The Importance of ARDSnet and Delta P in ARDS Treatment

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Objectives

- Briefly describe Acute Respiratory Distress Syndrome.
- Understand the history, purpose, and protocols developed from the ARDSnet research.
- Describe how the optimal use of Delta P can help prevent and treat ARDS.

What is ARDS?

- ARDS is a type of acute lung injury affecting ~200,000 patients annually in the U.S.[1]
- Results in nearly 75,000 deaths per year[1]
- Mortality rate is approximately 35-46%[1]

Criteria

- Mild: P/F 200-300
- Moderate: P/F 100-200
- Severe: P/F < 100

1. Radiographic severity
2. Compliance ≤ 40ml/cmH_2O
3. PEEP ≥ 10cmH_2O
4. VE ≥ 10L/min [2]

Salihefendic N, Zildzic M, Ahmetagic S. Acute Respiratory Distress Syndrome (ARDS) from Endemic Influenza A/H1N1: Prehospital Management. Med Arch (2015) **Figure 5:** Chest X-ray third day of disease-ARDS. Bilateral lung infiltrates Influenza A/H1N1

ARDSnet

- Formed in 1994 by the NIH and NHLBI to research effective treatments for ARDS patients.[3]
- Tested use of lower VT as a mechanical ventilation strategy in ARDS patients.
- Found a 22% decease in mortality.[4-5]

ARDSnet Protocols

- First recognize the patient is experiencing acute onset of ARDS.
- Use patient's PBW to achieve a V_T of 6ml/kg and set a RR to achieve appropriate M_{Ve}.
- Then adjust accordingly to achieve pH of 7.30-7.45 and $P_{PL} \leq 30$ cmH_2O.
- Use a minimum PEEP setting of 5 cmH_2O and adjust PEEP and FiO_2 incrementally to achieve PaO_2 of 55-80 mmHg and SpO_2 of 88-95%.[6]

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 ml/kg PBW
4. Reduce V_T by 1 ml/kg at intervals ≤ 2 hours until V_T = 6ml/kg PBW.
5. 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_2 55-80 mmHg or SpO_2 88-95%
Use a minimum PEEP of 5 cm H_2O. Consider use of incremental FiO_2/PEEP combinations such as shown below (not required) to achieve goal.

Lower PEEP/higher FiO2

FiO_2	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_2	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_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO_2	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

PLATEAU PRESSURE GOAL: ≤ 30 cm H_2O
Check Pplat (0.5 second inspiratory pause), at least q 4h and after each change in PEEP or V_T.
If Pplat > 30 cm H_2O: decrease V_T by 1ml/kg steps (minimum = 4 ml/kg).
If Pplat < 25 cm H_2O and V_T< 6 ml/kg, increase V_T by 1 ml/kg until Pplat > 25 cm H_2O or V_T = 6 ml/kg.
If Pplat < 30 and breath stacking or dys-synchrony occurs: may increase V_T in 1ml/kg increments to 7 or 8 ml/kg if Pplat remains ≤ 30 cm H_2O.

NIH NHLBI ARDS Clinical Network. Mechanical ventilation protocol summary. ARDSNet Website. 2008. Cited on 19 March 2018 from http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf

pH GOAL: 7.30-7.45

Acidosis Management: (pH < 7.30)

If pH 7.15-7.30: Increase RR until pH > 7.30 or $PaCO_2$ < 25 (Maximum set RR = 35).

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If pH < 7.15: Increase RR to 35.

If pH remains < 7.15, V_T may be increased in 1 ml/kg steps until pH > 7.15 (Pplat target of 30 may be exceeded).

May give $NaHCO_3$

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

I: E RATIO GOAL: Recommend that duration of inspiration be ≤ duration of expiration.

PART II: WEANING

A. Conduct a SPONTANEOUS BREATHING TRIAL daily when:

1. $FiO_2 \leq 0.40$ and PEEP ≤ 8 OR $FiO_2 \leq 0.50$ and PEEP ≤ 5.
2. PEEP and FiO_2 ≤ values of previous day.
3. Patient has acceptable spontaneous breathing efforts. (May decrease vent rate by 50% for 5 minutes to detect effort.)
4. Systolic BP ≥ 90 mmHg without vasopressor support.
5. No neuromuscular blocking agents or blockade.

B. SPONTANEOUS BREATHING TRIAL (SBT):

If all above criteria are met and subject has been in the study for at least 12 hours, initiate a trial of UP TO 120 minutes of spontaneous breathing with FiO2 ≤ 0.5 and PEEP ≤ 5:

1. Place on T-piece, trach collar, or CPAP ≤ 5 cm H_2O with PS ≤ 5
2. Assess for tolerance as below for up to two hours.
   a. $SpO_2 \geq 90$: and/or $PaO_2 \geq 60$ mmHg
   b. Spontaneous $V_T \geq 4$ ml/kg PBW
   c. RR ≤ 35/min
   d. pH ≥ 7.3
   e. No respiratory distress (distress= 2 or more)
      - HR > 120% of baseline
      - Marked accessory muscle use
      - Abdominal paradox
      - Diaphoresis
      - Marked dyspnea
3. If tolerated for at least 30 minutes, consider extubation.
4. If not tolerated resume pre-weaning settings.

Definition of UNASSISTED BREATHING

(Different from the spontaneous breathing criteria as PS is not allowed)

1. Extubated with face mask, nasal prong oxygen, or room air, OR
2. T-tube breathing, OR
3. Tracheostomy mask breathing, OR
4. CPAP less than or equal to 5 cm H_20 **without pressure support or IMV assistance.**

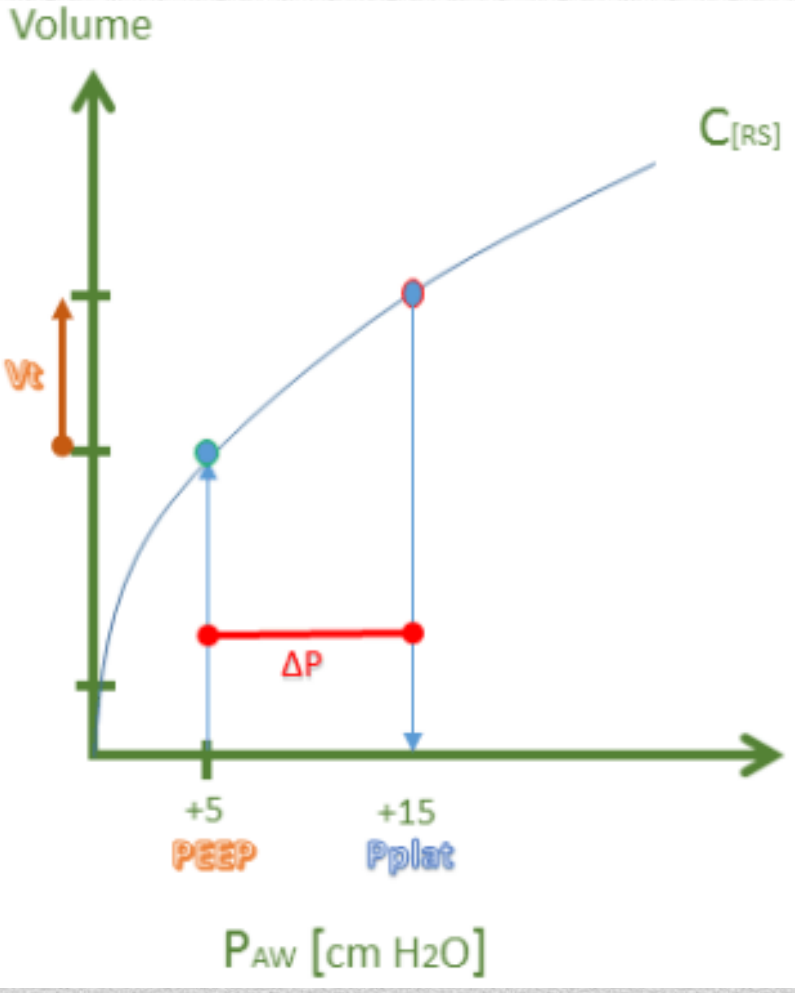
NIH NHLBI ARDS Clinical Network. Mechanical ventilation protocol summary. ARDSNet Website. 2008. Cited on 19 March 2018 from http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf

What is Delta P?

- ΔP is calculated as "the airway pressure changes from PEEP to end-inspiratory plateau pressure."[7]
- Biotrauma: "Shear Stress" caused by the repeated opening and closing of the lung during ventilation.[8]
- Amato et al. found that "decreases in ΔP were strongly associated with increased survival."[9]

$$Pplat - PEEP^{*} = \frac{[Vt^{*}]}{Crs}$$

* indicates clinician controlled [independent variable]



Kenney JES. ICU Physiology in 1000 Words: Driving Pressure & Stress Index. Cited 20 March 2018 from https://pulmccm.org/review-articles/icu-physiology-in-1000-words-driving-pressure-stress-index/

Summary

- ARDS is a rapid onset disease process that needs to be recognized early and treated aggressively and appropriately with lung protective strategies.
- ARDSnet played a significant role in the development of the protocols used to ventilate ARDS patients.
- While more research needs to be done, using reduced ΔP ventilation strategies can improve patient outcomes.

References

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