



by Scott Weingart MD

This handout came from a lecture I recently gave at Beth Israel. It is based on my interpretation of the best available evidence. If you disagree with any of the points made, I would love to hear your thoughts.

It details the only two ventilator strategies I feel are needed to manage ED patients. This is as simple as I can make ventilator management; yet, no intensivist, pulmonologist, or medical resident will be able to argue with your vent settings if you go this way.

Also included is the post-tube package—a list of the therapies I believe every intubated patient should receive. These are standard of care in the ICU, but vent patients in the ED are sometimes treated as second-class citizens by respiratory therapy. Fight for your patients!

A handwritten signature in blue ink, appearing to read 'S Weingart MD'.

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

OXYGENATION GOAL: PaO₂ 55-80 mmHg or SpO₂ 88-95%

Use incremental FiO₂/PEEP combinations below to achieve goal

FiO₂	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

FiO₂	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0
PEEP	14	14	14	16	18	20	22	24

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			

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 H₂O. Keep lowering the V_t 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

V_t-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.

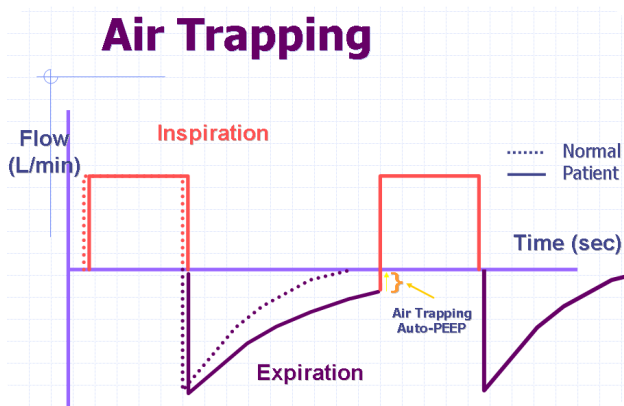
Permissive Hypercapnia

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



The Post Tube Package

- Tube Securing Device-Use a commercial device whenever available; tape works in the OR, not the ED
- Raise the Head of the Bed (HOB) to 30-45°-this simple action decreases vent assoc. pneumonia
- Place a Heat Moisture Exchanger (HME)-your nose adds heat and moisture to your inspiration, this device does the same thing for the vented patient—they need it even more than you do
- Place In-line suction and use it-if the in-line is not there it is a pain to suction, we do not like to do painful tasks. Make it easy instead.

continued...

- **ETCO₂ Monitoring**-not a substitute for checking PaCO₂, but gives immediate feedback on tube displacement. When the ETCO₂ is high, the PaCO₂ definitely is as well. When low, who knows.
- **Check Cuff Pressure (< 30 cm H₂O)**-We (anesthesiologists, emergency physicians, intensivists, paramedics) are really bad at guessing proper cuff inflation by feel. You must measure! Get a cufflator or ask resp to check it.
- **Nebulizers/MDI**-all intubated patients benefit from nebs; in asthma/copd patients they are an absolute necessity
- **Gastric Tube**-all intubated patients need gastric decompression to lower aspiration risk
- **ABG**-get it 5-10 minutes after you intubate and then trend
- **Chest Xray**-'nuff said
- **Sedation/Pain Control**-patients need sedatives and opioids
- **BVM ± PEEP Valve**-a BVM with a mask should be at the bedside of every intubate patient. If they are on a PEEP greater than 10, then there better be a PEEP valve attached to it. If they are ventilated with the BVM without PEEP their sats will drop like a stone.
- **DVT Prophylaxis**-consider starting in the ED; the dvt clock starts ticking as soon as the patient stops moving

Other Package Concerns

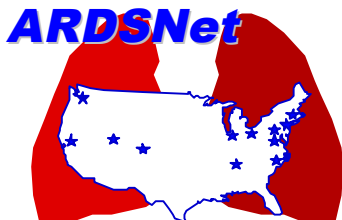
Large Tubes

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
www.ardsnet.org

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 Assist Control Mode
3. Set initial TV to 8 ml/kg PBW
4. Reduce TV by 1 ml/kg at intervals ≤ 2 hours until TV = 6ml/kg PBW.
5. Set initial rate to approximate baseline VE (not > 35 bpm).
6. Adjust TV and RR to achieve pH and plateau pressure goals below.
7. Set inspiratory flow rate above patient demand (usually > 80L/min)

OXYGENATION GOAL: PaO₂ 55-80 mmHg or SpO₂ 88-95%

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PLATEAU PRESSURE GOAL: ≤ 30 cm H₂O

Check Pplat (0.5 second inspiratory pause), SpO₂, Total RR, TV and pH (if available) at least q 4h and after each change in PEEP or TV.

If Pplat > 30 cm H₂O: decrease TV by 1 ml/kg steps (minimum = 4 ml/kg).

If Pplat < 25 cm H₂O: TV < 6 ml/kg, increase TV by 1 ml/kg until Pplat > 25 cm H₂O or TV = 6 ml/kg.

If Pplat < 30 and breath stacking occurs: may increase TV in 1 ml/kg increments (maximum = 8 ml/kg).

pH GOAL: 7.30-7.45

Acidosis Management: (pH < 7.30)

If pH 7.15-7.30: Increase RR until pH > 7.30 or PaCO₂ < 25 (Maximum RR = 35).

If RR = 35 and PaCO₂ < 25, may give NaHCO₃.

If pH < 7.15: Increase RR to 35.

If pH remains < 7.15 and NaHCO₃ considered or infused, TV may be increased in 1 ml/kg steps until pH > 7.15 (Pplat target may be exceeded).

Alkalosis Management: (pH > 7.45) Decrease vent rate if possible.

Questions

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