Spinning Dials
How to dominate the Ventilator

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Two Strategies of Ventilation

Injury  This strategy is for patients with lung injury and those prone to lung injury. Essentially this means every intubated patient except those with…
Obstruction  Use this strategy when patients are in the midst of an Asthma/COPD exacerbation

Injury Strategy
Based on ARDSnet (ARMA Study-N Engl J Med 2000;342,1301-1308)

Mode
Assist Control (AC)-Volume

Tidal Volume (Vt)=Protection
6-8 cc/kg, based on PBW (see last page). If ALI/ARDS, the goal is to get down to 6 cc/kg.
Why? Injured lungs are baby lungs
This setting should not be altered to fix ventilation
It only gets changed for lung protection (i.e. to prevent barotrauma/volutrauma)

Flow Rate (IFR)=Comfort
60-80 lpm
This setting controls how quickly the air goes in

Rate (RR)=Ventilation
Initially 18, adjust based on CO₂ and ventilatory needs
Va for a normal CO₂ when not intubated is 60 cc/kg/min
We need to double that to 120 cc/kg/min when intubated b/c of increased deadspace
Need double that volume (240 cc/kg/min) to send CO₂ from 40 to 30
Try to keep mildly hypercarbic

FiO₂/PEEP=Oxygenation
Many ventilator evils would be fixed if these were on one knob
1. Start at 100% and PEEP of 0 or 5
2. Wait 5 minutes and then draw an ABG
3. Then set the FiO₂ to 30% and start titrating based on the chart. Go up every 5-10 minutes; quicker if low sats

<table>
<thead>
<tr>
<th>OXYGENATION GOAL: PaO₂ 55-80 mmHg or SpO₂ 88-95%</th>
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</thead>
<tbody>
<tr>
<td>Use a minimum PEEP of 5 cm H₂O. Consider use of incremental FiO₂/PEEP combinations such as shown below (not required) to achieve goal.</td>
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<table>
<thead>
<tr>
<th>Lower PEEP/higher FiO₂</th>
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<tbody>
<tr>
<td><strong>FiO₂</strong></td>
</tr>
<tr>
<td><strong>PEEP</strong></td>
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</table>

| **FiO₂**   | 0.7 | 0.8 | 0.9 | 0.9 | 1.0 |
| **PEEP**   | 14  | 14  | 14  | 16  | 18  |

Many doctors, even in specialties that should know better, are irrationally afraid of PEEP.

Good  | Bad  | Ugly Myths
--- | --- | ---
Improves V/Q Match  | Decreased Venous Return  | Causes Pneumothorax
Decreases Shunt  | May need more fluid  | Pt’s head will explode
Decreases Atelectasis/trauma  |  |  
Improves Spont. Breathing  |  |  

Many doctors, even in specialties that should know better, are irrationally afraid of PEEP.
Check Plateau Pressure
Check it after initial settings and at regular intervals thereafter
Use the inspiratory hold button, hold for 0.5 sec—look at pressure gauge
The peak pressure is essentially meaningless
Plateau pressure must be maintained <30 cm H20. Keep lowering the Vt until Plat <30. You may need to go as low as 4 cc/kg.

Disadvantages of this strategy
It is not the most comfortable strategy of ventilation for awake, spontaneously breathing patients
Use sedation/pain medications
Give enough flow; if you see the patient sucking the straw, increase the IFR setting

Obstructive Strategy
Goal is to give as much expiratory time as possible

Mode-Assist Control
Vt-8 cc/kg by PBW
IFR-80-100 lpm
PEEP-0
FiO2-use whatever you need, most folks are fine at 40%
RR-Start at 10 bpm. Look for I:E of 1:4 or 1:5 Adjust the rate to achieve this.

Permissive Hypercapnia
Patients will need tons of sedation/opioids
Keep pH above 7.1; rarely, you may need a bicarb drip to accomplish this

AutoPEEP and Airtrapping
They decrease venous return, impede expiration, & impede spont vent

Other Concerns
Large Tubes
At least 8.0 whenever possible, for both male and female patients. Pulmonary toilet and ICU care is miserable with small tubes. Biofilm forms within the first two days reducing tube size dramatically.
Ventilator Alarms
Treat them like a code announcement. The closest person should run to the patients bedside and assess the situation.

Appendix

INCLUSION CRITERIA: Acute onset of
1. PaO2/FiO2 ≤ 300 (corrected for altitude)
2. Bilateral (patchy, diffuse, or homogeneous) infiltrates consistent with pulmonary edema
3. No clinical evidence of left atrial hypertension

PART I: VENTILATOR SETUP AND ADJUSTMENT
1. Calculate predicted body weight (PBW)
   - Males = 50 + 2.3 [height (inches) - 60]
   - Females = 45.5 + 2.3 [height (inches) -60]
2. Select any ventilator mode
3. Set ventilator settings to achieve initial VT = 8 ml/kg PBW
4. Reduce VT by 1 ml/kg at intervals ≤ 2 hours until VT = 6ml/kg PBW.
5. Set initial rate to approximate baseline minute ventilation (not > 35 bpm).
6. Adjust VT and RR to achieve pH and plateau pressure goals below.

OXYGENATION GOAL: PaO2 55-80 mmHg or SpO2 88-95%
Use a minimum PEEP of 5 cm H2O. Consider use of incremental FiO2/PEEP combinations such as shown below (not required) to achieve goal.

Lower PEEP/higher FiO2
<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
<th>0.5</th>
<th>0.5</th>
<th>0.6</th>
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<tbody>
<tr>
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<td>5</td>
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<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>0.9</th>
<th>0.9</th>
<th>1.0</th>
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<tbody>
<tr>
<td>PEEP</td>
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<td>14</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>18-24</td>
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</tbody>
</table>

Higher PEEP/lower FiO2
<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.3</th>
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<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
<th>0.5</th>
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</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>16</td>
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<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.5</th>
<th>0.5-0.8</th>
<th>0.8</th>
<th>0.9</th>
<th>1.0</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>24</td>
</tr>
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PLATEAU PRESSURE GOAL: ≤ 30 cm H2O
Check Pplat (0.5 second inspiratory pause), at least q 4h and after each change in PEEP or VT.
If Pplat > 30 cm H2O: decrease VT by 1ml/kg steps (minimum = 4 ml/kg).
If Pplat < 25 cm H2O and VT < 6 ml/kg, increase VT by 1 ml/kg until Pplat > 25 cm H2O or VT = 6 ml/kg.
If Pplat < 30 and breath stacking or dys-synchrony occurs: may increase VT in 1ml/kg increments to 7 or 8 ml/kg if Pplat remains ≤ 30 cm H2O.

How to perform an Insp Hold to Check Plateau Pressure
1. Press the “Insp Hold” button and hold it
2. Read the value here

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