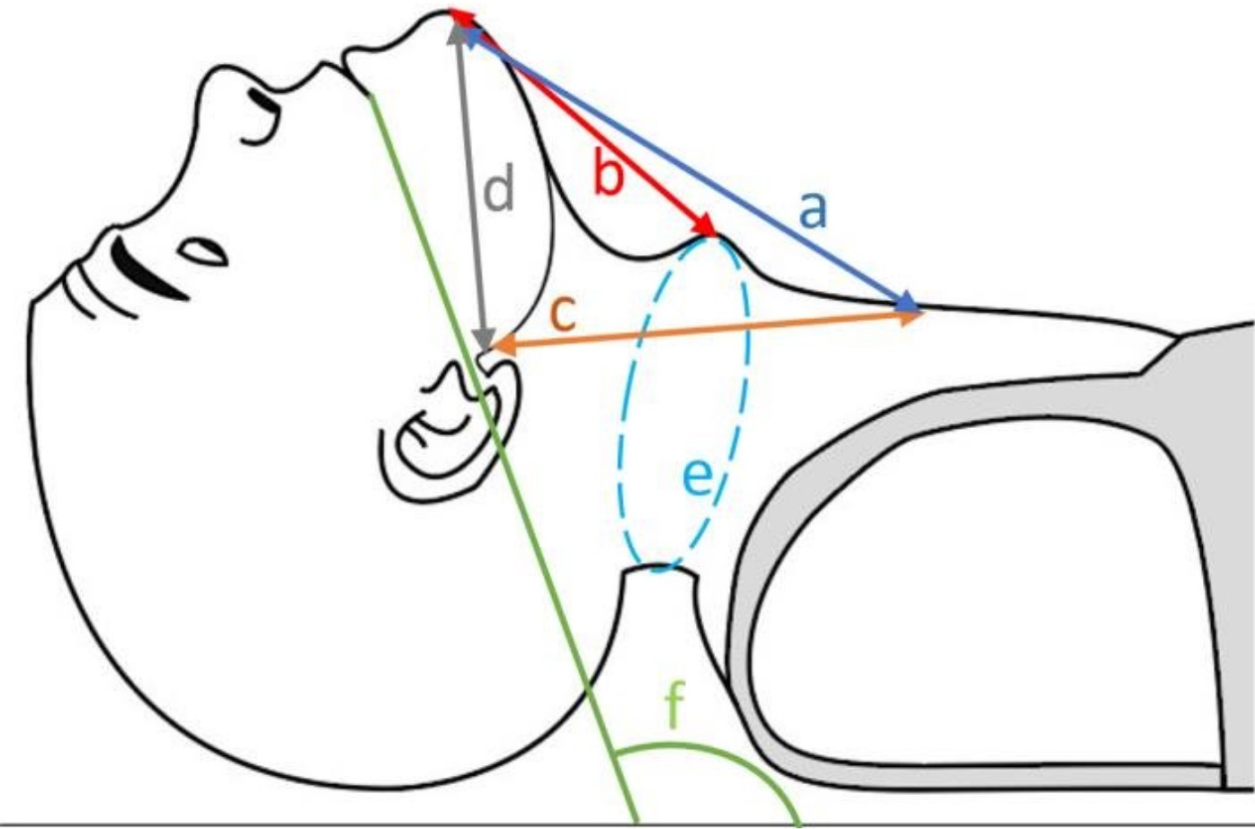
Anthropometric measurements. a. sternomental distance, b. thyromental distance, c. neck length, d. horizontal mandible length, e. neck circumference, f. atlanto-occipital joint movement
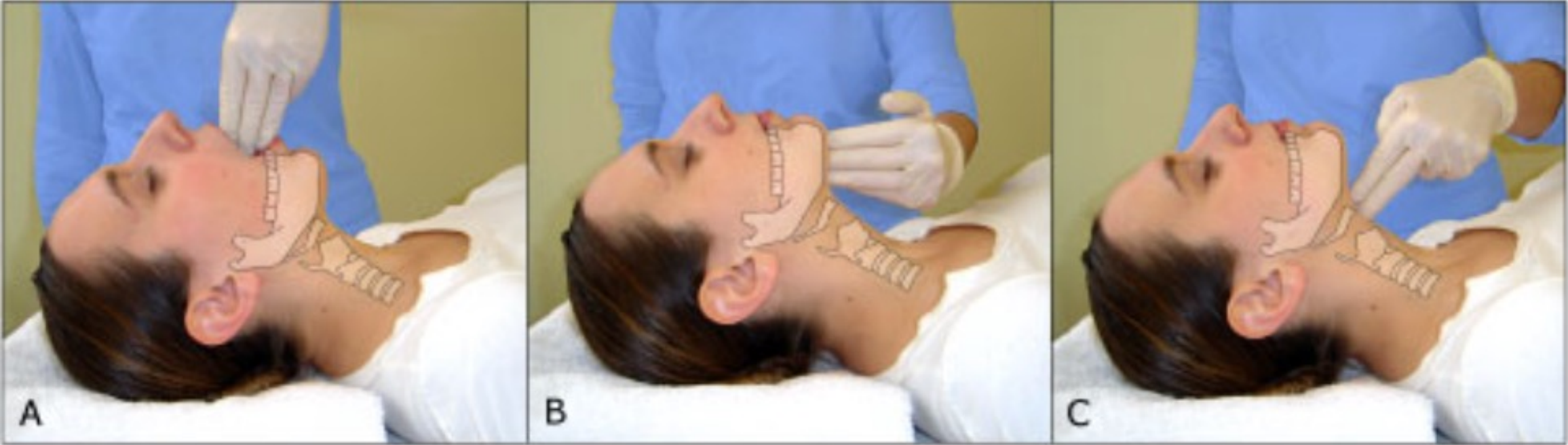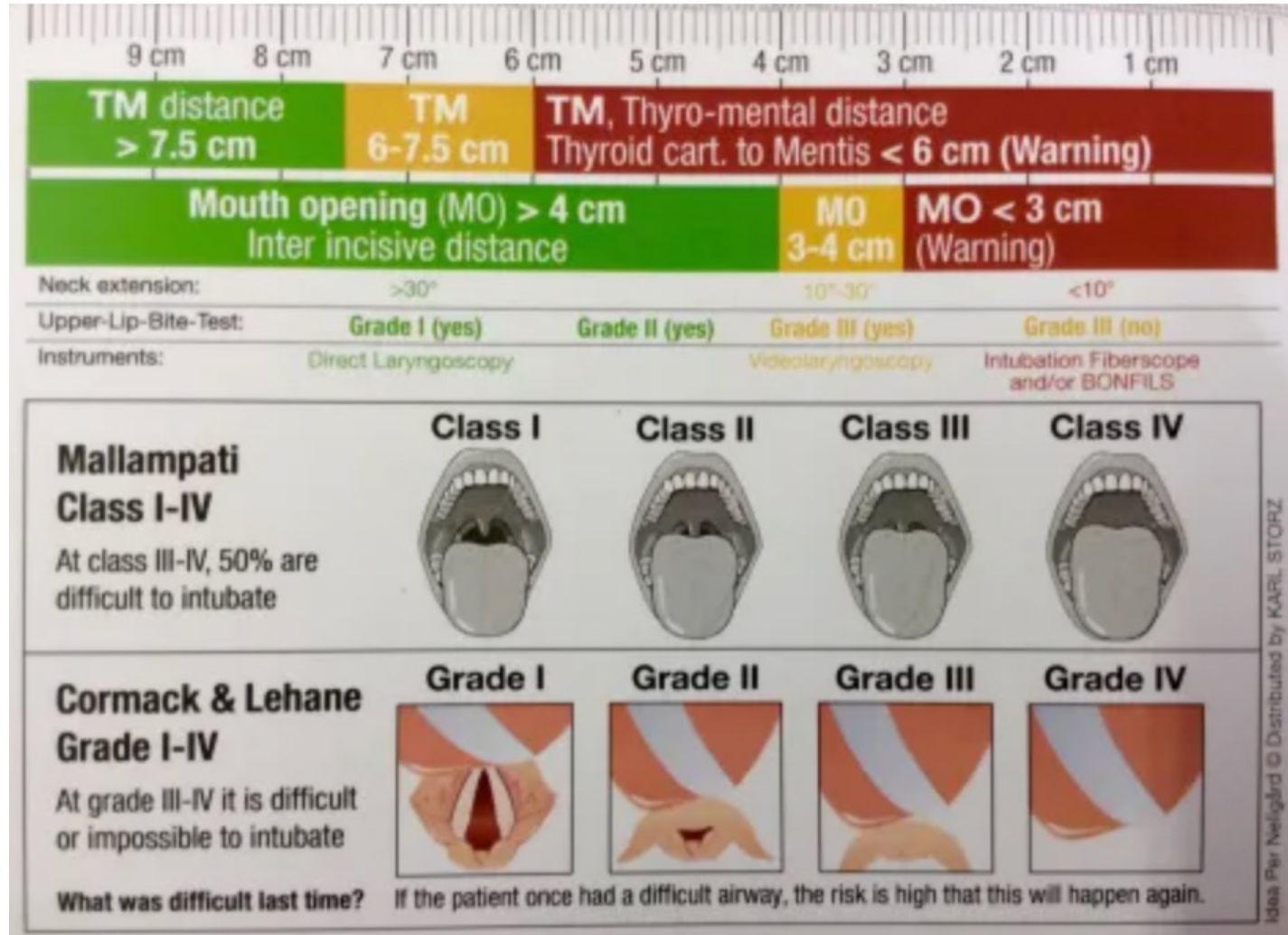
Airway Examination: Upper lip bite test

Airway Examination: facial hair/dentition

Airway Examination: Oral opening (3-3-2 rule)

# Airway Examination: Putting it all together

Learner Outcome 2

Examine specific considerations of:

the pediatric airway and congenital conditions that alert the provider to anticipate a difficult airway.

Pediatrics/Genetics

- Physiology

- 1.35% difficult mask or intubation

- Higher in neonates and infants, higher ASA status and higher MP score

- Parents/caregivers

Adult vs pediatric airway
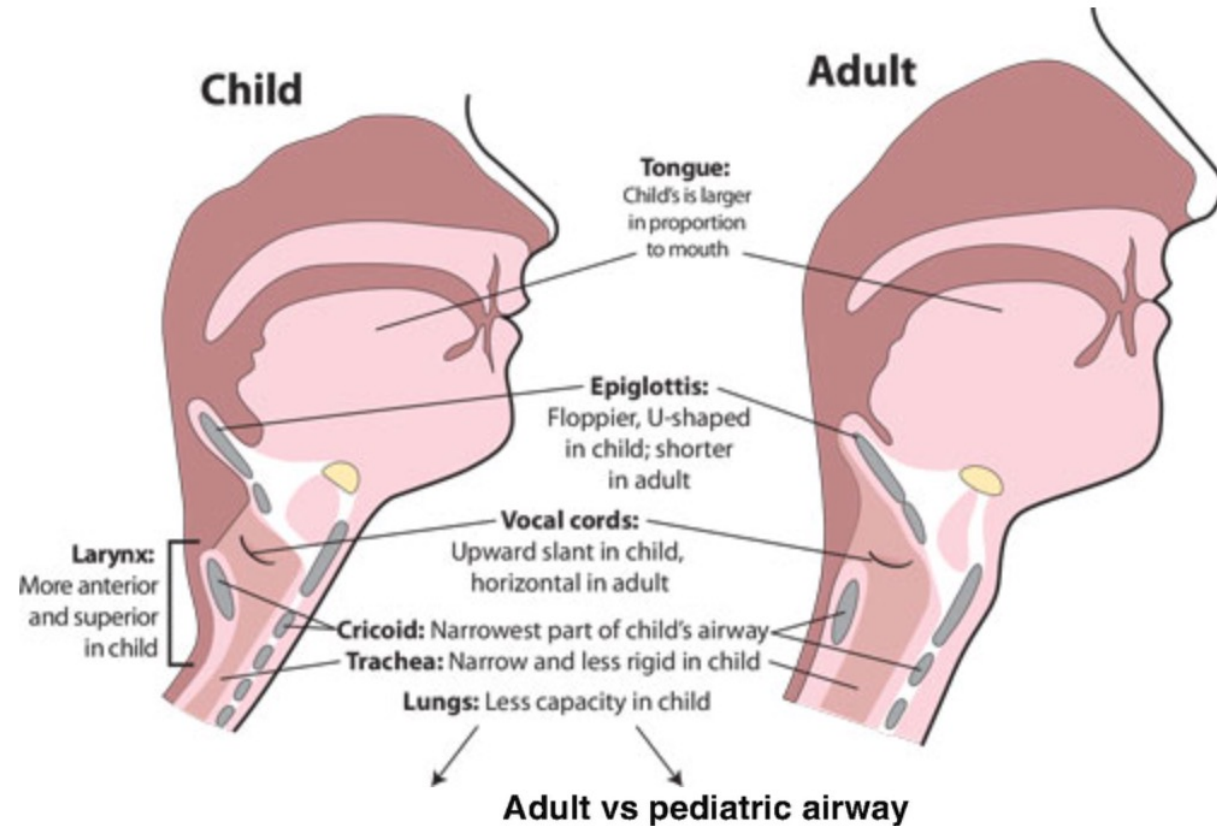
Pediatrics/Genetics

- Colorado Pediatric Airway Score (COPUR)

COPUR index assessing airway in paediatric patient

- **C**-chin   From the side view the chin is: **score**

Normal	1
Small, moderately hypoplastic	2
Markedly recessive	3
Extremely hypoplastic	4

- **O**-Opening of the mouth(Interdental space)

> 40mm	1
20-40 mm	2
10-20mm	3
<10	4

- **P**-Previous Intubation or OSA

Previous attempt easy	1
No previous attempt, no hx OSA	2
OSA, previous hx difficult intubation	3
Extremely difficult previous intubation	4

COPUR index

- **U**-Uvula (Mouth open tongue out)

Tip of uvula visible	1
Uvula partially visible	2
Uvula concealed, soft palate visible	3
Soft palate not visible	4

- **R** Range (estimate range of motion looking up and down)

>120°	1
60°-120°	2
30°-60°	3
< 30°	4

- **Prediction Points**
- 5-7 Easy normal intubation   **score >10 predict difficult airway**
- 8-10 laryngeal pressure may help
- 12   more difficult, fiberoptic may be less traumatic
- 14   Difficult intubation, fiberoptic or other advanced technique
- 16   Dangerous airway, consider awake intubation, potential trach

https://theanaestheticroom.com/2020/10/09/paediatric-airway-and-breathing-considerations/

Pediatrics/Genetics

Pediatrics/Genetics

Table 2 Difficult airway in congenital syndromes based on anatomical site

Anatomical site	Related syndromes
Nasopharynx	Mucopolysaccharidoses
Oral cavity/oropharynx	Trisomy 21
	Beckwith–Wiedemann syndrome
	Mucopolysaccharidoses
Mandible/maxilla	Pierre Robin sequence
	Treacher Collins syndrome
	Goldenhar syndrome
	Apert syndrome
Pharynx/larynx	Trisomy 21
Trachea	Trisomy 21
	Mucopolysaccharidoses
Cervical spine	Trisomy 21
	Klippel–Feil syndrome
	Goldenhar syndrome
	Mucopolysaccharidoses

Pediatrics/Genetics

Mucopolysaccharidoses

Adenotonsillar hypertrophy
Macroglossia
Flattened nasal bridge
Limited jaw mobility

Atlantoaxial instability
Spinal cord compression
Short neck
Limited neck mobility
Laryngeal distortion

Cardiomyopathy, valvular disease
(commonly mitral and/or aortic valve)

Tracheobronchomalacia
Distorted, tortuous, compressed trachea
Restrictive lung disease
Obstructive lung disease
Thick secretions

Short stature
Scoliosis
Pectus carinatum

MPS I – Obstructive Sleep Apnea

MPS II – macroglossia, vocal cord enlargement, narrow airway and OSA

MPS III – enlarged tonsils and adenoids as well as frequent upper respiratory infections

MPS IV – alanto-axial instability and odontoid hypoplasia

Pediatrics/Genetics

Trisomy 21

1: 600-800 live births

- short neck

- macroglossia (large tongue)

- hypoplastic mandible

- atlanto-axial instability

- subglottic and/or tracheal stenosis

- enlarged tonsils and adenoids/OSA

- Asystole

Pediatrics/Genetics

Pierre Robin Sequence

Pierre Robin Syndrome

Cleveland Clinic ©2021

High arched, cleft palate (roof of the mouth)

Large tongue obstructing the airway

Underdeveloped, small chin

- - - - Normal anatomy
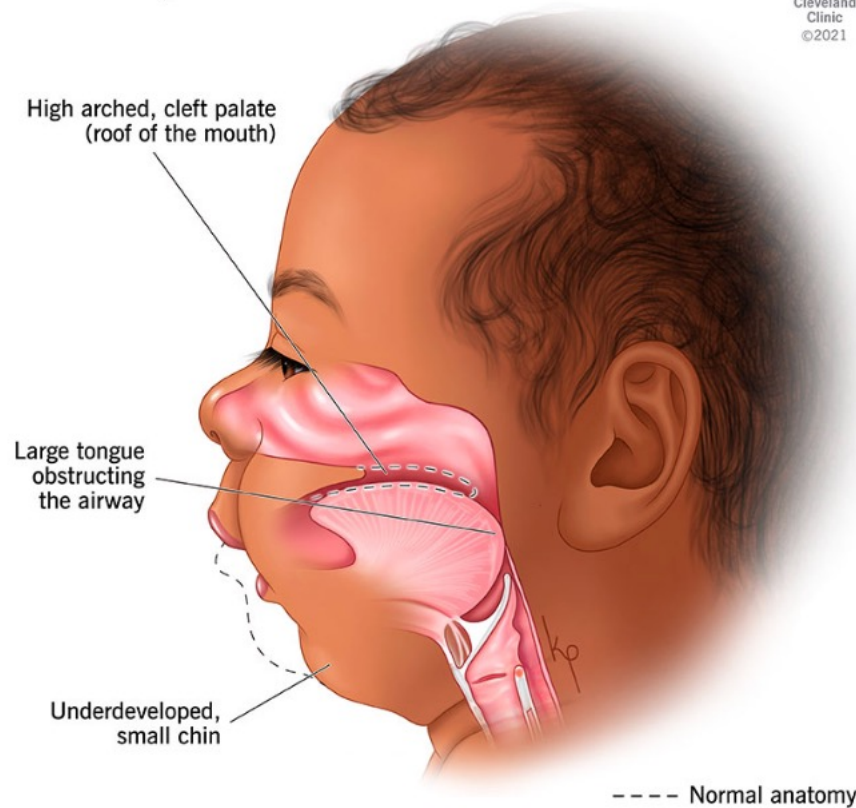
Rare: 1:8,500-14,000

Cleft Palate/arched palate

Large tongue

Displaced tongue

Small chin

Pediatrics/Genetics

Treacher Collins Syndrome

Rare: 1:20k even 1:50k

Difficult Mask ventilation

Airway obstruction – zygomatic arch malformation

Micrognathia

Pediatrics/Genetics

Goldenhar Syndrome

One-sided development

All or some structures are smaller or under formed

Soft palate

Nose

Mandible

Pediatrics/Genetics

Klippel- Feil Syndrome:

    - limited mouth opening and joint mobility

    - fused cervical vertebrae

Pfeiffer Syndrome:
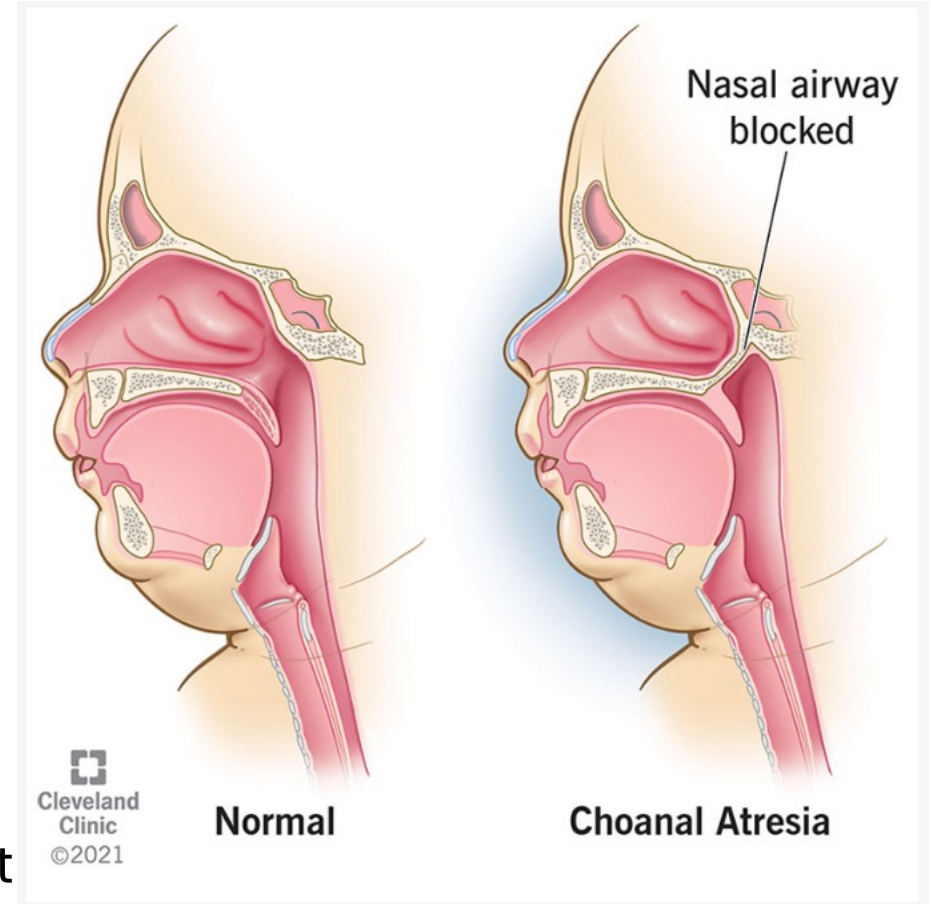
    - hypoplasia of midface

    - narrow nasopharynx

    - choanal atresia (blocked nasal passage)

Beckwith-Wiedman Syndrome:

    - macroglossia

Crouzon Syndrome:

    - midface and maxillary hypoplasia

    - short neck and restricted neck movement

Nasal airway blocked

Cleveland Clinic ©2021

Normal   Choanal Atresia

Pediatrics/Infection

- Retropharyngeal and peritonsillar abscesses: larynx

- Epiglottitis: supraglottic structures

- Croup and tracheitis: subglottic structures

RETROPHARYNGEAL + PERITONSILLAR ABSCESS
└ COLLECTION OF PUS

~ RETROPHARYNGEAL ABSCESS
└ BEHIND THE PHARYNX

~ PERITONSILLAR ABSCESS
└ AROUND THE TONSILS (PALATINE TONSILS)

https://www.osmosis.org/learn/Retropharyngeal_and_peritonsillar_abscesses

Learner Outcome 3

Understand how traumatic injuries affect airway management
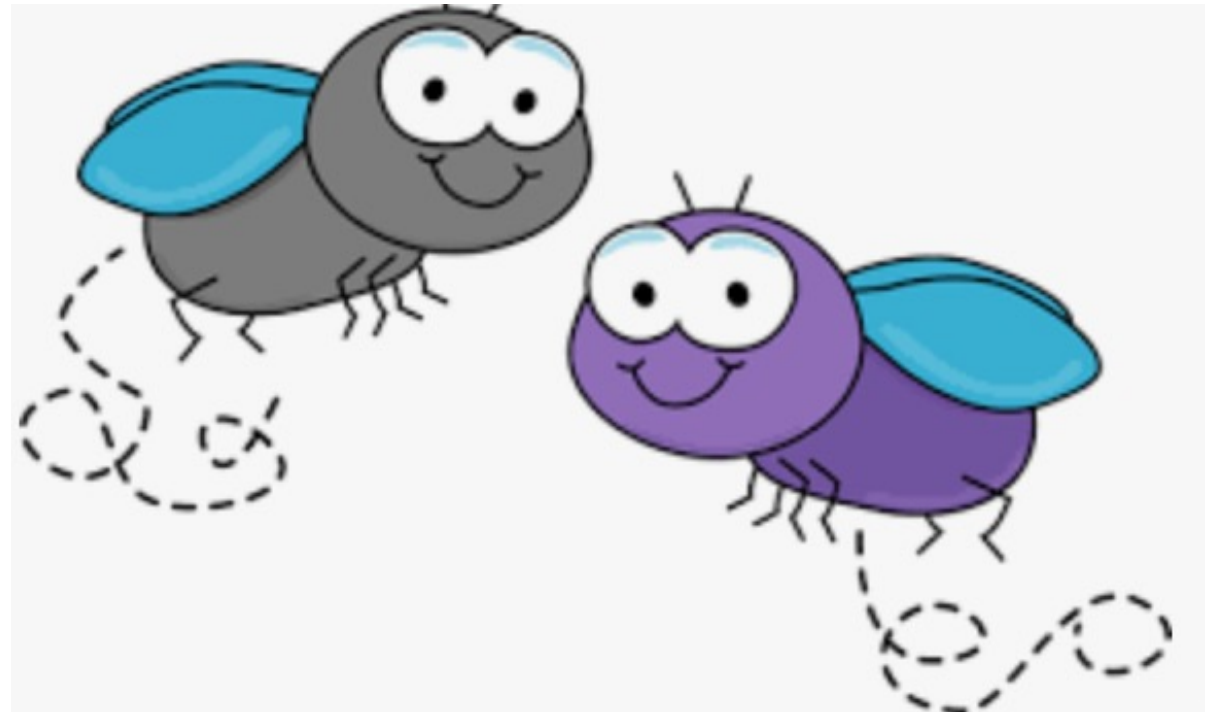
Learner Outcome 4

Understand how traumatic injuries affect airway management.
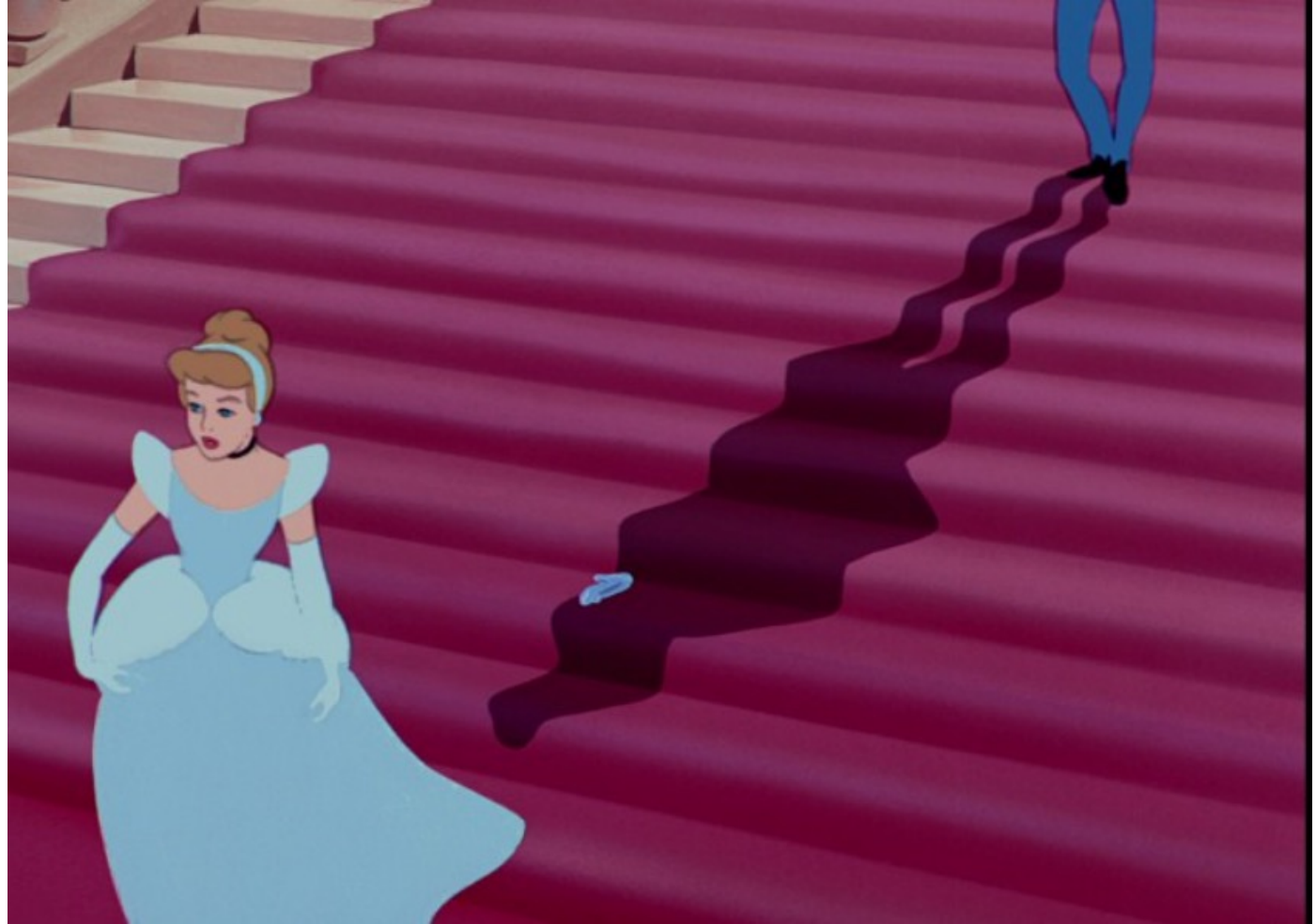
Trauma

Are there facial fractures?
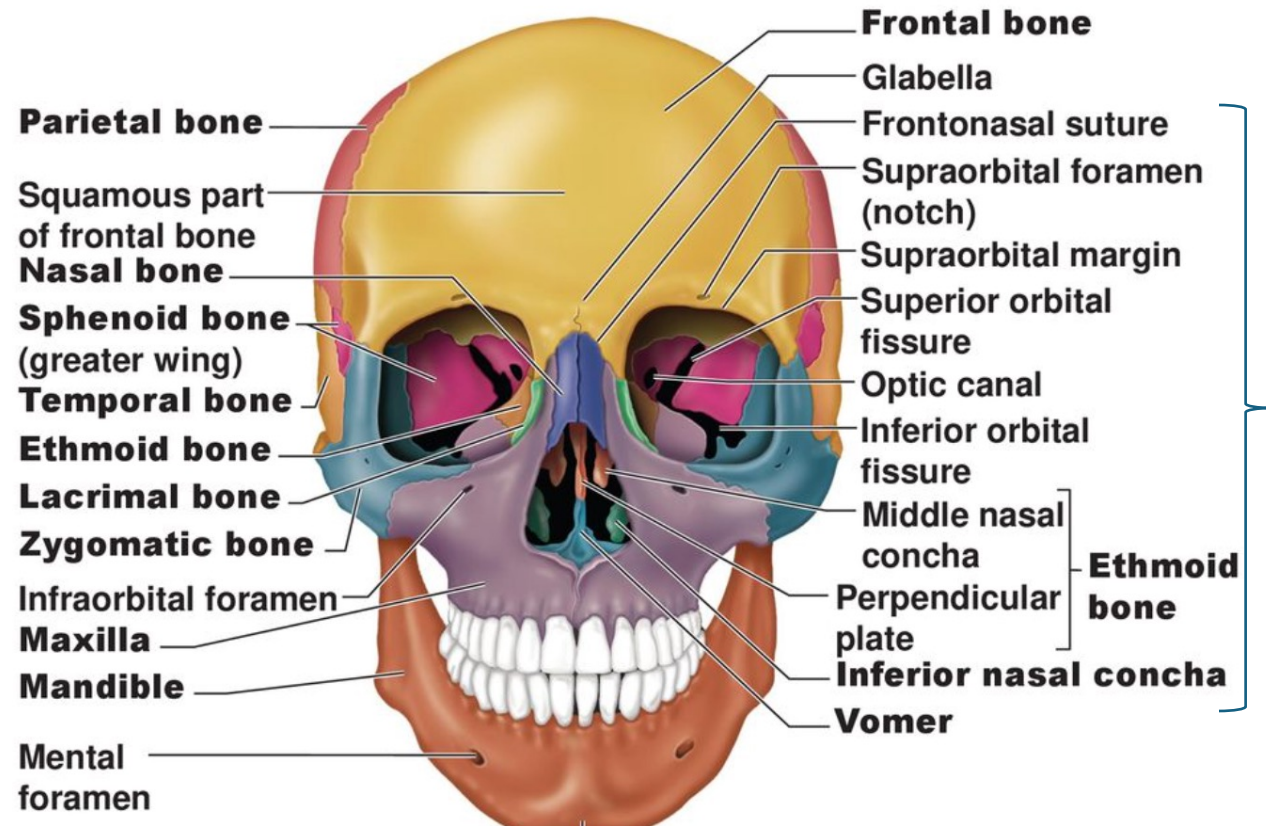
Trauma

Initial Key points

        Medication/induction agents

        RSI vs. Slow induction

        Slow sequence vs maintaining airway until transport to OR

        Injuries: facial fractures, burns, c-spine, caustic agents

        Know several approaches

Trauma

Compliance of patient

Communication with surgical team

Support

Trauma

Swelling

Secure

Support

Trauma

Difficult Mask Ventilation (ROMAN) [35]	Difficult Intubation (LEMON) [36]
R adiation (head and neck)/ *R* estriction (lung)	*L* ook externally
O besity/ *O* bstruction/ *O* bstructive sleep apnea	*E* valuate 3-3-2 rule [a]
M ask seal/ *M* allampati/ *M* ale	*M* allampati score
A ge >55	*O* bstruction/ *O* besity
N o teeth	*N* eck mobility

Trauma

Aspiration
- All are full stomachs
- Gastric contents
- Blood
- Foreign body

Hemodynamic instability
- Choose your medications wisely
- Etomidate vs Propofol
- Long acting vs Short acting
- Suggamadex
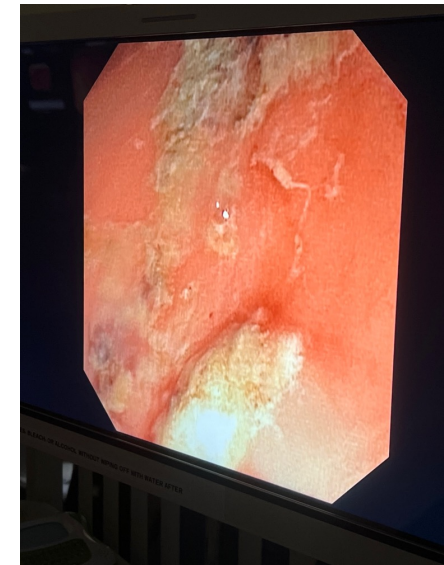
Trauma

Rapid Sequence Intubation:
Many helpers – organize and lead
Cricoid pressure
Pre-oxygenate with 100% oxygen and good mask seal

Trauma

1. Collar position

2. Ability of mask ventilate if failed RSI

3. Video scope

4. Document

Learner Outcome 4

Identify critical elements for:

room set up (or other applicable environment),

including medications and equipment,

when preparing for a difficult airway.

Room set up Equipment

- SALT
- Monitors x 4
- Drugs for induction
- Organization

The new Trauma bay at St. Michael's Hospital. Photo credit: Katie Cooper, Medical Media.

Room set up
Equipment

Room set up Equipment

COMPONENTS OF ADVANCED PEDIATRIC AIRWAY DESKTOP

Assortment of Nasal / Oral Airways

Allison

ETT Suction catheter

Non-Latex Gloves

Oxymetazolin Nasal Decongestant

Soft Gauze

R'pogle OG/NG Tube SurgiLube

Mastisol Adhesive

Tongue Depressor/ Bite Block

Air Q Intubating LMA* (*in case difficult airway is suspected)

Classic LMA

Tape Pink Silk Cloth

Assortment of Anesthesia Masks and Laryngoscope Blades

Viscous Lidocaine

Microcuff ETTs

Always have one size down than what is planned. For babies < 3Kg have uncuffed ETTs available

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SETUP SHOWN IS TO DEMONSTRATE ESSENTIAL SUPPLIES WHICH MUST BE AVAILABLE TO AVOID WASTAGE AND CONTAMINATION, PLEASE TRY TO KEEP SUPPLIES IN THEIR RESPECTIVE STERILE PACKS

Room set up Equipment

A classification of videolaryngoscopic devices. CTrach image courtesy of LMA North America. Pentax AWS image courtesy of Ambu USA. Airtraq image courtesy of Prodol Meditec S.A. Bonfils and C-MAC Â©2012 Photo Courtesy of KARL STORZ Endoscopy-America, Inc. GlideScope image courtesy of Verathon, USA. The McGrath series 5 image courtesy of Aircraft Medical, UK.

Room set up
Equipment

Room set up
Equipment

Room set up Equipment

Scott-Herring, M., Morosanu, L., Bates, J., & Bonjo, B. (2020). Cut to air. *American Association of Nurse Anesthesiology*.

Figure 2. Surgical Airway Setup

Left: Melker Cuffed Emergency Cricothyrotomy Catheter Set (Seldinger technique, Cook Medical). Center: Scalpel/size 6 Shiley tracheostomy tube (Covidien, now Medtronic). Right: Scalpel/bougie/6-mm endotracheal tube.

Room set up Medications

DRUG	DOSE	DRUG	DOSE
ANTIBIOTIC		**VASOACTIVE**	
Neonatal (< 5 kg) Antibiotic Dosing	Refer to pharmacist	Adenosine	0.1mg/kg (max 6mg) 1st dose
Ampicillin all indications	50 mg/kg max 2 gm		0.2mg/kg (max 12mg) 2nd dose
Ampicillin Sulbactam(Unasyn) < 40kg	2.6 mL/kg max 100ml (3gm)	Atropine for tx of bradycardia	0.02mg/kg (no less than 0.1 mg)
Ampicillin Sulbactam(Unasyn) >40kg	3 gm (100ml)	Ephedrine <15yo	0.1 mg/kg
CeFAZolin	30 mg/kg max 2 gm (3 gm if > 120kg)	Ephedrine >15yo	5-25 mg/dose
Cefepime	50 mg/kg max 2 gm	EPINEPHrine (resuscitation)	10 mcg/kg
Clindamycin	10 mg/kg max 900 mg	**Calcium Chloride** hypocalcemia	**10 -20 mg/kg** IV slowly
Gentamicin	2.5 mg/kg		***CaCl via large or central vein only**
Pipercillin Tazobactam (Zosyn) < 40kg	1.5 mL/kg max 50ml (3.375gm)	Calcium Gluconate	50-125 mg/kg per dose
Pipercillin Tazobactam (Zosyn) > 40kg	3.375 gm (50ml)	Phenylephrine	1mcg/kg per dose titrate
Vancomycin	15 mg/kg	**NEUROMUSCULAR BLOCK**	
INDUCTION/SEDATION		Cisatracurium	0.1-0.15 mg/kg
Etomidate	0.3 mg/kg	Rocuronium intubation 0.45-0.6 mg/kg	RSI 0.9-1.2 mg/kg
Ketamine IM	3-7 mg/kg	Rocuronium maintenance of relaxant	0.075-0.15mg/kg
Ketamine IV	1-2 mg/kg	Vecuronium	intubation 0.1 mg/kg
Ketamine PO	3-6 mg/kg	Vecuronium maintenance of relaxant	0.01-0.015mg/kg
Ketamine intranasal	3-6 mg/kg	Succinylcholine IM	4 mg/kg
Propofol Induction	2.5-3.5 mg/kg	Succinylcholine IV	2mg/kg
Propofol IV gtt	125-300 mcg/kg/min titrated	**MISCELLANEOUS**	
Dexmedetomidine load	0.5-1 mcg/kg over 5-10 min * bradycardia	Aminocaproic acid < 40kg	Load: 100 mg/kg over 30 min
Dexmedetomidine intranasal	0.5-3 mcg/kg	Aminocaproic acid < 40kg	IV gtt: per service protocol
Dexmedetomidine IV gtt	0.2-1 mcg/kg/hr titrated	Amincoaproic acid > 40 kg	Load: max 5 gms over 30 min
NARCOTIC		Aminocaproic acid > 40kg	IV gtt: per service protocol
Fentanyl IV	1-2 mcg/kg	Dexamethasone (airway)	0.5 mg/kg max 10 mg
Fentanyl intranasal	1.5 mcg/kg	Dexamethasone (anti-emetic)	0.1-0.15 mg/kg max 10 mg
HYDROmorphone	10-15 mcg/kg	Diphenhydramine	1.0-1.25 mg/kg max 50 mg
Remifentanil IV gtt	0.05- 1.3 mcg/kg/min	Flumazenil	0.01 mg/kg max dose 0.2mg
SUFentanil IV gtt	0.3-0.9 mcg/kg/hr	Glycopyrrolate (reversal of NMB)	0.2mg for each 1mg of neostigmine
ANALGESICS/Anxiolytics		Lasix	1 mg/kg
Acetaminophen PO	10-15 mg/kg/dose q6 hrs	Mannitol	0.25-1 gm/kg
Acetaminophen Rectal	20-40 mg/kg PR x1 loading	Metoclopramide	0.1mg/kg max 10 mg
Acetaminophen < 23mo	Call Pharmacy	Naloxone (full reversal)	0.1 mg/kg max 2 mg
Acetaminophen IV < 50kg	10-15 mg/kg max dose 750mg	Neostigmine	0.03-0.07 mg/kg max 5 mg
Acetaminophen IV > 50kg	650 mg q4h max single dose 1000mg	Sugammadex (routine use)	2mg/kg
Acetaminophen	max 4 grams daily ≤ 5 doses/24hrs	Sugammadex (1-2 post-tetanic twitches)	4 mg/kg
Ketorolac IM	0.5-1 mg/kg IM max 30mg	Sugammadex (emergency)	16 mg/kg
Ketorolac IV	0.5 mg/kg max 30mg	Ondansetron	0.1-0.15 mg/kg max 4 mg
Midazolam IN	0.2-0.3 mg/kg max dose 10mg	Ryanodex	2.5 mg/kg
Midazolam IV	0.05-0.1 mg/kg	Tranexamic acid max 2 gm	Load: 100 mg/kg over 20 min
Midazolam PO	0.5-1 mg/kg max 20mg	Tranexamic acid	IV gtt: per service protocol
LOCAL ANESTHETIC **Refer to local anesthetic drug card		**PHARMACY- 64564 or 20708 or OR black work phone under: pharmacy**	

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Lexi Comp on-line 2017

Pediatric Advanced Life Support Provider Manual

Cote, Lerman, & Todres (2009). A practice of Anesthesia for Infants and Children (4th ed.).

Rev. 9/14/17

Learner Outcome 6

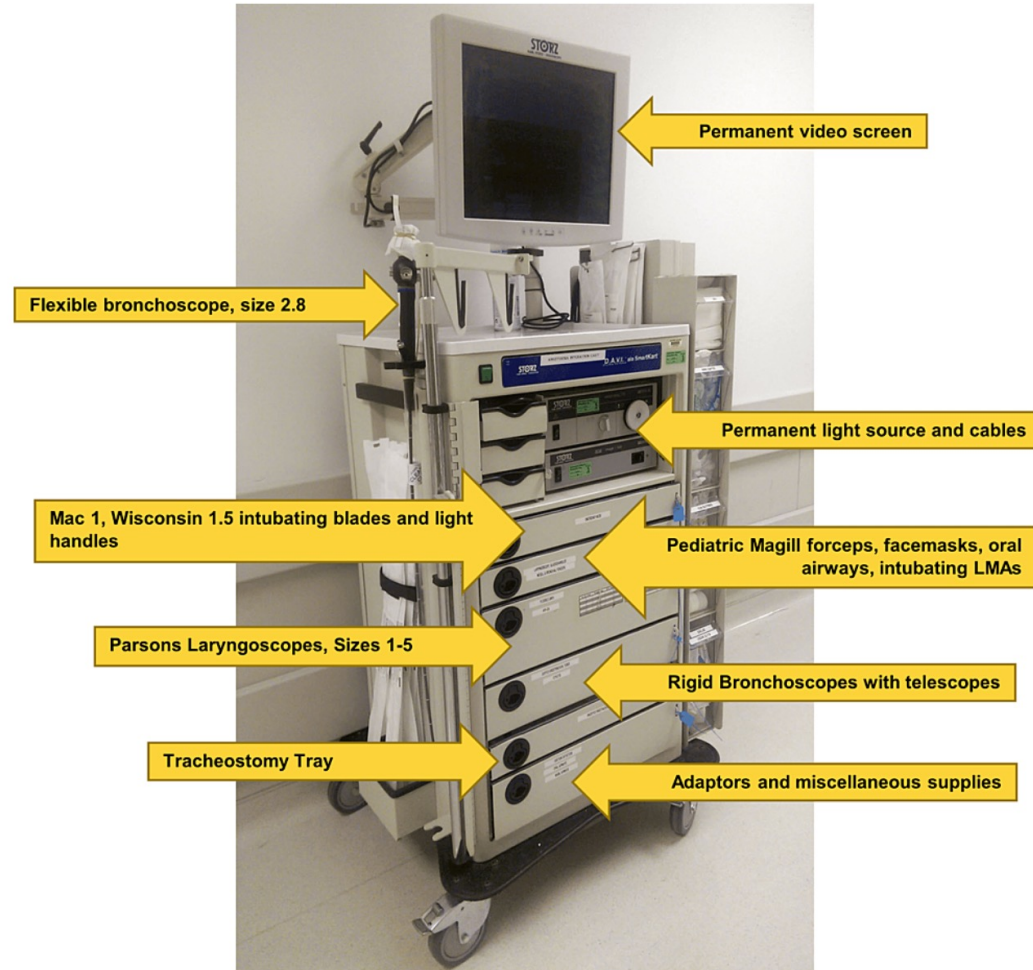*Inspect the Difficult Airway Algorithm*

Lets Intubate!

Figure 1: Suggested configuration of pediatric emergency airway cart. Includes addition of an onboard video tower, Macintosh 1 direct laryngoscope, a flexible bronchoscope, a needle cricothyrotomy kit, and pediatric sizes of equipment already present on existing carts
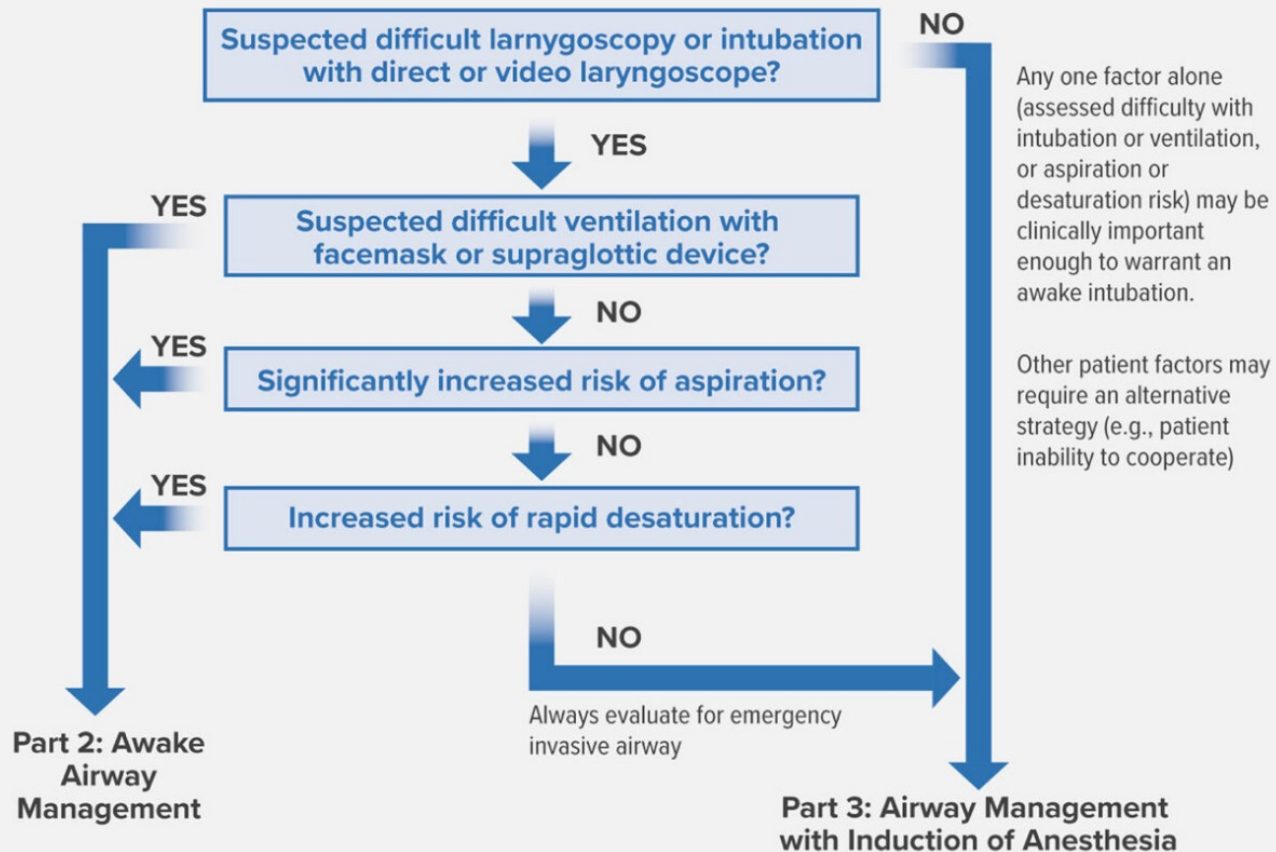
LMA: laryngeal mask airway.

Difficult Airway Algorithm

- Updated in 2022
- International Panel
- Changes:
    - Includes pediatric patients
    - O2 delivery and Co2 confirmation
    - preinduction decision chart was included
    - new infographics for easier visualization
    - airway devices and new technologies were included
    - Extubation with a plan for reintubation added
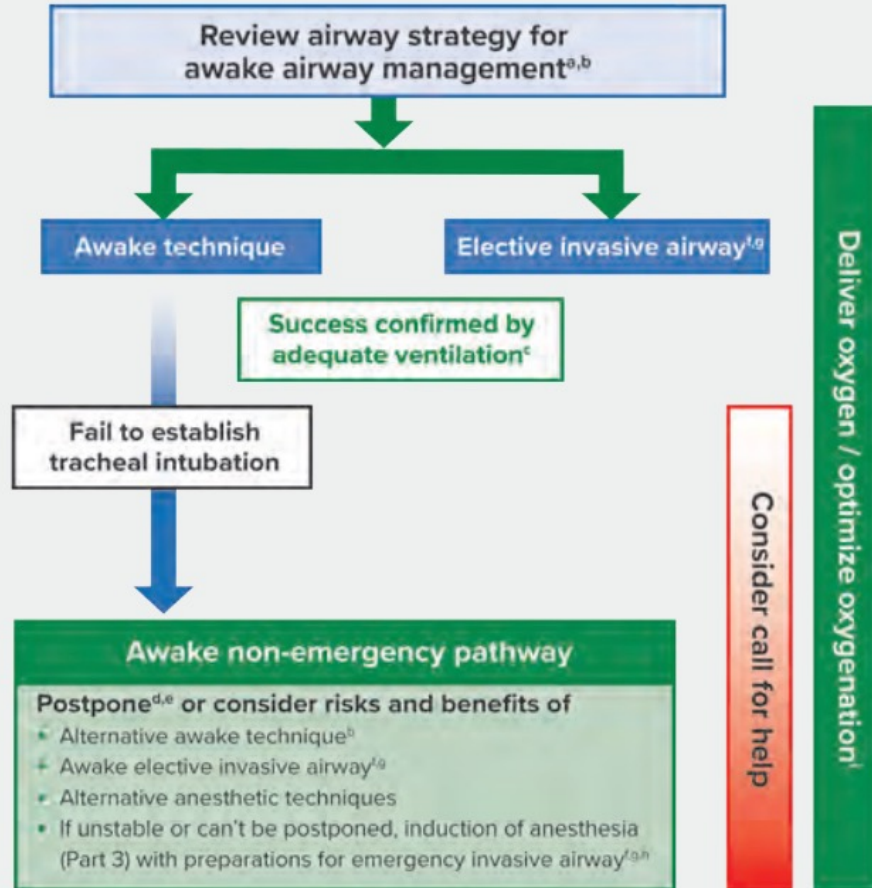
Difficult Airway Algorithm

Part 1: Pre-Airway Management Decision-Making Tool (planning)

This tool can be used to choose between the awake or post-induction airway strategy. Each assessment should be made by the clinician managing the airway, using their techniques of choice.[a]

Suspected difficult larnygoscopy or intubation with direct or video laryngoscope?

NO → Any one factor alone (assessed difficulty with intubation or ventilation, or aspiration or desaturation risk) may be clinically important enough to warrant an awake intubation.

Other patient factors may require an alternative strategy (e.g., patient inability to cooperate)

YES ↓

Suspected difficult ventilation with facemask or supraglottic device?

NO ↓

Significantly increased risk of aspiration?

NO ↓

Increased risk of rapid desaturation?

NO → Always evaluate for emergency invasive airway

YES → Part 2: Awake Airway Management

Part 3: Airway Management with Induction of Anesthesia

Difficult Airway Algorithm

Part 2: Awake Airway Management

Review airway strategy for awake airway management[a,b]

Awake technique

Elective invasive airway[f,g]

Success confirmed by adequate ventilation[c]

Fail to establish tracheal intubation

Awake non-emergency pathway

Postpone[d,e] or consider risks and benefits of
- Alternative awake technique[b]
- Awake elective invasive airway[f,g]
- Alternative anesthetic techniques
- If unstable or can't be postponed, induction of anesthesia (Part 3) with preparations for emergency invasive airway[f,g,h]

Consider call for help

Deliver oxygen / optimize oxygenation[i]

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See footnotes a-m on next page.

Difficult Airway Algorithm

Part 3: Airway Management with Induction of Anesthesia
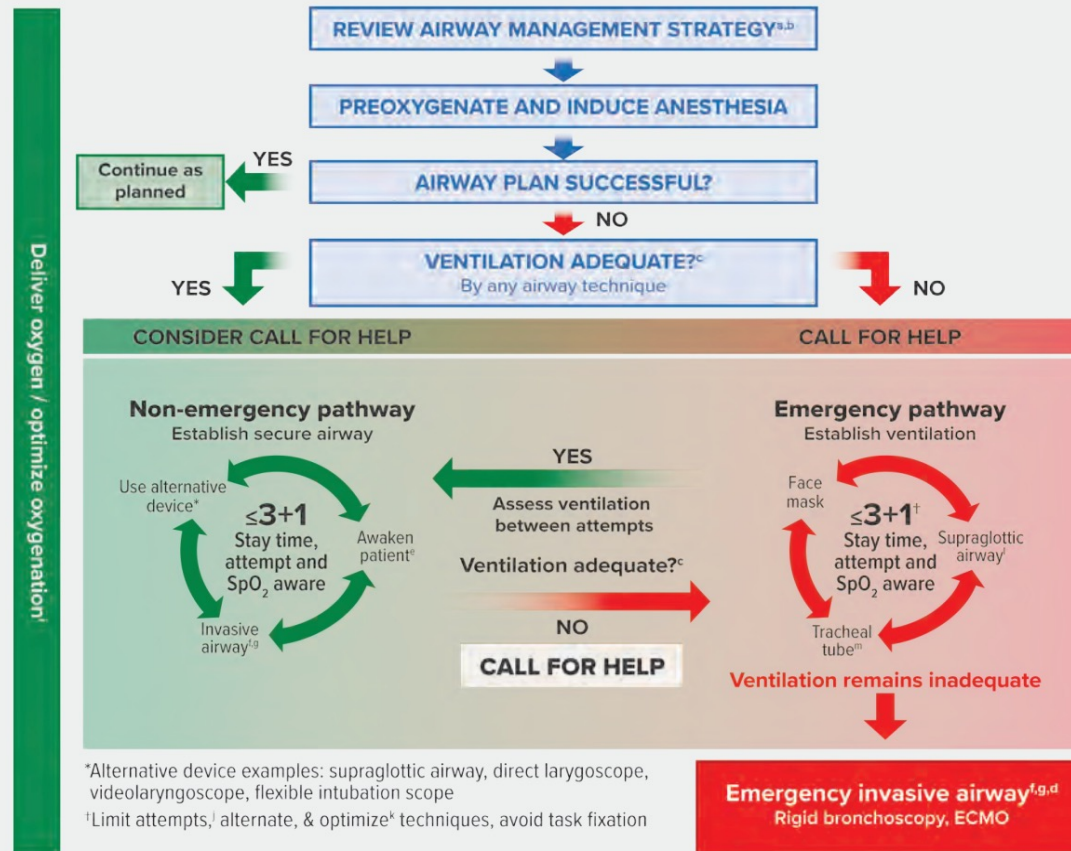
Reproduced and modified with permission (Wolters Kluwer Health, Inc.). Apfelbaum JL, et al. 2022 American Society of Anesthesiologists practice guidelines for management of the difficult airway. *Anesthesiology.* 2022;136:31–81.

Airway Management Pearls

Major Components of Airway Management

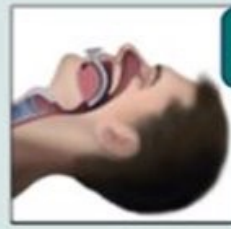1. Head-tilt chin-lift
2. Jaw-thrust maneuver
3. Cervical spine immobilization
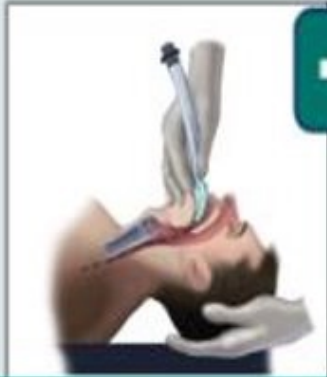4. Cricoid pressure (Sellick's maneuver)
5. One or two person bag-mask ventilation with an adequate mask seal
6. Appropriate sizing and placement of an oral pharyngeal airway
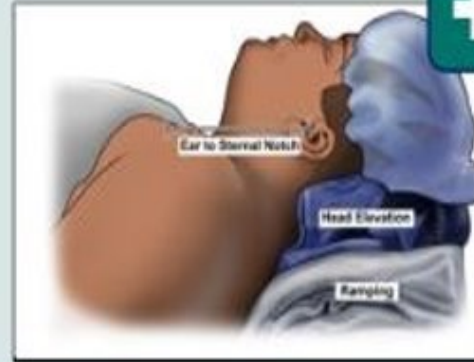
Airway Management Pearls

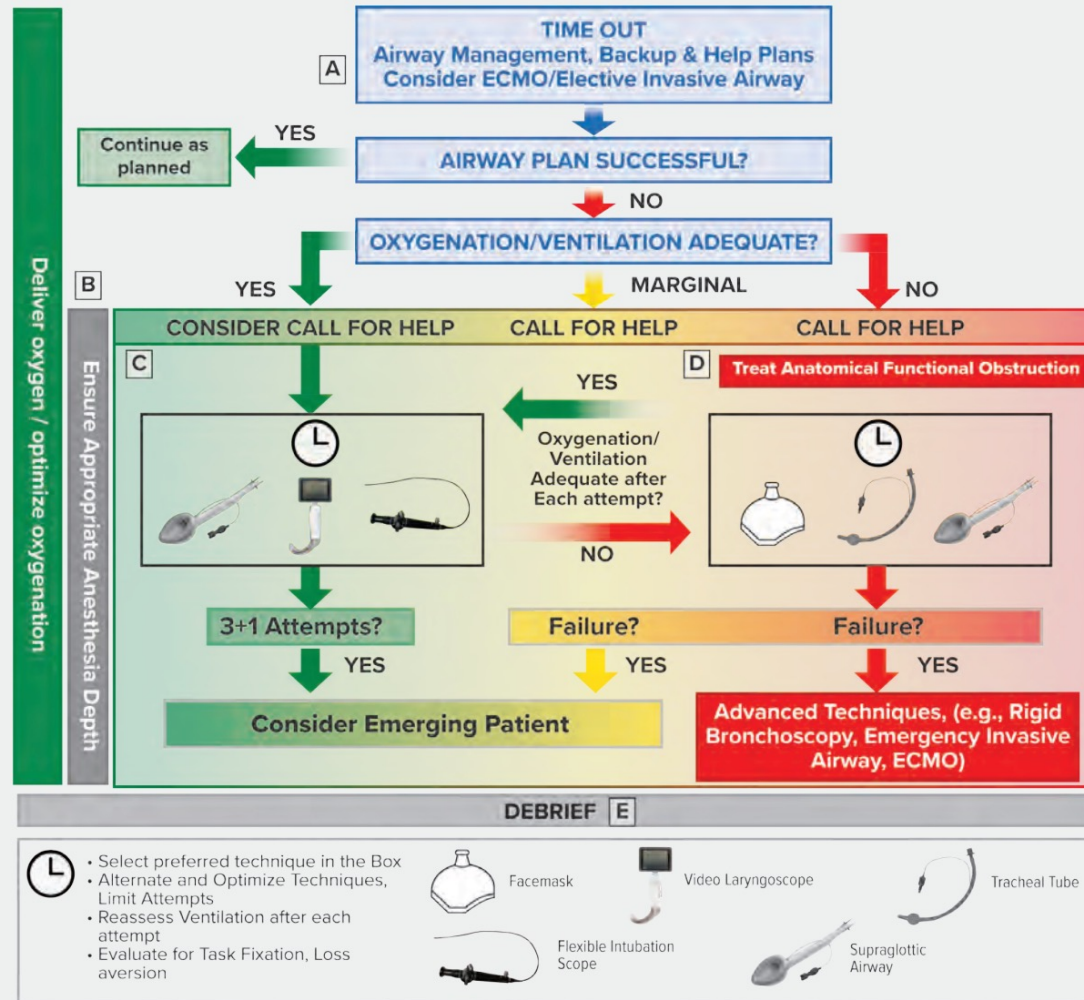7. Appropriate placement of a supraglottic device (e.g., LMA)

8. Recognition of inadequate ventilation

9. Ramping: Shoulders and head elevated

Difficult Airway Algorithm

Difficult Airway Infographic: *Pediatric Patients*

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