

Basic Pediatric Mechanical Ventilation

Settings for getting started: Volume Ventilation Mode SIMV/VC

1. **FiO₂** - 50%, if sick 100%. Wean rapidly to FiO₂ < 50% if possible.
2. **Inspiratory time** (I time)- minimum 0.5 seconds, ranging up to 1 second in older kids
3. **Rate** (IMV)- age appropriate 30 (infants) down to 15(adult sized patients) to start.
4. **Tidal volume** (Vt) - 10ml/kg rounding down then look at chest rise, listen for breath sounds and check Peak Inspiratory Pressure (PIP).
5. Decrease Vt **IF** exam reveals excessive chest rise, large air entry and higher than expected PIPs (<30-35 cm H₂O). Elevated PIPs may result from R main stem ET tube placement, mucous plugging, excessive Vt or poor lung compliance, ie. 1° pulmonary disease. Strongly consider switching to pressure control style breath for severe lung disease.
6. Increase Vt **IF** exam reveals poor chest rise, minimal air entry and lower than expected PIPs (<15 cm H₂O). Be aware that adult size ventilator circuits may gobble large amounts of volume each breath. (2-3 cc/ every cm H₂O pressure difference between PIP and PEEP). If this occurs increase Vt or change to a pressure control style breath.
7. **PEEP** - 4cm, higher if FRC compromised by atelectasis, abdominal distension or severe lung disease. Increase in 2cm H₂O aliquots. Volume recruitment with PEEP takes hours but can be lost in minutes.
8. **Pressure Support** (PS)- (If available) for spontaneous breathing patients PS starts at 10 cm H₂O.
9. ABG to accurately assess ventilation status.
10. CXR to confirm adequacy of ET tube placement and chest expansion.
11. End Tidal CO₂ monitors if available.

Settings for getting started: Pressure Ventilation Mode SIMV/PC

1. Same initial settings as Volume control for **FiO₂ , It, Rate, PEEP, and PS.**
2. Although not intuitive Pressure style ventilation offers advantages by allowing effective Vt at lower PIP, and improves oxygenation for any given Vt. Strongly consider pressure ventilation (if available) for large air leaks due to small ET tube size, ineffective ventilation 2° adult vent circuit on small infant/child, or poor lung compliance.
3. Set Pressure control to give effective chest rise and adequate air entry. Expect PIPs 18-22 cm H₂O in patients with healthy lungs, 23-27 cm H₂O for moderate lung disease, 28-35 cm H₂O in more severe disease.
4. Once PC is established, look at machine measured inspiratory and expiratory volumes as an estimate of patients lung compliance. Volumes should be <10ml/kg to avoid overstretch.

Simple Problem solving: When a ventilated patient acutely deteriorates don't be a....

Dislodged ET Tube- check for equal breath sounds, EtCO₂ ?,

Obstructed – Mucous plug, suction!

Pneumothorax- check for equal breath sounds, needle compression vs CXR based on relative urgency

Equipment failure- disconnect from circuit, hand bag, confirm 100% O₂ is flowing

Strategies for more Complex problems:

Hypoxemia: goal is to wean FIO₂ < 50%

1. Minimize airleak by placing larger Et tube, by repositioning head or changing to pressure mode.
2. Increase **PEEP** in 2cm H₂O increments to increase functional residual capacity (Aerated lung volume). Consider paralytics for PEEP > 10.
3. Increase **I time** to increase Mean Airway pressure.
4. Increase Rate especially if PCO₂ is elevated as well and there is need to increase minute ventilation.
5. Changing to **Pressure control** will result in improved oxygenation for the same volume delivered.
6. Once the appropriate Vt is established, recommend against changing volumes. In ARDS ventilator induced lung injury is associated with Tv > 8-10 ml/kg.

High Peak Pressures: (>35 cmH₂O or plateau pressure > 30 cm H₂O)

1. Suction Et tube
2. Check tube position with CXR
3. Consider inhaled bronchodilators especially if patient with prolonged expiratory phase and develop autopeep
4. Changing to **Pressure control** will result in lower peak pressure for the same Vt.
5. Consider adopting a **Permissive hypercapnia strategy** if lung compliance and oxygenation is poor in the face of high peak pressures. This entails limiting delivered Tv to roughly 6ml/kg of ideal body weight, living with much higher PCO₂ and lower saturations (85%), using Higher PEEP and longer It for recruitment and oxygenation.

Considerations for Extubation: Improved lung disease?

Secretions / Sedation / Spontaneous Vt (>5ml/kg) – minimal suction frequency?
Patient awake enough to breath and protect airway?

Oxygenation FiO₂ <35%

Airway - Maintainable? Leak?, Consider steroids 12 hours prior if mechanical ventilation >48° or after multiple airway intubations

Pressures - PIP <25, PEEP < 5

Predictors of Extubation Failure

Variable	Low risk <10%	High Risk >25%
Tv spontaneous	>6.5 ml/kg	<3.5 ml/kg
FIO₂	<0.30	>0.40
PIP	<25cmH ₂ O	>30cmH ₂ O

