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Outreach Education Follow-up Initiative
Pediatric Critical Care

StEP
Stabilization Essentials in Pediatrics

Respiratory Failure: Assessment and Management

October 2025

Objectives

- Discuss differences in respiratory anatomy/physiology in children
- Recognize clinical signs of acute respiratory failure
- Understand the pathophysiology of obstructive vs restrictive lung disease and how it guides management

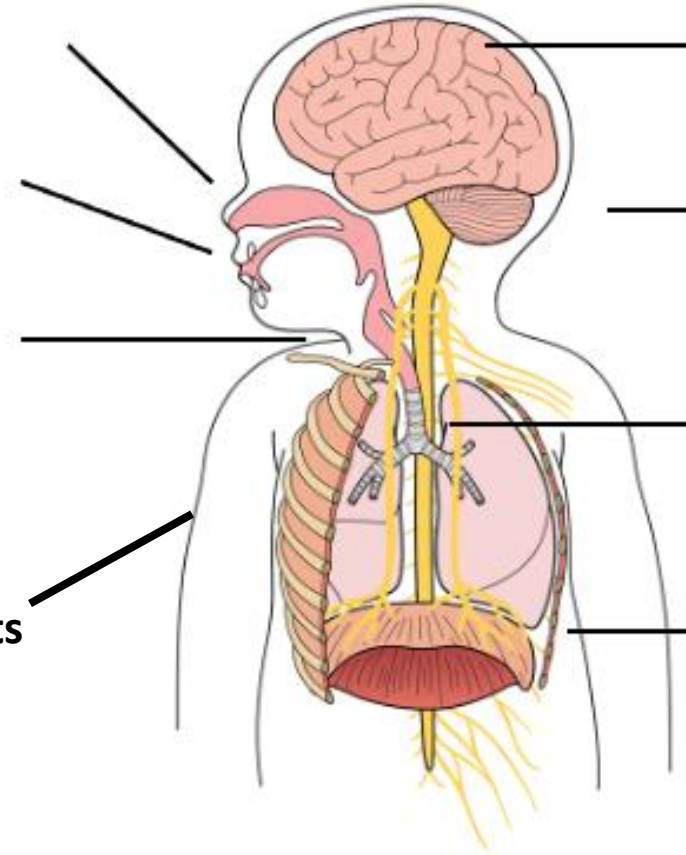
Respiratory Anatomy/Physiology

Nose breather

Large tongue, small oropharynx

High/anterior larynx
Large floppy epiglottis
Short compressible trachea

Higher Metabolic Requirements

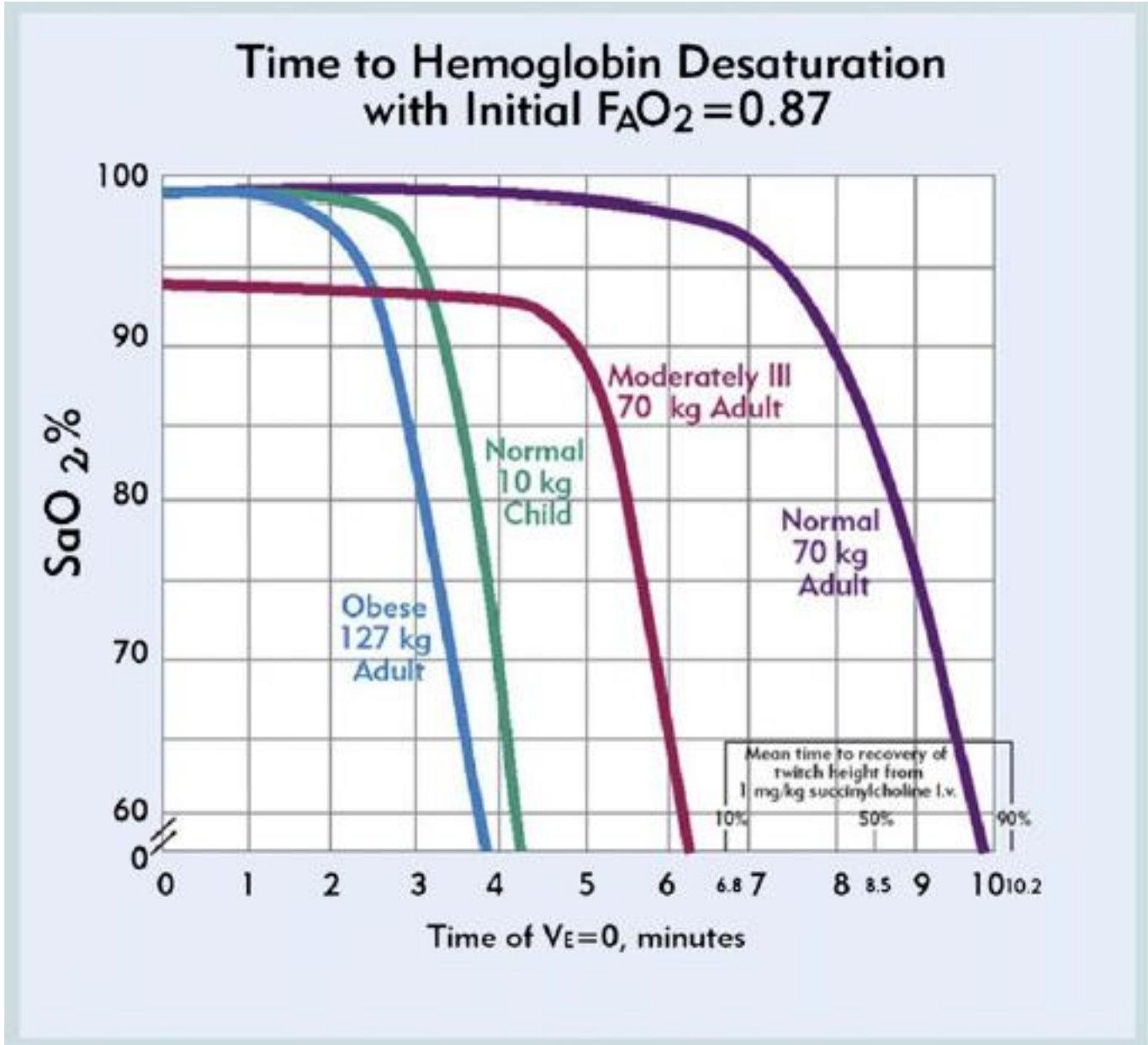


Immature control of breathing

Large head, short neck, prominent occiput

Small airways with less cartilaginous support

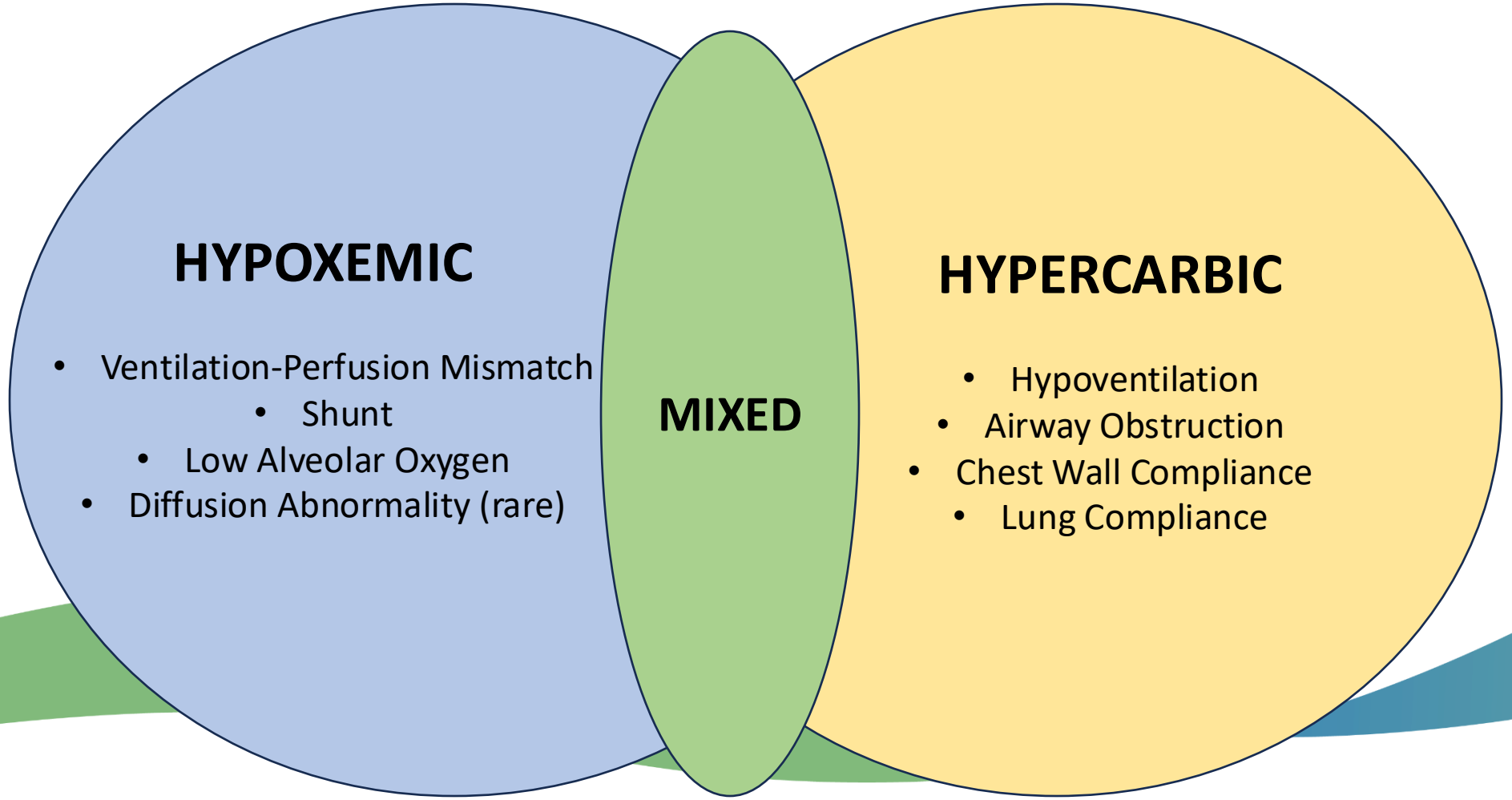
Inefficient respiratory mechanics:
Horizontal ribs
Flat diaphragm
Under-developed accessory muscles
Compliance chest>>> lungs



StEP Stabilization Essentials in Pediatrics

Infants and children have limited respiratory reserve and decompensate rapidly in the face of respiratory compromise

Types of Respiratory Failure



Normal Vital Signs

BC PEWS Vital Signs Reference Card

Age	Heart Rate Beats per minute	Respiratory Rate Breaths per minute	Systolic / Diastolic BP	MAP mmHg
0 – 28 days*	104 – 162	31 – 60	60 – 80 / 30 – 53	40 or higher
1 – 3 months*	104 – 162	31 – 60	73 – 105 / 36 – 68	48 or higher
4 – 11 months*	109 – 159	29 – 53	82 – 105 / 46 – 68	58 – 80
1 – 3 years†	89 – 139	25 – 39	85 – 109 / 37 – 67	53 – 81
4 – 6 years†	71 – 128	17 – 31	91 – 114 / 50 – 74	63 – 87
7 – 11 years†	60 – 114	15 – 28	96 – 121 / 57 – 80	70 – 94
12 plus years†	50 – 104	12 – 25	105 – 136 / 62 – 87	76 – 103
Temperature °C	**Oral:** 35.5 – 37.5, **Axilla:** 36.5 – 37.5, **Rectal:** 36.6 – 38.0, **Temporal:** 36.3 – 37.8			

HR and RR ranges: CTAS 2013
Temperature ranges: CPS 2015
BP ranges: *Modified from American Heart Association (2012). *Pediatric emergency assessment, recognition, and stabilization (PEARS) provider manual.*† National Heart, Lung and Blood Pressure Institute (2004). The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics, 114(2)*, 555-556.

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StEP Stabilization Essentials in Pediatrics

Signs of Respiratory Distress

- **Tachypnea and tachycardia**
- "noisy breathing"
- Work of breathing
  - Nasal flaring = ↑ nasal airways
  - Retractions = accessory muscle use = ↑ tidal volume
  - Grunting = auto-PEEP
  - See-saw = active exhalation (abdominal muscles)
  - Head bobbing

FREQUENT REASSESSMENTS IS KEY

StEP Stabilization Essentials in Pediatrics

StEP Stabilization Essentials in Pediatrics

Signs of impending Respiratory Failure

- Progressive increase in RR and HR despite interventions
- Severe work of breathing
- Decreased/absent work of breathing, decreased respiratory rate

- Altered mental state: agitation/confusion then lethargy
- ↓ heart rate and blood pressure (LATE)
- Cyanosis*

Case #1

2 year old, fully immunized boy presented to ED with saturation in low 80s. Started on O2 via non-rebreather mask at 10L/min. Given epinephrine neb and dexamethasone. Has now received 4 doses of epinephrine with only temporary improvement. Moderate to severe work of breathing when upset. Stridor at rest goes away post epinephrine neb for 15-30 min. Does not look toxic.

- VS: Sat 97-97%, RR 45, HR 150, BP 80/35 T38.1
- Normal CXR and lateral neck x-ray

Worried?
Dx?
Immediate management?

Upper Airway Obstruction

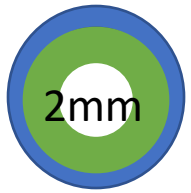
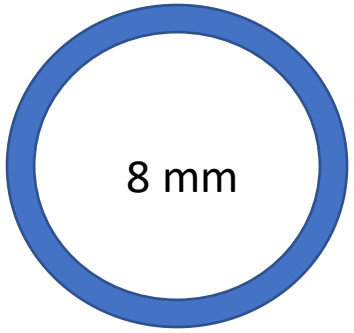
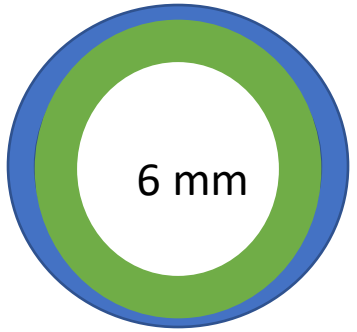
- Location: supraglottic, glottic, subglottic
- Can be fixed or variable which will affect type of flow limitation
- Age related airway dynamics
  - Smaller airways
  - Less cartilaginous support (more prone to collapse)

Acute upper airway obstruction - DDx

- Croup
- Anaphylaxis
- Inhaled foreign body
- Retropharyngeal or peritonsillar abscess
- Epiglottitis
- Bacterial tracheitis
- Trauma, burns
- Decreased level of consciousness

Resistance

$$\frac{8 \times \text{length} \times \text{viscosity}}{\pi \times (\text{radius})^4}$$

	Normal	Edema (1mm)	Area/resistance
Infants			↓75% / ↑ 16x
Adults			↓44% / ↑ 3x

PEDIATRIC CROUP MANAGEMENT ALGORITHM

Provincial Health Services Authority | CHILD HEALTH BC | BC Children's Hospital

⚠ Minimize unnecessary interventions, including examination of the throat, as distress can worsen respiratory compromise. Keep child with caregiver (e.g., on their lap) to reduce anxiety and support comfort. Children often assume positions that help relieve airway obstruction — these should not be altered. Assessment and management should be child-centered, tailor strategies to support children with neurodiversity.

💡 Diagnosis of croup is based on clinical assessment. X-rays and blood tests are not routinely indicated. Consider alternative diagnosis (e.g., tracheitis, epiglottitis, abscess, foreign body) if the child has significant drooling or does not improve with treatment. Chest/soft tissue lateral neck x-ray may be useful to evaluate alternative causes of upper airway obstruction but should only be done **once the child is stabilized.**

MILD

- Occasional barking cough
- No stridor at rest
- Minimal to no indrawing at rest

↓

Administer **dexamethasone** 0.6 mg/kg/dose (max 16 mg/dose) PO (preferred), IM/IV if necessary

Consider analgesic/ antipyretic PRN

May discharge home without further observation

Tip: To improve palatability, mix **dexamethasone** with a small amount of drink or flavored syrup or, provide sips of juice or a popsicle after

MODERATE

- Frequent barking cough
- Intermittent inspiratory stridor at rest
- Mild to moderate indrawing at rest
- No agitation
- No oxygen desaturation

↓

RRT consult (if available)

Administer **dexamethasone** 0.6 mg/kg/dose (max 16 mg/dose) PO (preferred), IM/IV if necessary

Consider administration of one dose of nebulized **epinephrine** 5 mg [1 mg/mL solution]. If persistent stridor/respiratory distress post **epinephrine**, treat as SEVERE

Consider analgesic/antipyretic PRN

Observe for a minimum of 2-4 hours

SEVERE

- Frequent barking cough
- Stridor (often biphasic)
- Severe chest wall indrawing
- Agitation or lethargy

↓

RRT consult (if available)

Administer **STAT nebulized epinephrine** 5 mg [1 mg/mL solution], repeat dose **PRN**

Administer **dexamethasone** 0.6 mg/kg/dose (max 16 mg/dose) PO (preferred), IM/IV if necessary

Consider analgesic/antipyretic PRN

Observe for a minimum 2-4 hours

IMPENDING RESPIRATORY FAILURE

- Oxygen desaturation
- Lethargy or decreased level of consciousness
- Marked decreased air entry
- Cyanosis
- Stridor may be quiet or decreased
- Work of breathing (may be decreased indicating fatigue)

↓

RRT consult (if available)

Administer **STAT nebulized epinephrine** 5 mg [1 mg/mL solution] repeat dose Q15 min **PRN**

Administer **dexamethasone** 0.6 mg/kg/dose (max 16 mg/dose) via most available and least invasive route (PO/IM/IV)

Prepare for potential intubation

Diagnosis of croup is based on clinical assessment. X-rays and blood tests are not routinely indicated. Consider alternative diagnosis (e.g., tracheitis, epiglottitis, abscess, foreign body) if the child has significant drooling or does not improve with treatment. Chest/soft tissue lateral neck x-ray may be useful to evaluate alternative causes of upper airway obstruction but should only be done **once the child is stabilized.**

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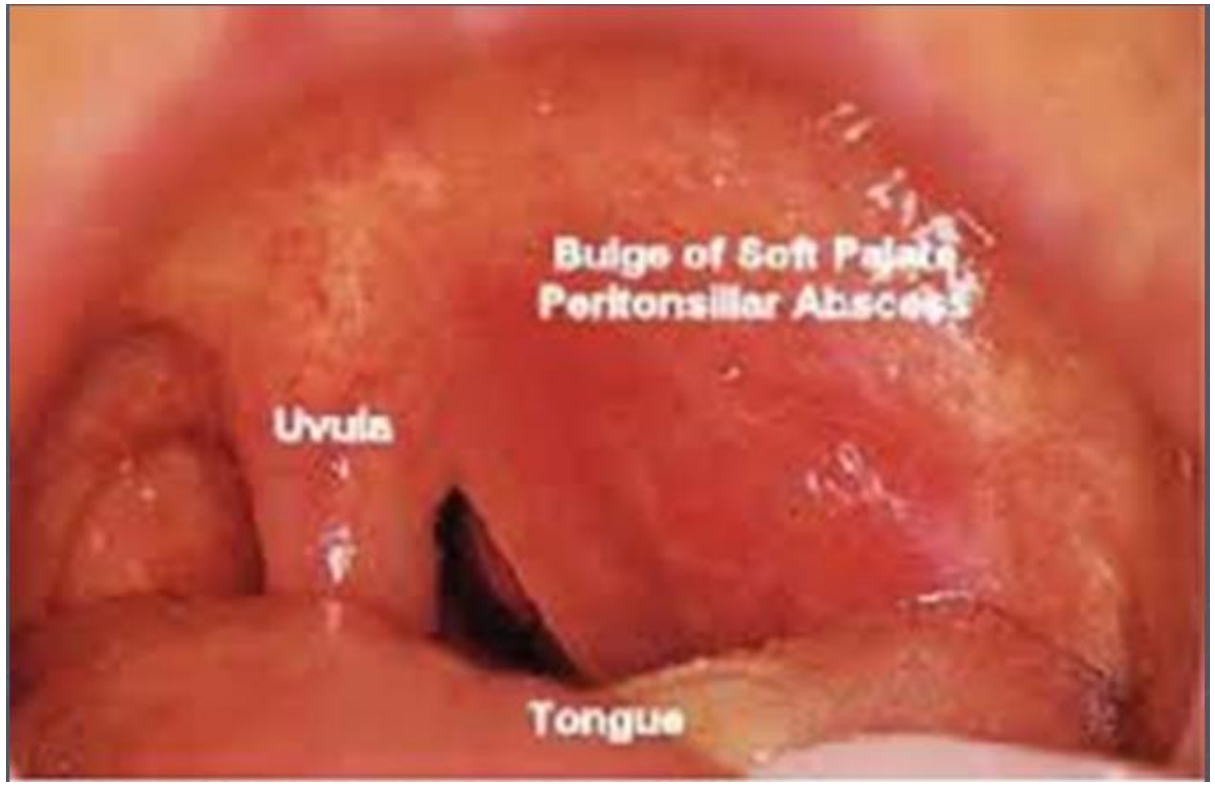
Prepare for potential intubation

A few pearls…..

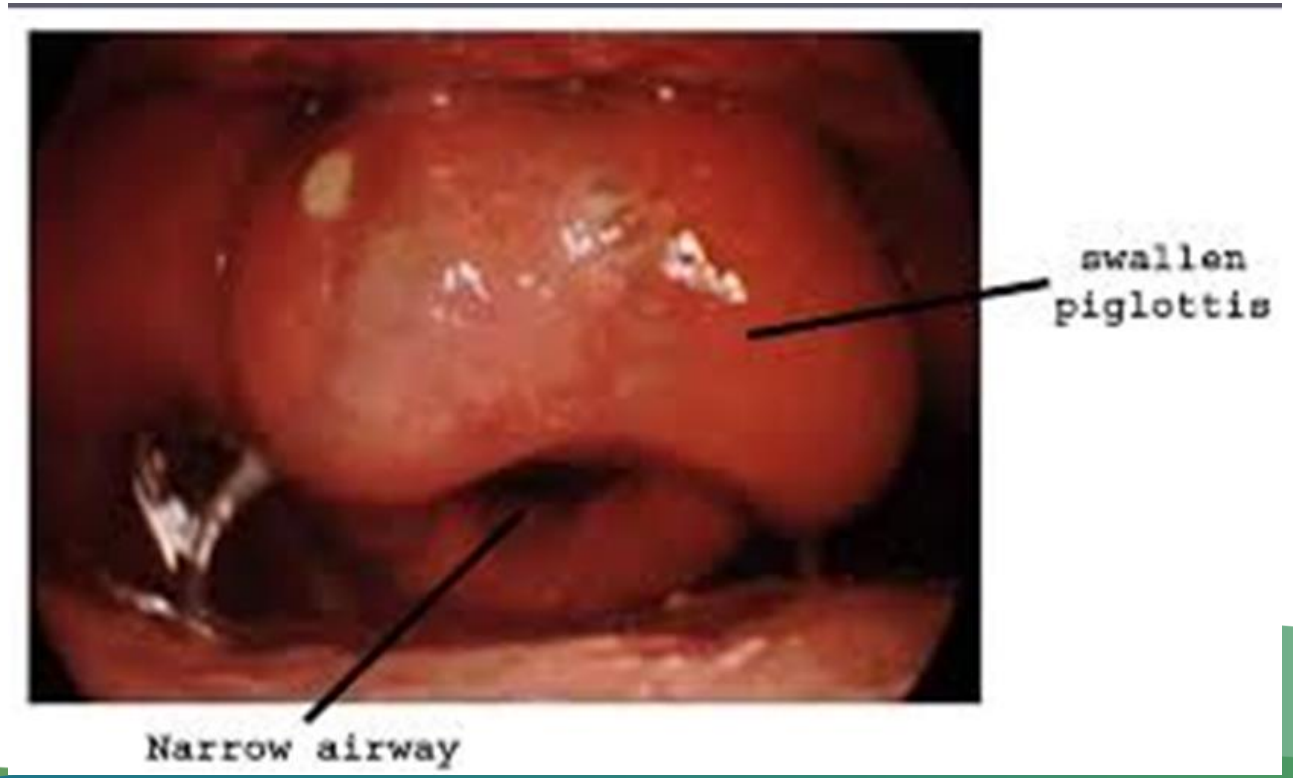
Retropharyngeal abscess



A few pearls…..

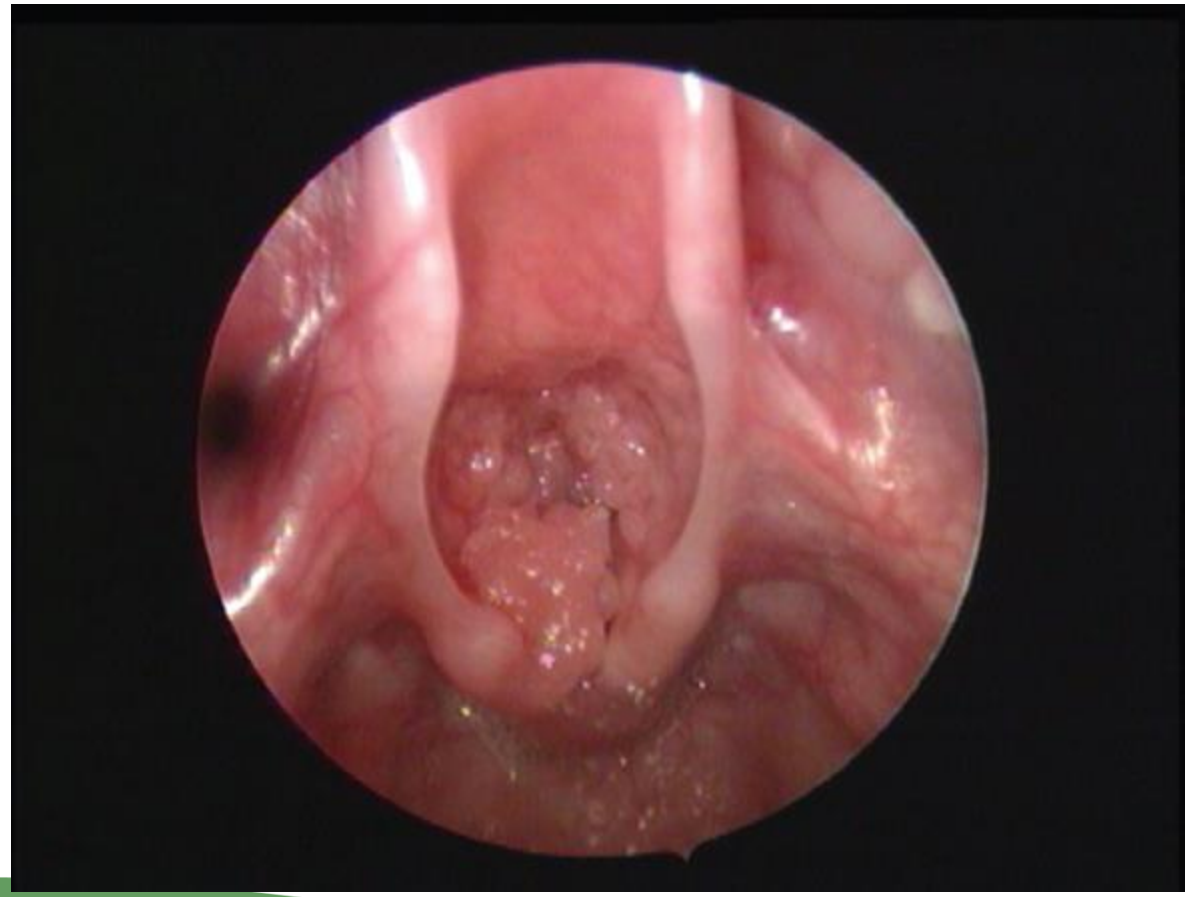
Acute epiglottitis

- Disease now virtually eradicated in the pediatric population who have been immunized to BC standard
  - Used to be most commonly caused by Hemophilus influenzae Type B (HIB)



A few pearls…..

Bacterial tracheitis



Hypercarbic Hypoxia

- Hypercarbic hypoxemic failure can be completely corrected with 30% FiO2

- Alveolar gas equation
  - PAO2= PiO2– PaCO2/RQ (0.8)
  - PiO2 = FiO2 (Pb-PH20)

Upper airway obstruction should not cause hypoxia.

O2 is correcting hypercarbic hypoxia

Upper Airway Obstruction - Management

- Oxygen can be given to improve saturations (!)
- Nebulized epinephrine for temporary relief
- Dexamethasone 0.6 mg/kg
- Emergency airway management = **difficult airway pathway**
  - ETT ½ to 1 size smaller
- Treat specific cause

High risk of deterioration and complete obstruction if upset, sedated, reposition

Delay investigation until airway is secure

Intubation: Why do we need to intubate?

- Hypoxia
- Hypercarbia
- Airway obstruction
- Airway protection – level of consciousness
- Tests and procedures

Predictors of Difficult Airways

- Dysmorphic facial features / syndromes
- Stridor/UAO
- Physical features:
  - Limited mouth opening
  - High arch or narrow palate
  - Small mandible
  - Short/wide neck
  - Limited head and neck range of motion

Intubation - Preparation

- Personnel : who will intubate, back up?
- Equipment
- Medications
  - Induction
  - Resuscitation drugs/fluids
- Checklist

"Hope for the best, but prepare for the worst"

Pediatric Intubation Checklist

1: Preparation: Consider Broselow and CONFIRM WEIGHT ..... kg

Medication:

Induction:
(reduce dose if hemodynamically unstable)
- ☐ Ketamine 1 mg/kg

Paralytic:
- ☐ Rocuronium 1 mg/kg

Adjuncts:
- ☐ Low dose push Epinephrine: 10 mcg/mL. Administer 1 mcg/kg for low blood pressure
- ☐ Sedation/analgesia and vasopressor infusions prepared

Respiratory Equipment:

(See sizing on reverse)
- ☐ Video laryngoscope ***ON***
- ☐ ETT (+ 0.5 smaller) ***stylet***
- ☐ ETT cuff balloon ***tested*** & syringe ready
- ☐ Capnography ***on BVM***
- ☐ BVM + mask (appropriate size) +/- PEEP with O_2 flow ***ON***
- ☐ Suction ***ON***

Rescue Equipment:
- ☐ OPA/NPA ***ready***
- ☐ Direct laryngoscopy, LMA/ iGel, and front of neck ***ready***

Patient Preparation:

- ☐ Vitals ***checked***
- ☐ Telemetry ***ON*** (+/- defib pads)
- ☐ BP cuff ***cycling q2min***
- ☐ IV Fluids running ***opposite*** BP cuff
- ☐ 2nd IV in place & ***flushed***

Positioning Optimized
- ☐ Bed tilt/Ramp/Roll under shoulders
- ☐ ***Dual Pre-oxygenate with 100% O_2***
  Under 1 year: 5 L/min
  1-7 years: 10 L/min
  Over 7 years: 15 L/min
- ☐ ***Hemodynamics Optimized***
  Consider 10 mL/kg fluid bolus, Pressors

2: Pre-Intubation Pause at Bedside VERBALIZE

Risk Assessment:

- Anatomically difficult airway?
- Physiologically difficult airway?
- Risk of hypotension or cardiac arrest?

If ANY of the above, CALL FOR BACKUP

Plan:

- Pre-oxygenation
- Meds & Doses - checked
- Passive apneic-oxygenation
- gentle bagging during apenic phase
- Airway Plan A, B, C, D
- Threshold to abort and backup plan

Discuss:

- Questions?
- Concerns?

READY TO INTUBATE

3: Post-Intubation

Airway Management:

- Inflate ETT cuff (check cuff pressure)
- Confirm $EtCO_2$ waveform
- Bilateral breath sounds
- Secure tube
- Connect ETT to ventilator
- Specify ventilator settings (See reverse)
- NG or OG tube insertion
- CXR confirmation

Patient Management:

- Repeat vital signs
- Hypertension & Tachycardia: possible inadequate sedation under paralysis. Consider bolus sedation (i.e. 1 mg/kg Ketamine)
- Hypotension? Consider fluid bolus, then Epinephrine or Norepinephrine infusion.
- Sedation and analgesia infusion (Dexmedetomidine, Midazolam and Morphine)
- Soft restraints

Pediatric Invasive Ventilation Size Guide (1 month – 17 years minus a day)

Bagger Size

Less than 10 kg	Infant bagger
0 – 30 kg	Pediatric bagger
30 kg and up	Adult bagger

Image Source (right):
Elsevier skill "Endotracheal Tube Intubation (Pediatric)", Nov. 2023

Correct	Incorrect	
A: Covers mouth and nose but not eyes	B: Too Large: Covers eyes	C: Too Small: Does not cover mouth and nose

EtCO2

ETT > 4.0: Adult/Pediatric **ETT ≤ 4.0: Neonatal/Infant**

ETT Securing

Neobar *(to be used on ETT < 5.0. For greater than 5.0, consider alternative securing device)*
Measure from tragus to mid-line under the nose. Position NeoBar® across center of mouth between upper and lower lip. It should not contact lips. Tabs must be just in front of ear. **Wrap cloth tape completely around NeoBar platform, then tape ETT to NeoBar spiraling tape towards ETT connector.**

Intubation

Color	Weight (kg)	Cuffed OETT*	Depth (cm)	Blade
Grey	3 – 5	3.0	9.0 – 9.5	1 Mil, lopro 1
Pink	6 – 7	3.0	9.0 – 9.5	1 Mil, lopro 2
Red	8 – 9	3.0	10.5 – 11	1 Mil, lopro 2
Purple	10 – 11	3.5	10.5 – 11	1 Mil, lopro 2
Yellow	12 – 14	4.0	12	2 Mac/Mil, lopro 2.5
White	15 – 18	4.5	13.5	2 Mac/Mil, lopro 2.5
Blue	19 – 23	5.0	15	2 Mac/Mil, lopro 2.5
Orange	24 – 29	5.5	16.5	2 Mac/Mil, lopro 2.5
Green	30 – 36	6.0	18	3 Mac, lopro 3

*Age/4 + 3.5 for cuffed ETT.

Inline Suction Size

ETT tube size	Inline suction size*
3.0 – 3.5	6 Fr
3.5 – 4.5	8 Fr
5.0 – 6.0	10 Fr
6.0 – 7.0	12 Fr

*ETT size × 2. Round down

Settings

Circuit Size (applies to Fisher & Paykel 950 System) **Neonatal: < 25 kg** **Adult: ≥ 25 kg**

Age	Mode	RR (brs/min)	Ti (sec)	PEEP	VT (actual body weight)
< 1 year	Volume Guarantee (PRVC, APV CMV) or Pressure Control* *PC if large leak or difficulty ventilating	25 – 35	0.60 – 0.70	5 – 8 cm H_2O	6 – 8 mLs/kg
1 – 3 years		20 – 26	0.70 – 0.75		
4 – 5 years		18 – 24	0.75 – 0.80		
6 – 10 years		16 – 20	0.80 – 0.90		
> 10 years		15 – 20	0.80 – 1.0		

Case #2

- 10 months old baby presented to ED with 4/7 rhinorrhea and cough and 1/7 WOB. On arrival sats 88% on RA. He has been started on LFNC with good response in his sats.
  - VS: RR 70 , Sat 92% on 2L/min LFNC, HR 140s, BP 70/35, T 38.2
  - Gas: 7.30-58-23 lactate 1.5
  - Exam: moderate WOB with supra-sternal and subcostal retractions, wheeze, good air entry, normal LOC/activity. “Happy wheezer”

Worried?
Dx?
Immediate management?

StEP Stabilization Essentials in Pediatrics

Bronchiolitis

- Viral LRTI with obstruction of the small airways: acute inflammation, edema and epithelial cell necrosis
- RSV most common pathogen, but can be caused by a plethora of viruses
- Diagnosis is CLINICAL - made on history and physical examination:
  - Usually < 2yo
  - Start with 2-3 days viral prodrome: cough, fever, rhinorrhea
  - Progressive respiratory distress

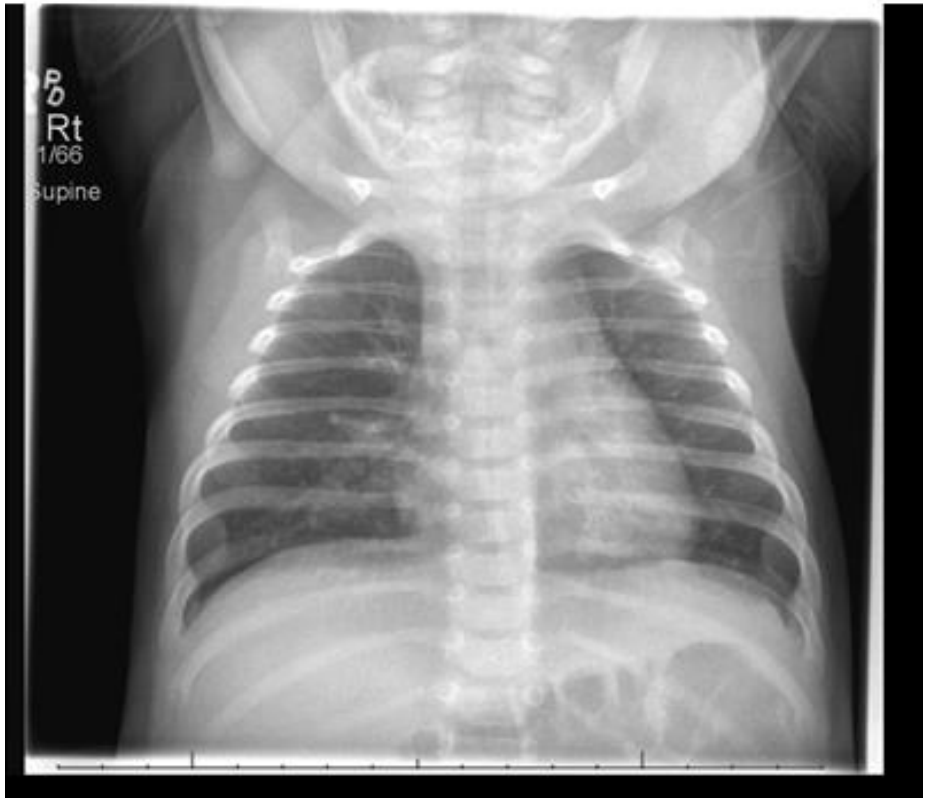
Severity factors:

- Apnea
- Respiratory acidosis
- Altered LOC/hypotonia
- Persistent hypoxemia
- Impending respiratory failure

- ***Age: < 6 weeks***
- ***Prematurity***
- *Chronic lung disease*
- *Congenital heart disease*
- *Neuromuscular disorders*
- *Immunodeficiency*

Case #2 (continued)

- Few hours later: RR-75, HR 160, Temp 37.2, BP 82/52, Saturations 88% on 3L LFNP with moderate to severe WOB. Remains alert and interactive
- You have decided to start this child on HFNC 2L/kg/min FiO2 30%. Feeds were transiently held
- Saturations and RR/WOB have improved over the next 2 hours
- The resident asks you why do infants get so sick with RSV and adults only get a cold?



Case #2 (Continued)

- Despite an initial improvement, after 6 hours the patient showed persistent deterioration:
  - RR 80-85, HR 180, sats 89% on 50%, HFNP 2L/kg/min Temp 36.8, BP stable.
  - Severe work of breathing
  - Not lethargic
  - CBG: 7.28/65/21

- MANAGEMENT OPTIONS?

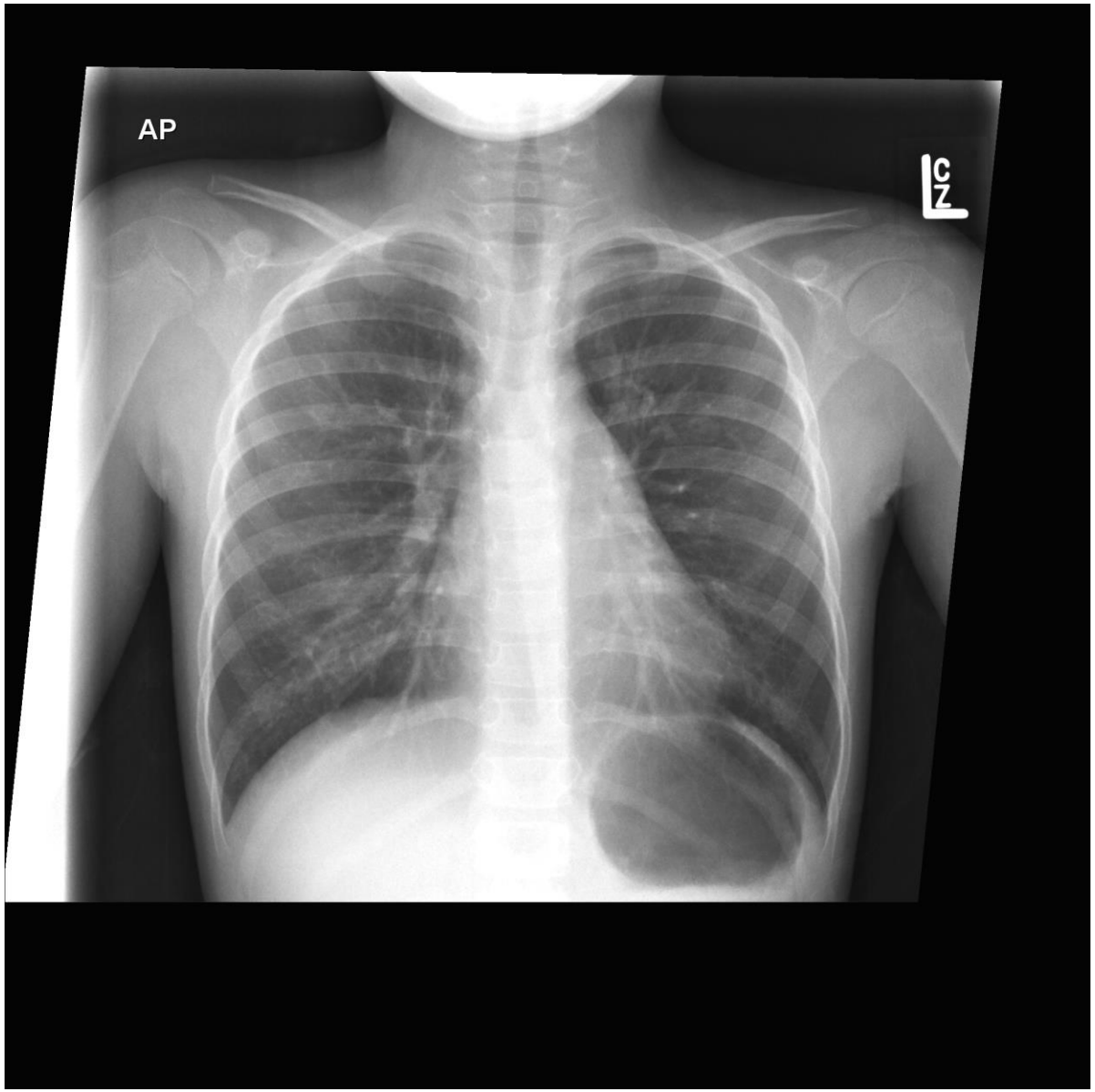
Bronchiolitis-Management

- Febrile neonate with clinical bronchiolitis
  - Septic workup?
- Symptomatic management: oxygen, hydration
- No medication recommended routine
  - B2-agonists "trial" no longer be considered
  - Antibiotics can be considered if strong suspicion/evidence of secondary bacterial pneumonia
- Respiratory support: HFNC, NIV, IPPV
  - Respiratory toilet: suctioning
  - Low respiratory rate/optimize expiratory time for obstructive lung disease (if sedated/paralyzed)
  - Permissive hypercapnia

Case #3

- 4 year old boy with history of asthma. 2/7 rhinorrhea/cough. 1/7 WOB on Ventolin q4h at home. On admission sats in low 80s, severe WOB. Started on the asthma protocol.
  - Has received back to back Ventolin/Atrovent x3, dexamethasone po, MgSo4 IV, methylpred IV and is now on Ventolin q 30 min via nebulizer
  - On 3L NP O2. Sats 92-94%. RR 30. HR 130-140 bpm. BP 85/42
  - The child is asleep in his mother's arm during your examination. You cannot appreciate any wheeze, but note diminished air entry throughout. There is moderate-severe WOB with shoulder shrug.
    - 7.2-60-22 lactate 5.2
    - CXR: no pneumothorax, hyperinflated +++

Worried?
Dx?
Immediate management?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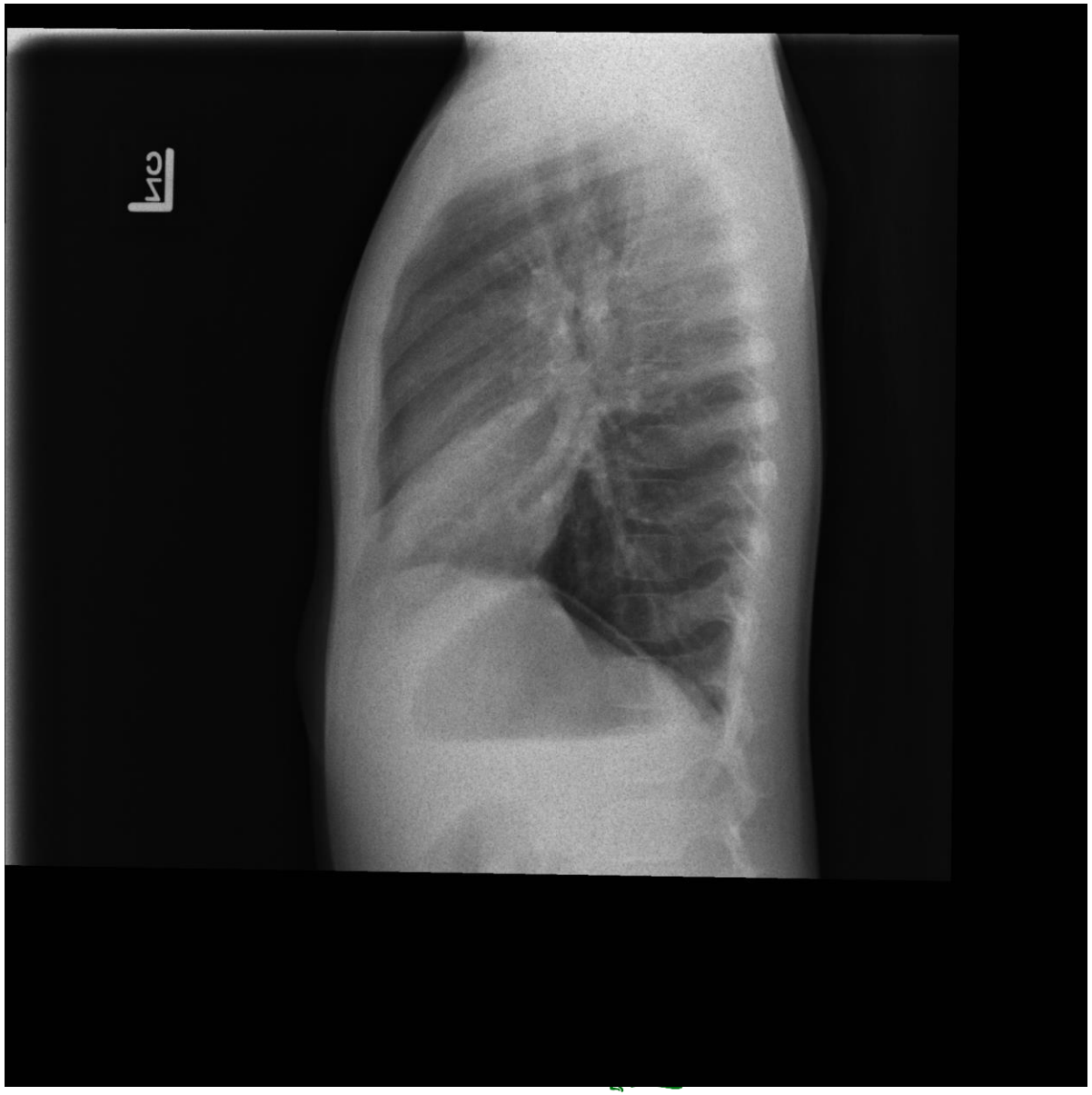


https://www.childhealthbc.ca/pcc/hurry

ACUTE CONDITIONS

- Acute Agitation
- Anaphylaxis
- Asthma

Asthma

- Recognition
- Management – Mild to Moderate (PRAM Score 0-7)
- Management – Severe (PRAM SCORE 8-12)
- Medication

In-a-Hurry Summary

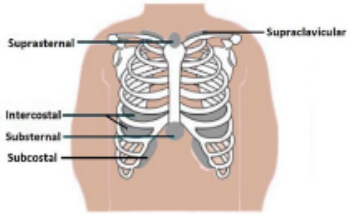
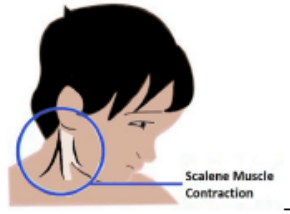
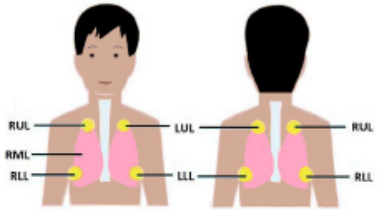
Non Invasive Positive Pressure Ventilation (NIPPV)

- Equipment
- Set Up & Management
- Settings on BiPAP
- Medication Administration

In-a-Hurry Summary

StEP Stabilization Essentials in Pediatrics

PRAM Scoring Table*

Criterions	Description	Score	Notes
Oxygen Saturation	Greater than or equal to 95%	0	O_2 saturation must be measured with the patient breathing ambient air until stabilization of the oximetry value for at least 1 minute.
	92-94%	1	**Turn off supplementary oxygen when measuring PRAM. If SpO_2 falls to less than 92%**
	Less than 92%	2	you can turn oxygen back on immediately as they have automatically scored maximum (2) points.
Suprasternal Retraction	Absent	0	Suprasternal retraction is visible indrawing of the skin above the sternum and between the sterno-cleido-mastoid muscle with every intake of breath. It may cause an involuntary shoulder shrug in small children. This is a visual assessment.
	Present	2	
Scalene Muscle Contraction	Absent	0	The scalenes are deep cervical muscles located in the floor of the lateral aspect of the neck.
	Present	2	Scalene contraction cannot be seen. **This is a palpable assessment.** It occurs only in those with severe asthma exacerbations. Scalene muscles are bordered on each side by the sterno-cleido-mastoid muscle, the trapezius (in the back) and the clavicle.
Air Entry	Normal	0	**In cases of asymmetry, the most severely affected lung field determines the rating.** Use lung fields to grade air entry. **Lung field=two contiguous VERTICAL** auscultation zones of the major lobes: Posterior lung fields: RUL & RLL or LUL & LLL Right anterior lung field: RUL & RML Left anterior lung field: LUL & LLL
	Decreased at bases	1	
	Decreased at the apex and the base	2	
	Minimal or absent	3	
Wheezing	Absent	0	Use auscultation zones to grade wheeze. **At least two auscultation zones must be affected to influence the rating.** In case of asymmetry, the two most severely affected auscultation zones, irrespective of their location (RUL, RML, RLL, LUL, LLL), will determine the rating criteria.
	Expiratory only	1	
	Inspiratory (± expiratory)	2	
	Audible without stethoscope or silent chest (minimal or no air entry)	3	
PRAM Score Total	**0 – 3 Mild**	**4 – 7 Moderate**	**8 – 12 Severe**

LLL: Left lower lobe LUL: Left upper lobe O_2: Oxygen RLL: Right lower lobe RML: Right middle lobe RUL: Right upper lobe SpO_2: Oxygen saturations

Adapted from: Ducharme, F. M., Chalut, D., Plotnick, L., Savdie, C., Kudirka, D., Zhang, X., Meng, L., & McGillivray. (2008). The Pediatric Respiratory Assessment Measure: A valid clinical score for assessing acute asthma in children. Journal of Pediatrics, 153(4), 478-80.

Algorithm: Initial Management of Pediatric Asthma Exacerbations (Page 2 of 3)

Start timing for reassessment and next dose when medication administration **starts** (1st puff/nebulization begins)

SEVERE: Score 8 to 12

- Inhaled salbutamol MDI with spacer or nebulizer q 20 minutes (3 total doses)
  - If salbutamol q 20 minutes x 3 already provided, administer continuous nebulized salbutamol
- Establish vascular access
- If not already provided, administer:
  - MethylPREDNISolone IV, even if PO steroid already provided
- Continuous SpO_2, heart rate and respiratory rate monitoring
- Most responsible physician at bedside, consult RRT (if available)
- Consider early respiratory support and magnesium sulfate infusion (see below for further recommendations)
- Consult local pediatrician on-call; if no pediatrician call CHARLiE via ZOOM/phone and a higher level of care center via PTN
- Rural/remote sites consider/prepare transfer to higher level of care

Refer to: Provincial Pediatric Asthma Guideline for detailed instructions on intervention and care.

See Medication Reference Table below (p.3) for doses and list of abbreviations

Signs of Impending Respiratory Failure

- **Decreased level of consciousness**
- **Agitation**
- **Cyanosis**
- **Decreased respiratory effort**
- **Confusion**

REASSESS PRAM SCORE 1 HOUR AFTER INITIATING TREATMENT

MILD: Score 0 to 3
or **MODERATE**: Score 4 to 7

Reassess vital signs and PRAM q 30 min x 2 (salbutamol 1 dose q 30 to 60 minutes); then

Move to **MILD** or **MODERATE** management (page 1)

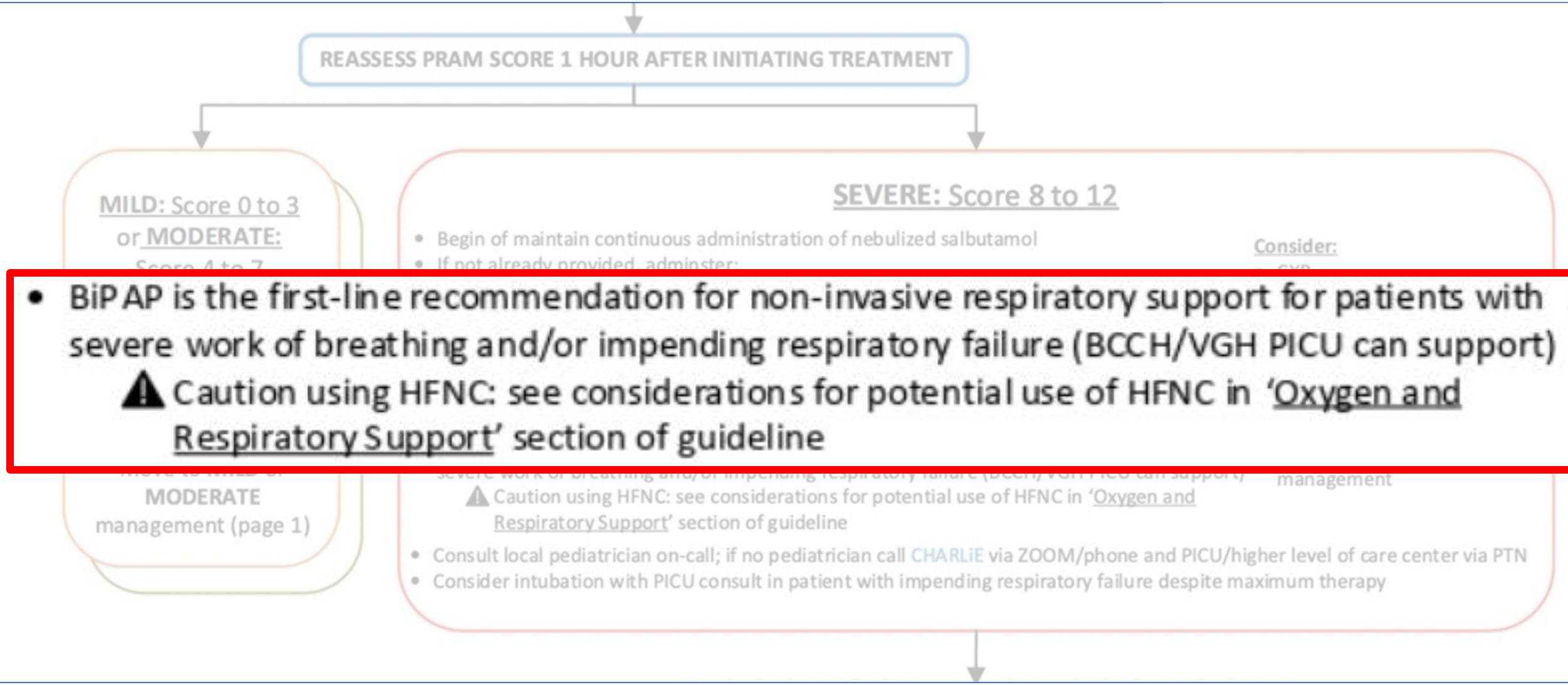
SEVERE: Score 8 to 12

- Begin of maintain continuous administration of nebulized salbutamol
- If not already provided, adminster:
  - MethylPREDNISolone IV (even if PO steroid already provided)
  - Magnesium sulfate IV (following appropriate health authority/agency guidelines). Monitor BP q 5 minutes during infusion, then q 30 minutes
- If signs of circulatory compromise, provide isotonic 10 to 20mL/kg bolus (max 1L) over 10-20 minutes to achieve adequate perfusion (monitor for fluid overload)
- Continuous SpO_2, heart rate and respiratory rate monitoring
- BiPAP is the first-line recommendation for non-invasive respiratory support for patients with severe work of breathing and/or impending respiratory failure (BCCH/VGH PICU can support)
  - ⚠ Caution using HFNC: see considerations for potential use of HFNC in 'Oxygen and Respiratory Support' section of guideline

Consider:

- CXR
- Blood gas (venous, capillary or arterial)
- Electrolytes, CBC & Differential
- POC blood glucose
- Possibility of a pneumothorax
- Anesthesia consult for airway management

- Consult local pediatrician on-call; if no pediatrician call CHARLiE via ZOOM/phone and PICU/higher level of care center via PTN
- Consider intubation with PICU consult in patient with impending respiratory failure despite maximum therapy



- BiPAP is the first-line recommendation for non-invasive respiratory support for patients with severe work of breathing and/or impending respiratory failure (BCCH/VGH PICU can support)
  - ⚠ Caution using HFNC: see considerations for potential use of HFNC in 'Oxygen and Respiratory Support' section of guideline

Case #3 (continued)

- You have appropriately identified that this child is in impending respiratory failure and have elected to start BiPAP in the ED and consult PICU.

- The medical student points out that the patient is already hyperinflated, won't BiPAP make him worse?

Status Asthmaticus Management

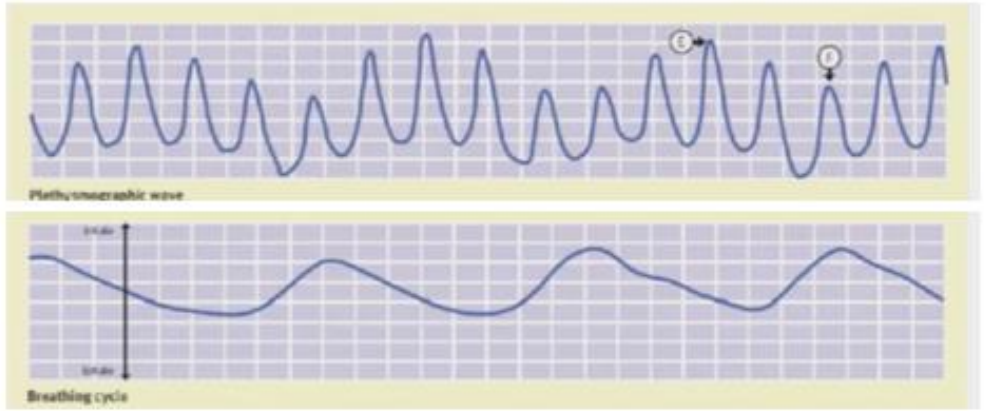
- Advanced therapies
  - IV steroids
  - IV magnesium sulfate (max 75mg/kg total)
  - Continuous salbutamol nebs vs IV infusion
  - Ketamine
  - Inhaled anesthetics
  - Aminophylline

BiPAP and Asthma Exacerbation

- Physiology
  - Heterogenous distribution of ventilation results in V/Q mismatch
  - Bronchoconstriction/mucus plugging
  - Hyperinflation
- Delta P = decreases work of breathing
- Hyperinflation = positive pressure in the alveoli
  - PEEP: positive pressure in the airway =
    - Decreases the amount of work necessary to initiate inspiration
    - Stent airways open = helps exhalation
    - Stent alveoli open = helps with V/Q mismatch

Case #3 (continued)

- Unfortunately, the patient has continued to deteriorate and now has an almost silent chest and is very somnolent.
  - Repeat gas: pH 7.05 CO2 73 lactate 7.5
  - VS: HR 150, BP
- You make the decision to intubate this patient
  - Anticipated complications on intubation?
  - Explanations for shock and lactic acidosis
  - Initial settings on ventilator?



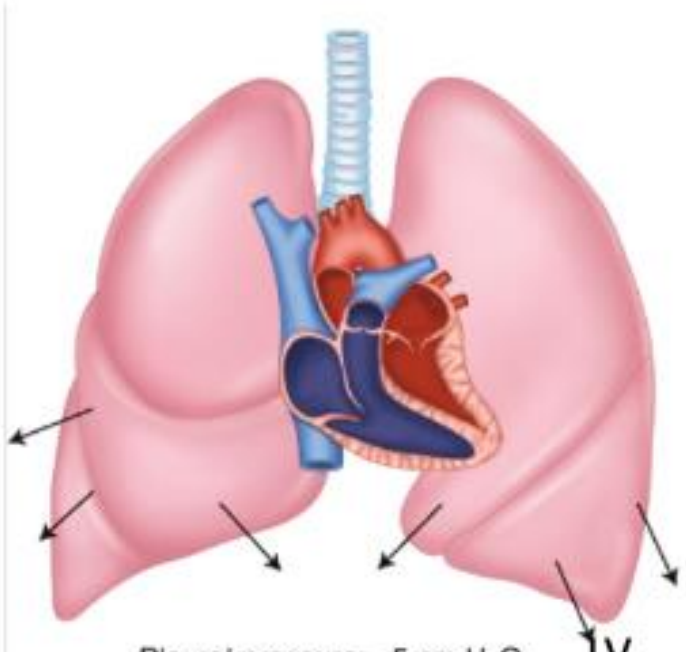
Status Asthmatic and Shock

- Dehydration = decreased pre-load
- Tachycardia = decreased diastolic RV/LV filling = decreased pre-load
- Effects of positive intra-thoracic pressure / obstructive physiology = affects both pre-load and afterload (next slide)
- Severe acidosis = can affect contractility + risk of arrhythmias

- Salbutamol (B-adrenergic) also causes hyperglycemia and hyperlactatemia

Heart-Lung Interactions

StEP Stabilization Essentials in Pediatrics

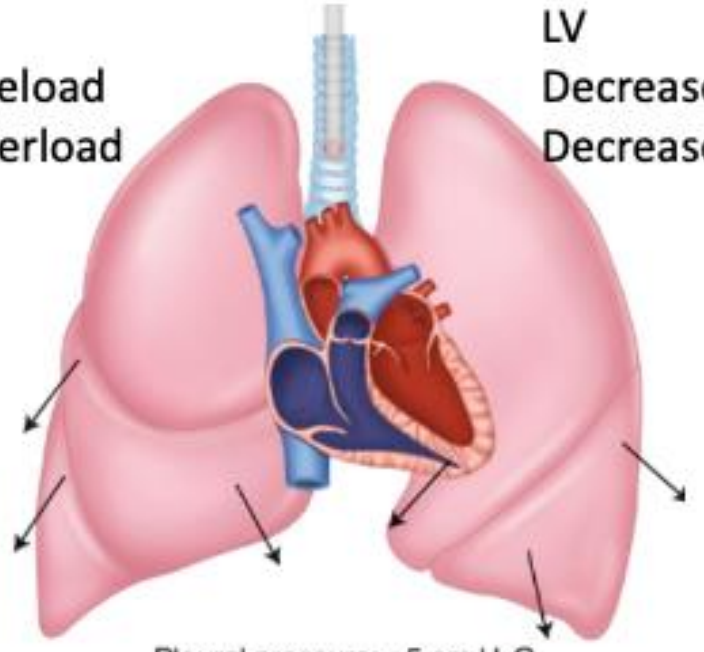


RV
Increased Preload
Decreased Afterload

Pleural pressure: –5 cm H_2O
Spontaneous Inspiration

LV
Increased Preload
Increased Afterload

RV
Decreased Preload
Increased Afterload



LV
Decreased Preload
Decreased Afterload

Pleural pressure: +5 cm H_2O
Positive pressure inspiration

Image adapted Cardiac Considerations in Chronic Lung Disease 2020

Ventilator Settings
Asthma

Low respiratory rate for age
Maximize eTime
“Optimal PEEP”
Permissive hypercapnia

StEP Stabilization Essentials in Pediatrics

KEEP CALM AND BREATHE ON

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