Conventional Mechanical Ventilation
For infants in the NICU, utilize volume targeted, pressure limited and time cycled ventilation mode
PC-ACVG

Goals
Mechanical ventilation will be provided with the aim of minimizing lung injury / the development of bronchopulmonary dysplasia (BPD) through the use of the following strategies:
- Gentle ventilation - respiratory support should provide adequate oxygenation and ventilation while preventing volutrauma, atelectrauma, barotrauma, and oxidative injury
- Open lung - maintain functional residual capacity (FRC) through the use of adequate PEEP (avoidatelectrauma)
- Permissive hypercapnia – accept elevated CO₂ and pH >= 7.25 in appropriate cases

Oxygen is a drug and should be administered and weaned judiciously following the NICU O₂ Saturation Guideline

Settings

PC-ACVG
Rate = 30-40 breaths per minute (bpm), adjust based on patient need and wean lower to ensure patient is triggering by evaluating RR trig value on ventilator
PEEP = 5-8 cmH₂O (adjust based on CXR, FiO₂)
Pmax = 25 cmH₂O then to be adjusted 5-7 cmH₂O above measured PIP and changed as necessary
VT = 4-6 ml/kg *see table 1 (for severe chronic lung disease or BPD, 6-8ml/kg may be required) *consider HFOV or HFJV
Ti = 0.3-0.4 sec (adjust based on flow/time waveforms)
Slope adjusted to 1/3 of the Ti

Target blood gases
- pH > 7.25
- pCO₂ = 45-60 mmHg
- SpO₂ = 90-95%
*Higher CO₂s may be acceptable for babies with chronic lung disease (CLD)

Yes
Ongoing evaluation of clinical condition required to optimize ventilation status and requirements

No
Potential Options:
- Consider PC AC
- HFOV or HFJV based on pathophysiology
- Assess for metabolic influences
- Check CXR: for evidence pneumothorax, atelectasis, pulmonary edema, need for ETT / patient repositioning

Consider HFOV/HFJV Strategy

Large leak with difficulty ventilating* despite leak adaptation and the presence of auto cycling

Respiratory Rate > 80*
Consider increasing VT or PEEP depending on cause

Any of the following*:
- VT > 6 ml/kg (unless CLD)
- PIP > 22-25cmH₂O
- FiO₂ > 0.40 (unless CLD)
- Inability to oxygenate or control CO₂

UNLESS

Weaning algorithm/SBT

Sick Kids NICU RRT PPG Group, 2012; updated December 2012; adapted from Calgary Ventilation Algorithms
Weaning Conventional Ventilation

**Goal**
- Continuously assess readiness to wean ventilation/ extubate
- SBT eligibility is to be assessed 2 x per day by team RT and more timely for post op patients depending on extubation plan
- Evaluate eligibility for spontaneous breathing trial (SBT) every shift to assess readiness for extubation and document SBT eligibility
- Consider extubation when patient demonstrates adequate respiratory drive as assessed by RR trig, PEEP level < 8 cmH2O, PIP level <25 cmH2O, VG ≤ 5 ml/kg, Fio2 <0.40 or maintaining steady baseline

**Patient Status**
- Temperature stable and within normal range (exception: therapeutic hypothermia)
- Appropriate vital signs and spontaneously breathing
- Blood gases and/or CO2 monitoring within target ranges (*see target ranges on previous sheet)
- CV stability
- Sedation and PIPP scores reviewed
- Airway protective reflexes present (suck, gag and cough)

**Ventilator Status**
- Set RR ≤ 40 bpm ensure patient is triggering
- Note RR trig and wean set RR to ensure triggering
- VT = 4-6ml/kg with PIP ≤ 25 cmH2O
- PEEP <8
- Fio2 ≤0.40 *note: these ventilator parameters may seem high, but the goal is to “speed up” weaning by using the SBT. Without the SBT, their potential to wean might otherwise be masked by high settings.

**Spontaneous Breathing Trial (SBT)**
*Review SickKids NICU Guidelines

**SWITCH to CPAP/PS mode for 10 minutes**
- PS 5-8 to achieve a spontaneous VT of 4-6 mls/kg and minimize work of breathing
- maintain original PEEP
- *CPAP/PS mode should be limited to a maximum of 2-4 hours if performing extended test to ensure

**Failure Criteria**
1. A decrease in HR>20% from baseline for > 5 seconds
2. A decrease in SpO2 despite a 0.15 increase in Fio2 from baseline
3. Apnea >20 seconds

**Failure Criteria met?**
- NO
  - Ready to extubate? No, as per medical team
  - Communicate results of SBT with Medical team
  - Obtain extubation order
  - Extubate within 1 hour of receiving order

- YES
  - Consider need for Non-invasive Respiratory Support prior to and post-extubation
  - Return to clinically appropriate ventilator settings
  - Discuss results with medical team
  - Re-evaluate sedation needs and weaning if failure was due to poor respiratory drive
  - Establish a plan regarding next trial

**Consider need for Non-invasive Respiratory Support**
- Prior to and post-extubation

Sick Kids NICU RRT PPG Group, 2012; updated December 2012; adapted from Calgary Ventilation Algorithms
Table 1

<table>
<thead>
<tr>
<th>Condition</th>
<th>Initial $V_t$</th>
<th>Initial PIP limit</th>
<th>Rationale for $V_t$, rationale for PIP</th>
<th>Reference for $V_t$, choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term, late preterm, normal lungs</td>
<td>4–4.5 mL/kg</td>
<td>18 cm H$_2$O</td>
<td>Baseline/normal compliance</td>
<td>Dawson, et al$^{19}$</td>
</tr>
<tr>
<td>Preterm RDS 1250–2500 g</td>
<td>4–4.5 mL/kg</td>
<td>26 cm H$_2$O</td>
<td>Low alveolar dead space/decreased compliance</td>
<td>Dawson, et al$^{19}$</td>
</tr>
<tr>
<td>Preterm RDS 700–1249 g</td>
<td>4.5–5 mL/kg</td>
<td>24 cm H$_2$O</td>
<td>Dead space of the flow sensor/decreased compliance, risk of air leak</td>
<td>Nassabeh-Montazami, et al$^{15}$</td>
</tr>
<tr>
<td>Preterm RDS &lt;700g</td>
<td>5.5–6 mL/kg</td>
<td>24 cm H$_2$O</td>
<td>Dead space of the flow sensor/decreased compliance, risk of air leak</td>
<td>Nassabeh-Monta-zi, et al$^{15}$</td>
</tr>
<tr>
<td>Preterm evolving BPD, 3 weeks old</td>
<td>5.5–6.5 mL/kg</td>
<td>26 cm H$_2$O</td>
<td>Increased anatomical and alveolar dead space/worsening compliance</td>
<td>Kessler, et al$^{17}$</td>
</tr>
<tr>
<td>Term MAS with classic CXR*</td>
<td>5.5–6 mL/kg</td>
<td>28 cm H$_2$O</td>
<td>Increased alveolar dead space/poor compliance</td>
<td>Sharma, et al$^{16}$</td>
</tr>
<tr>
<td>Term MAS with white-cut CXR</td>
<td>4.5–5 mL/kg</td>
<td>30 cm H$_2$O</td>
<td>Alveolar dead space less of a problem/very poor compliance</td>
<td>Kessler$^{10}$</td>
</tr>
<tr>
<td>Term CDH</td>
<td>4–4.5 mL/kg</td>
<td>24 cm H$_2$O</td>
<td>Maintain normal alveolar minute ventilation/risk of air leak</td>
<td>Sharma, et al$^{18}$</td>
</tr>
<tr>
<td>Established severe BPD</td>
<td>7–12 mL/kg</td>
<td>30 cm H$_2$O</td>
<td>Greatly increased alveolar and anatomical dead space; lower respiratory rate due to long time constants, needs larger $V_t$</td>
<td>Abman, et al$^{81}$</td>
</tr>
</tbody>
</table>

* Classic CXR in MAS shows heterogeneous inflation and air trapping.

BPD, bronchopulmonary dysplasia; CDH, congenital diaphragmatic hernia; CXR, chest radiograph; MAS, meconium aspiration syndrome; RDS, respiratory distress syndrome.

Keszler M. Arch Dis Child Fetal Neonatal Ed 2018;0:F1–F5. doi:10.1136/archdischild-2017-314734

References


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