

Acute Ventilation in Pediatrics

BC Children's Hospital PICU Physicians
& Respiratory Therapists

December 16, 2022

PHYSICIAN TO PHYSICIAN

CRITICAL CARE SUPPORT FROM BCCH PEDIATRIC INTENSIVE CARE UNIT (PICU)



Most Responsible Physician (MRP)
identifies the need for pediatric consult
for transport or advice
from the BCCH Pediatric ICU (PICU)



MRP/delegate phones
Patient Transfer Network (PTN):

1-866-233-2337

Requests a call with BCCH Pediatric Transport
Advisor

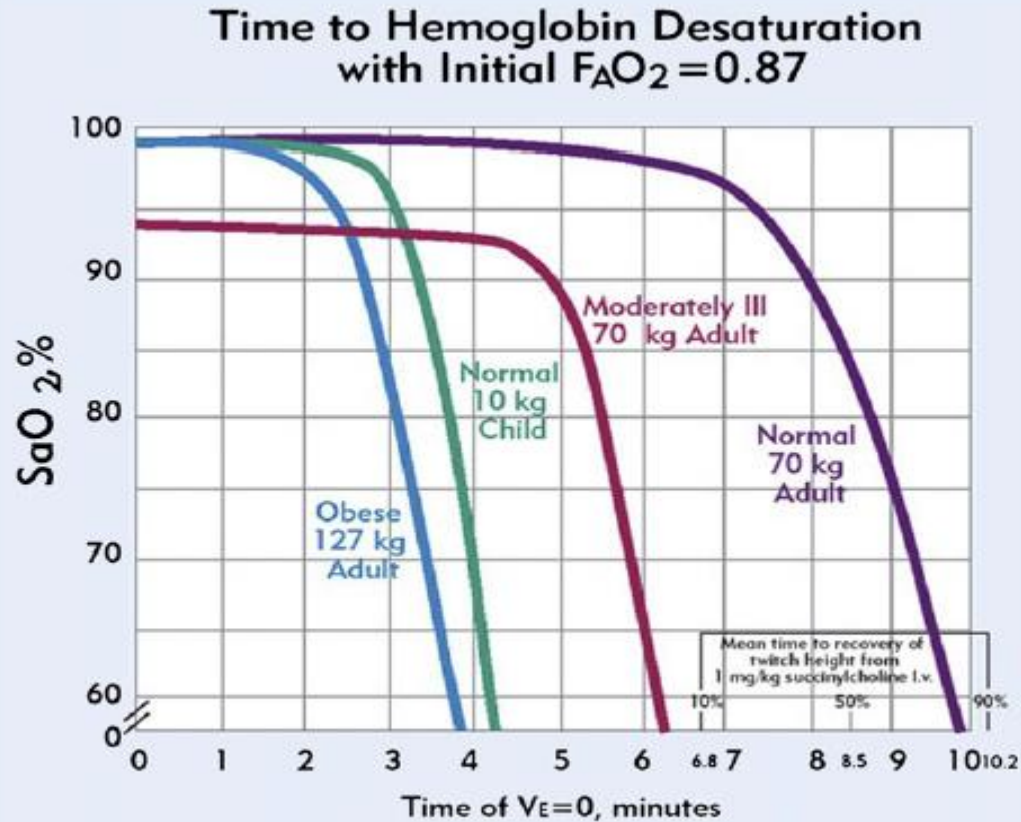


PTN connects with
PICU Pediatric Transport Advisor & MRP
to collaborate on an **ADVICE CALL**

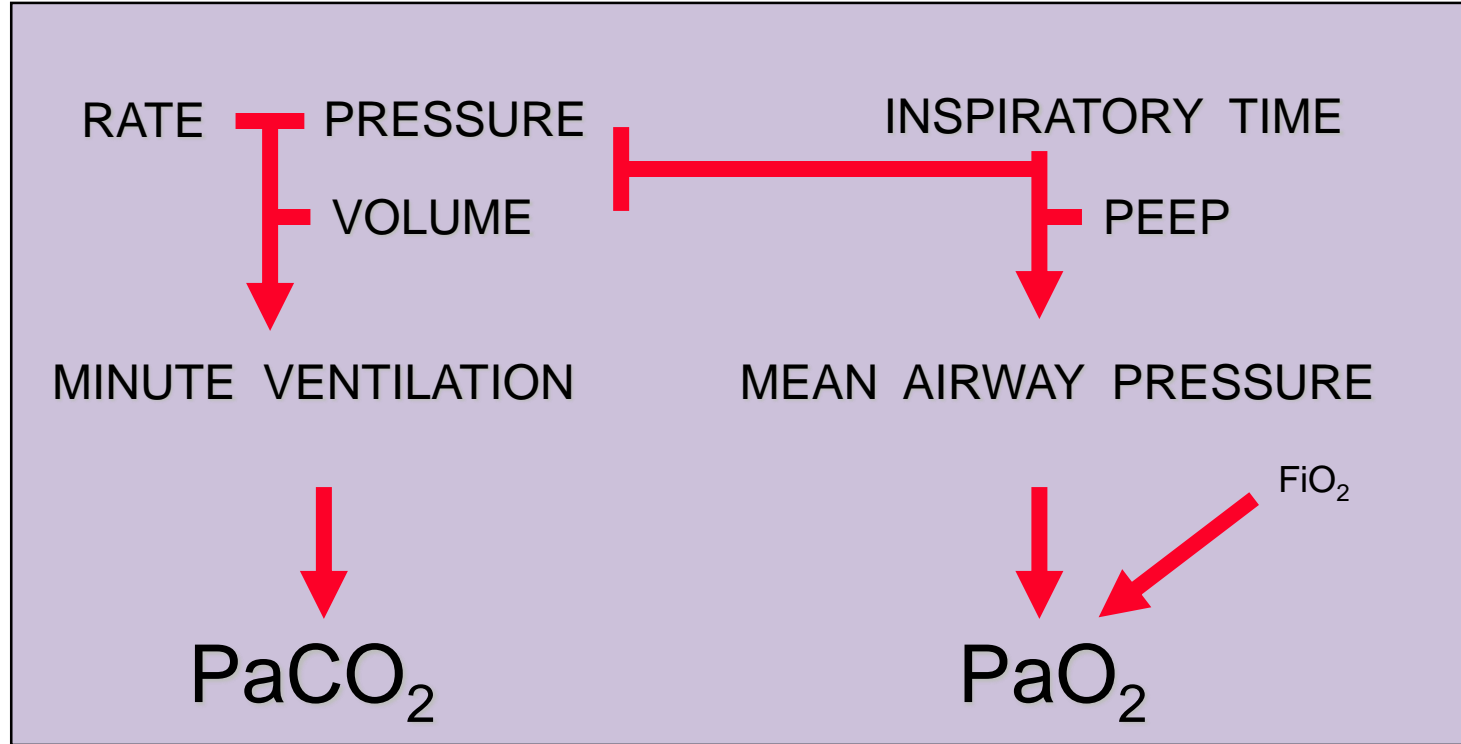
New option available:
PTN can facilitate a secure [GoodSAM video conference](#) for MRP + PICU Transport Advisor +
additional specialists as needed

- Low flow oxygen
- Heated humidified high flow nasal cannula oxygen therapy (HHHFNC)
 - 2L/kg/min
 - maybe useful in some children with bronchiolitis with desaturation not responding to low flow oxygen
- BiPAP (Bi-level positive airway pressure)
 - ventilator delivers an inspiratory positive pressure
 - expiration returns to baseline continuous positive end expiratory pressure
 - good for oxygenation and ventilation problems
 - early initiation in asthma not responding to aggressive medical therapy
- Invasive mechanical ventilation

- Children more prone to respiratory failure
 - greater airways resistance at baseline
 - pliable chest walls predispose to reduced FRC and atelectasis
 - desaturate much quicker with apnea – airways close above FRC



- Oxygenation failure
- Ventilation failure



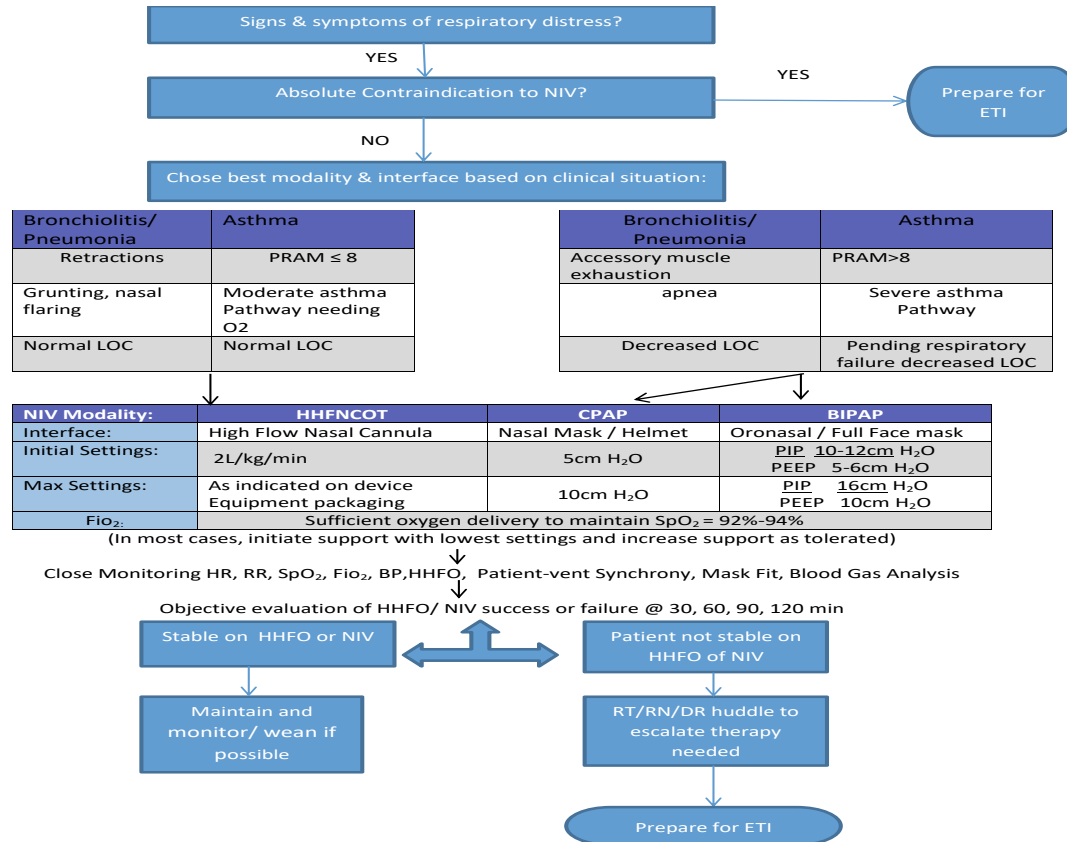
Oxygenation Support

- simple nasal cannula oxygen
- heated humidified high flow nasal cannula oxygen
- non invasive Bilevel (BiPap)
- invasive MV

Ventilation Support

- non invasive Bilevel (BiPap)
- invasive MV

Decision Tree – Deciding Initial Modality



Goal: deliver adequate oxygen flow to meet or exceed the patient's peak inspiratory flow

- establishes control of FiO₂ delivery (as not diluting with room air)
- reduce WOB by supporting inspiratory flow demand
- humidification to optimize secretion clearance
- reduction of upper airway dead space

| Flow Recommendations: | | |
|--|--|-----------------|
| Weight | NHF Flow rates | FPH Mode to use |
| 0-12 kg | 2 liters/min/ kg To a max 25 liters | Junior Mode |
| 13-15 kg | 30 liters/min | Adult mode |
| 16-30 kg | 35 liters/min | Adult Mode |
| 31-50 kg | 40 liters/min | Adult mode |
| >50kg | 50 liters/min | Adult mode |
| For flow rates 25 liters/min the flow rates are increased gradually over two minutes and observe how the flow rates are tolerated. | | |



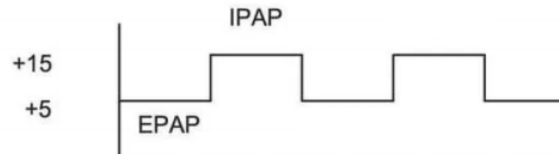
Noninvasive PPV (NIV or BiPAP)



Useful for both oxygenation/ventilation failure

Total face masks allow quick fitting, and eliminate nasal bridge challenges by sealing around the perimeter of the face where patients have less pressure sensitivity and smoother facial contours.





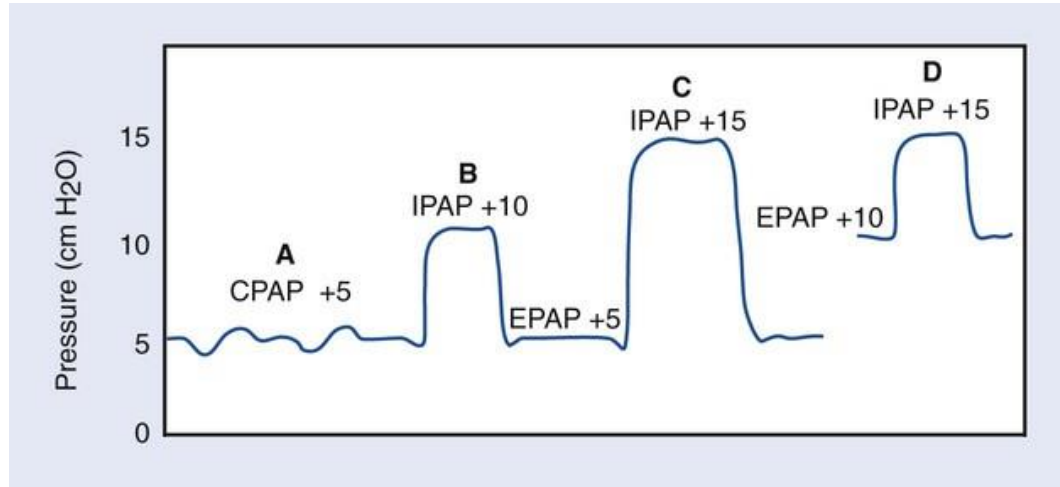
BiPAP is defined as the application of two positive airway pressures

- **EPAP** (expiratory positive airway pressure) = CPAP or PEEP
 - typically start at 5 or 6cmH₂O
- **IPAP** (inspiratory positive airway pressure) upon trigger = peak pressure
 - typically start at 10 or 12cmH₂O adjusting to achieve adequate V_t or chest rise, CO₂ clearance, patient comfort
 - IPAP is set independently of EPAP (eg. 12/6 offers a pressure gradient of 6)

- Optimize FRC by increasing EPAP, optimize Vt by increasing IPAP

Example: 12/6 → 14/7 → 16/8 → 18/8 → 18/10 → 20/10 → 20/12

- consider intubation at higher pressures
 - discuss with PICU
- Optimize airway patency
 - positioning/frequent check for mask leak
 - airway suctioning (oropharyngeal, nasopharyngeal),
 - medications such as salbutamol
 - prone positioning
- Optimize patient comfort
 - sedation may be required
 - optimize settings for patient comfort/confirm each breath is triggered and delivered



Infants and children are NOT ventilated like neonates

| | |
|--|------------------|
| Vt | 6-8mL/kg |
| RR | 15-30 |
| Ti | 0.6-1.2 |
| PEEP | 5-10 |
| Target MV | 100-200mL/min/kg |
| IBW is generally reflected by actual body weight | |

| | Newborn <1mo | Infant 1mo to 1yo | Toddler 1 to 3yo | Child 3 to 10yo | Adolescent >10yo |
|----------------|-----------------|----------------------|---------------------|--------------------|---------------------|
| Target MV | 200mL/min/kg | 175mL/min/kg | 150mL/min/kg | 125mL/min/kg | 100mL/min/kg |
| V _t | 7mL/kg | 7mL/kg | 7mL/kg | 7mL/kg | 7mL/kg |
| RR | 30 | 25 | 22 | 18-20 | 15 |
| Ti | 0.5-0.6 | 0.6-0.7 | 0.7-0.8 | 0.8-1.0 | 0.8-1.0 |

If using lower V_t for lung protection, increase RR to maintain MV

Pay attention to I:E ratio if increasing RR

- Normal lungs/acute lung injury
 - lung protective
- Obstructive lung disease
 - minimize gas trapping

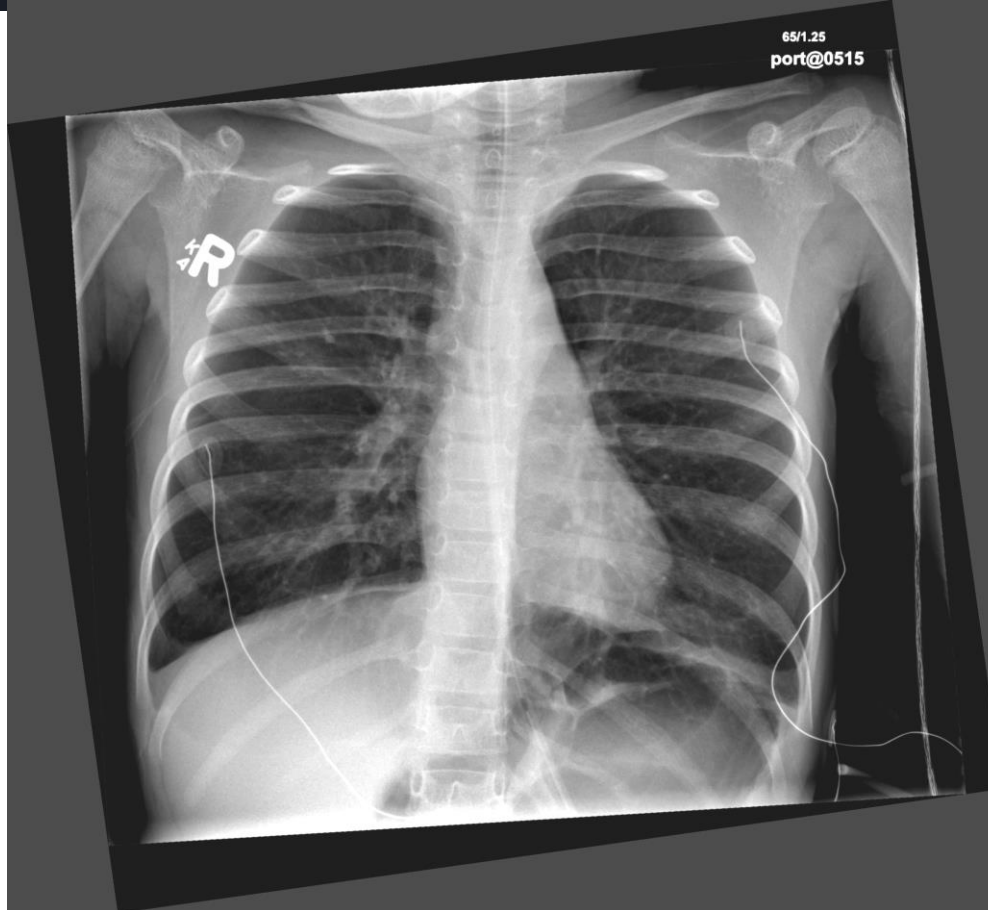
- Depends on the primary disease process
 - normal lungs
 - airspace disease
 - obstructive disease

- Paralyzed vs spontaneously breathing?
- TV 6-8mls/kg
- PEEP 5-6cm H₂O
- I time/RR age dependent
 - paralyzed (see table)
 - spontaneously breathing – determined by the patient
- Reassess patient

- Paralyzed vs spontaneously breathing?
- TV 5-6mls/kg
- PEEP 6-8cm H₂O
 - may increase to 10cm H₂O depends on saturations
- I time/RR age dependent
 - paralyzed (see table)
 - spontaneously breathing – determined by the patient
- Reassess patient

- NIV best initial option
 - BiPAP
- Targets
 - avoid worsening gas trapping / offset intrinsic PEEP
 - unload respiratory muscles / reduce resistance to exhalation
- Settings
 - $TV < 8\text{mls/kg}$
 - Long E time/short I time (patient age dependent/set by patient while spontaneously breathing)
 - Observe patient trigger
 - EPAP set to match intrinsic PEEP in spontaneously breathing patient
 - FIO_2 to maintain sats $> 92\%$

Airway Obstruction Strategy





Waveform Capnography – BAVLS

Obstruction

MORE VIDEOS



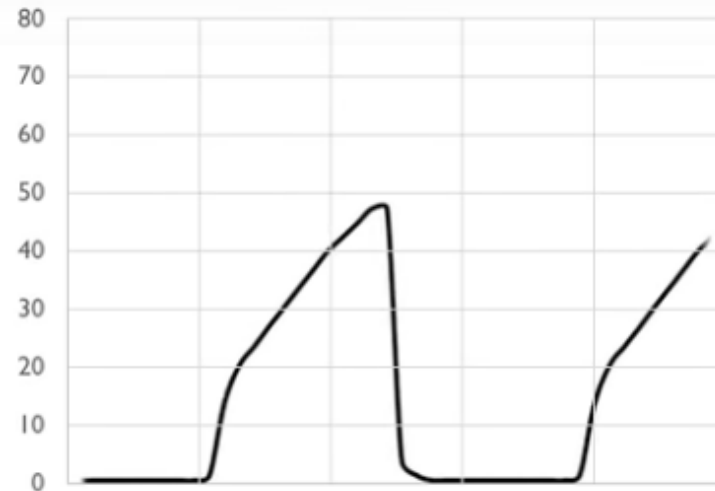
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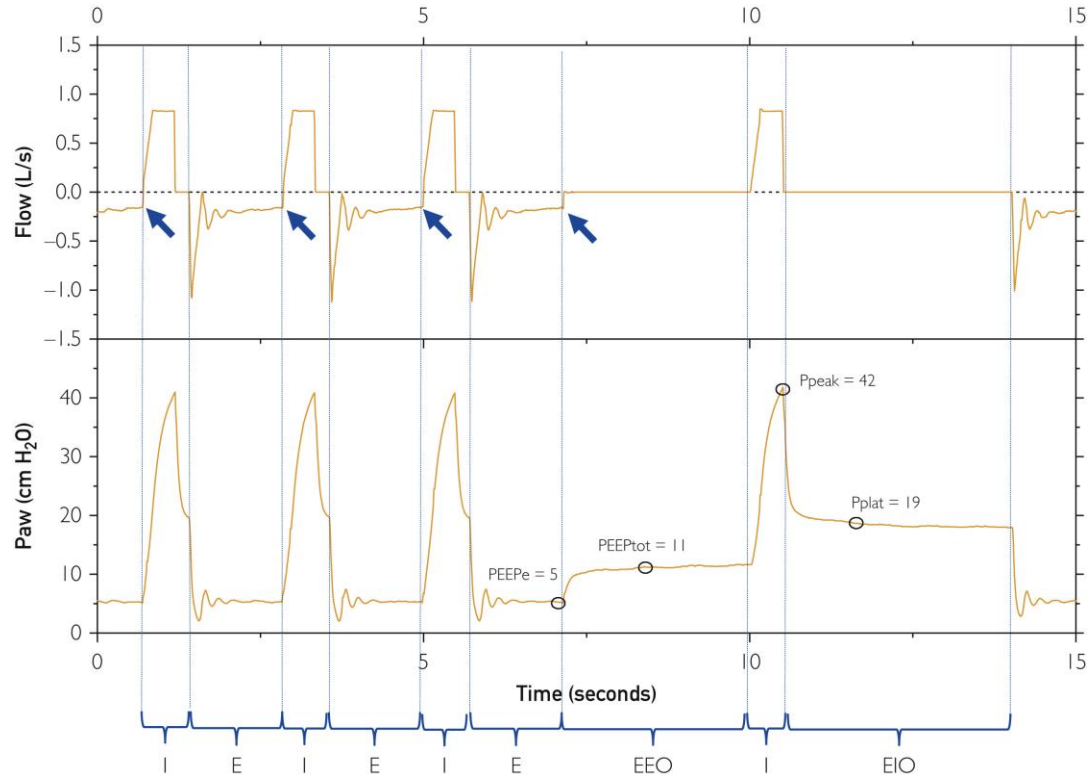
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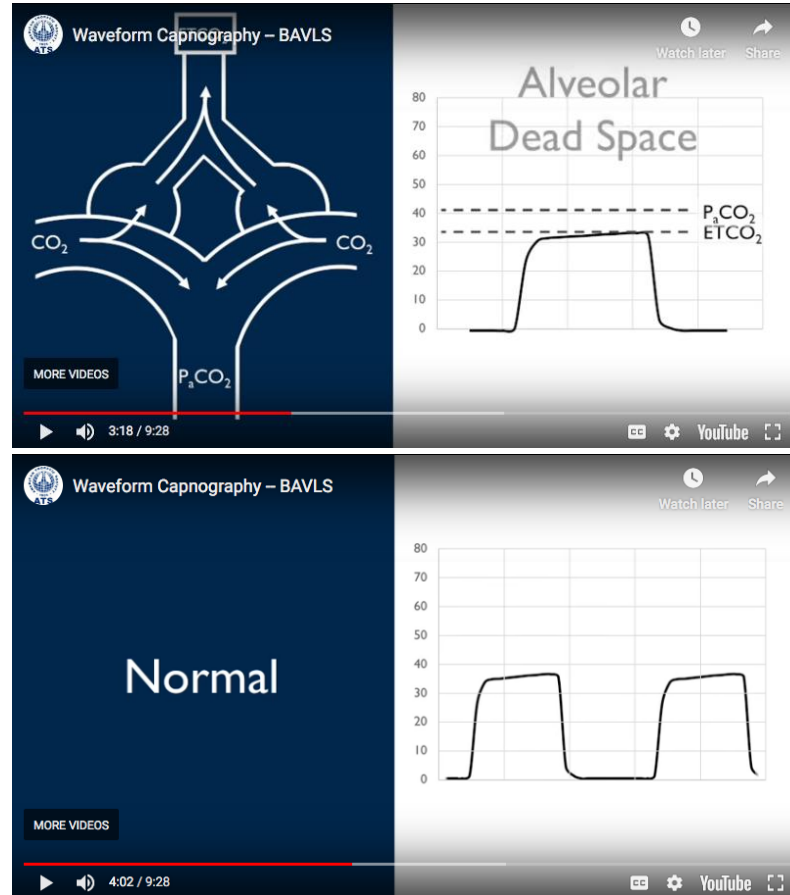
Expiratory Flow Obstruction



- Can't ventilate
 - disconnect to manual ventilator with 100% oxygen
 - gentle manual breaths with long expiratory time to allow lung decompression
- Hypotension
 - as for “can't ventilate”
 - give fluid bolus
 - exclude/treat tension pneumothorax
 - bolus IV adrenaline 10mics/kg
- Worsening hypoxemia
 - 100% oxygen/minimize PEEP/minimize gas trapping

- Sedation/analgesia +/- paralysis
- NG to drain the stomach/provide nutrition
 - D5NS routine 75% maintenance until nutrition initiated
 - provide nutrition
- Patient positioning to reduce pressure sores
 - prone positioning for acute lung injury

- Clinical exam
 - chest rise equal bilaterally
 - patient - ventilator synchrony
- CXR
 - confirm ETT above carina
 - understand disease process
 - identify air leak
- Monitors
 - saturation
 - ETCO_2 /transcutaneous CO_2
 - BP/heart rate
 - ventilator waveforms – know the basics
 - intermittent blood gases
 - capillary/venous/arterial



- **D**isplacement
- **O**bstruction
- **P**neumothorax
- **E**quipment

- Disconnect from ventilator
 - attach to manual ventilator and manually ventilate with 100% high flow oxygen
 - check ETCO₂
- Assess patient using MASH
 - chest **Movement** with bagging
 - **A**rterial saturations?
 - **S**kin color?
 - **H**emodynamic stability?
- Difficult to bag?
 - tube or patient?
 - suction down ETT
 - directly check ETT placement through the cords
 - CXR

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