Alveolar Recruitment during Lung Protective Ventilation in Acute Respiratory Distress Syndrome (ARDS)

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ABSTRACT

TITLE: Alveolar Recruitment during Lung Protective Ventilation in Acute Respiratory Distress Syndrome (ARDS)

BACKGROUND: Recent alveoli and reverse atelectaxis for the ARDS mechanically ventilated patient

OBJECTIVE: Reduce Mortality Rates from the current range of 22-41%

METHODS: Literature Review of ARDSNet Protocol, ART trials, and other alveolar recruitment studies

RESULTS: Recruitment maneuvers (RM) featuring stepwise PEEP increases to 45cmH2O along with prone positioning (PP) increase PaO2/PO2 (PF) ratios up to 59%

CONCLUSIONS: Bi-level ventilation following RM of PP plus stepwise PEEP increases to 45cmH2O maintain an open lung to help correct refractory hypoxemia and reduce alveolar collapse in ARDS patients

INTRODUCTION

Ventilator Management of ARDS Patient during Lung Protective Ventilation (VT: 4-6 ml/kg)

Recognition of Atelectasis and Refractory Hypoxemia

BiLevel / APRV maintain an Open Lung through PEEP

RM of sequential PEEP Increases up to 45 cmH2O

PEEP 5 5 8 8 10 10 10 12 14 14 16 18 20 24

Table 1 ARDSNet table of FiO2 and PEEP values to keep SpO2 ≥ 88% or PaO2 ≥ 55 mmHg

Predicted body weight should be calculated for all patients according to the formula:

Men: Predicted body weight(kg)=50+2.3(Height[cm]*0.394)−60
Women: Predicted body weight(kg)=45.5+2.3(Height[cm]*0.394)−60

METHODS

Literature review of ART Trials, ARDSNet Protocol, Prone Positioning in the Low tidal volume (VT) era, Airway Pressure Release Ventilation. PEEP-induced Changes in ARDS. Efficacy & Safety of RM in ARDS. Prone Positioning and RM (the combined effect improves oxygenation), and other similar studies.

RESULTS

PEEP

Using minimal PEEP, up to 53% of lung tissue is non-aerated.
Using maximal PEEP, non-aerated lung tissue reduced to 8%.
Loss of PEEP for as little as 10 seconds causes marked CO2 increases and marked PO2 decreases during ventilator disconnects.
High PEEP does not cause VILI
Large VT of 8-12 ml/Kg does cause VILI due to sheering and over-distending alveoli.

Prone Positioning (PP)

Prone Positioning can reduce ARDS mortality by 50%
Prone Positioning is a RM by itself and/or can be used in combination with step-wise PEEP increases to 45 cmH2O as a RM.

Recruitment Maneuvers

PF Ratios increased 59% from 159 to 300 while Plateau Pressure decreased following step-wise PEEP increases to 45 cmH2O as a RM with PP
One time, sequential PEEP increases up to 45 cmH2O helps to achieve a “Open Lung”.
Utilize PEEP ladder for conventional ventilation or Bi-level to maintain PEEP and integrity of utilization of alveoli/veoli that have been recruited

ARDSNet Protocol

Utilizing the ARDSNet Protocol VT of 6 ml/kg has reduced ARDS mortality by 9%
Use ideal body weight (IBW) for lung protective ventilation VT of 6 ml/Kg
Utilize PEEP ladder from table 1.

BiLevel/APRV

APRV applied early on in ARDS maintains alveolar surfactant levels and improves oxygenation.
Bi-level/APRV improves trans-pulmonary pressures with a reduction of dead space plus improved ventilation/perfusion (VQ) matching.
Bi-level/APRV reduces alveolar microstrain and VILI
Spontaneous respirations account for 10-30% of minute ventilation (VE) in Bi-level.

REFERENCES

The ART Investigators Trials. (2011). Rationale, study design, and analysis plan of the Alveolar Recruitment for ARDS Trial (ARTT): Study protocol for a randomized controlled trial. JAMA, 305(15). Retrieved from http://www.thelancet.com/content/331/5910/1
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ECMO should be used as a rescue therapy only.

CONCLUSIONS

PF Ratio increased up to 59% with Plateau Pressure decreases following Step-Wise PEEP RM to 45 cmH2O with Prone Positioning.
Combining RM with PP leads to the largest increases in PF Ratios.
Maximum VT of 6 ml/Kg and Plateau Pressure < 30 cmH2O improves ARDS survival rates.
High PEEP prevents rapid lung de-recruitment and increases functional residual capacity (FRC).
HFV should not be used as it increased mortality by 12% vs. conventional ventilation.