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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  $CO_2$  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

## FiO<sub>2</sub>/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 OXYGENATION GOAL: PaO<sub>2</sub> 55-80 mmHg or SpO<sub>2</sub> 88-95%

Use a minimum PEEP of 5 cm  $H_2O$ . Consider use of incremental FiO<sub>2</sub>/PEEP combinations such as shown below (not required) to achieve goal.

#### Lower PEEP/higher FiO2

| FiO <sub>2</sub> | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.7 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| PEEP             | 5   | 5   | 8   | 8   | 10  | 10  | 10  | 12  |
|                  |     |     |     |     |     |     |     |     |

| FiO <sub>2</sub> | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0   |
|------------------|-----|-----|-----|-----|-----|-------|
| PEEP             | 14  | 14  | 14  | 16  | 18  | 18-24 |

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

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

#### **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

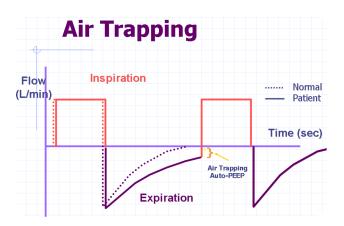
Mode-Assist Control Vt-8 cc/kg by PBW IFR-80-100 lpm PEEP-0 FiO2-use whatever you need, most folks are fine at 40% RR-Start at 10 bpm. Look for I:E of 1:4 or 1:5 Adjust the rate to achieve this.

#### 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**



NIH NHLBI ARDS Clinical Network Mechanical Ventilation Protocol Summary

#### **INCLUSION CRITERIA: Acute onset of**

- 1.  $PaO_2/FiO_2 \leq 300$  (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  $V_T = 8 \text{ ml/kg PBW}$
- 3. Set ventilator settings to achieve initial  $V_T = 8 \text{ ml/kg PBW}$
- Reduce V<sub>T</sub> by 1 ml/kg at intervals ≤ 2 hours until V<sub>T</sub> = 6ml/kg PBW.
  Set initial rate to approximate baseline minute ventilation (not > 35 bpm).
- 6. Adjust  $V_T$  and RR to achieve pH and plateau pressure goals below.

#### OXYGENATION GOAL: PaO<sub>2</sub> 55-80 mmHg or SpO<sub>2</sub> 88-95%

Use a minimum PEEP of 5 cm  $H_2O$ . Consider use of incremental FiO<sub>2</sub>/PEEP combinations such as shown below (not required) to achieve goal.

#### Lower PEEP/higher FiO2

| FiO <sub>2</sub> | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6   | 0.7 | 0.7 |
|------------------|-----|-----|-----|-----|-----|-------|-----|-----|
| PEEP             | 5   | 5   | 8   | 8   | 10  | 10    | 10  | 12  |
|                  |     |     |     |     |     |       |     |     |
| FiO <sub>2</sub> | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0   |     |     |
| PEEP             | 14  | 14  | 14  | 16  | 18  | 18-24 |     |     |

#### Higher PEEP/lower FiO2

| FiO <sub>2</sub> | 0.3 | 0.3   | 0.3 | 0   | .3 | 0.3 | 0.4 | 0.4 | 0.5 |
|------------------|-----|-------|-----|-----|----|-----|-----|-----|-----|
| PEEP             | 5   | 8     | 10  | 1   | 2  | 14  | 14  | 16  | 16  |
|                  |     |       |     |     |    |     |     |     |     |
| FiO <sub>2</sub> | 0.5 | 0.5-0 | .8  | 0.8 | (  | 0.9 | 1.0 | 1.0 |     |
| PFFP             | 18  | 20    | 20  |     |    | 22  | 22  | 24  |     |

#### PLATEAU PRESSURE GOAL: $\leq$ 30 cm H<sub>2</sub>O

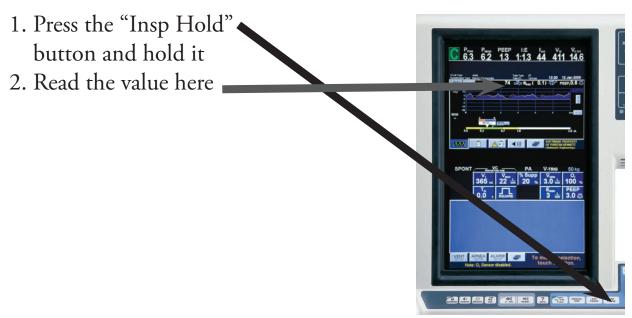
Check Pplat (0.5 second inspiratory pause), at least q 4h and after each change in PEEP or  $V_{\mbox{\scriptsize T}}.$ 

If Pplat > 30 cm H<sub>2</sub>O: decrease  $V_T$  by 1ml/kg steps (minimum = 4 ml/kg).

If Pplat < 25 cm H<sub>2</sub>O and V<sub>T</sub>< 6 ml/kg, increase V<sub>T</sub> by 1 ml/kg until Pplat > 25 cm H<sub>2</sub>O or V<sub>T</sub> = 6 ml/kg.

If Pplat < 30 and breath stacking or dys-synchrony occurs: may increase V<sub>T</sub> in 1ml/kg increments to 7 or 8 ml/kg if Pplat remains  $\leq$  30 cm H<sub>2</sub>O.

# How to perform an Insp Hold to Check Plateau Pressure



#### **Questions**

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