

# Recruitment Maneuvers in ARDS

*Nepean WTET summary 31/3/20*

## Rationale and Methods

- The heterogeneity of lung parenchyma in ARDS means areas of lung are collapsed, not involved in gas exchange and/or are subject to atelectotrauma. If opened (open-lung strategy) could become involved in gas exchange with improved oxygenation (allowing reduced FiO<sub>2</sub> requirement and improved systemic organ function) and reduced over-distension of healthy alveoli (baby lung)
- A recruitment maneuver (RM) involves a transient increase in alveolar pressure aimed at opening up collapsed alveoli (therapeutic)
- Responders to recruitment in ARDS forms a sub-phenotype associated with better outcomes (prognostic; but shouldn't be used for this purpose)
- Methods;
  - 40cmH<sub>2</sub>O for 40-50s
  - Inspiratory hold >10s
  - 3 consecutive sighs /min; plateau pressure 45cmH<sub>2</sub>O
  - 2 mins peak pressure 50cmH<sub>2</sub>O and PEEP above upper inflection point
  - Slow increase in inspiratory pressure up to 40cmH<sub>2</sub>O (ramp)
  - Staircase RM;
    - Adjust FiO<sub>2</sub> to SpO<sub>2</sub> 90-92% and set fixed driving pressure 15cmH<sub>2</sub>O
    - Increase PEEP every 2mins 20/30/40cmH<sub>2</sub>O (peak pressure will be 55cmH<sub>2</sub>O)
    - Reduce PEEP to 25cmH<sub>2</sub>O then every 2-3mins 22.5/20/17.5/15 (min 15) cmH<sub>2</sub>O until decrease in SpO<sub>2</sub>  $\geq$ 1% from max observed SpO<sub>2</sub> (→ de-recruitment point)
    - Increase PEEP to 40cmH<sub>2</sub>O for one minute then return to 2.5cmH<sub>2</sub>O above de-recruitment point
    - Adjust Vt to 6ml/kg PBW, Pplat<30cmH<sub>2</sub>O, tolerate permissive hypercapnoea pH>7.15, max RR 38

## Advantages and Disadvantages

- Advantages;
  - Quick, easy, cheap, no special equipment
  - Patients usually already sedated and paralysed; most benefit in prone position
  - Can select technique tailored to patient's individual risk
  - Improved oxygenation and gas exchange, reduced inflammatory biomarkers
- Disadvantages;
  - Needs sedation and paralysis; ARDS heterogenous population – doesn't work for all
  - May cause barotrauma/VILI to healthy lung and/or pneumothorax/pneumomediastinum
  - CVS instability (increased RV afterload, reduced preload)
  - No consensus on how RM should be performed; improvement in oxygenation ?transient

## Evidence

- Small studies and animal studies
  - Showed improvement in lung mechanics and gas exchange
  - No real patient-centered benefit demonstrated

- Cochrane review 2016
  - Recruitment in adults with acute respiratory failure due to lung injury
  - 10 trials, n=1658 with ARDS
  - Low quality evidence shows improvement in ICU survival but not 28d or hospital mortality
  - Quality 'low' as often part of other ventilation strategies and not studied as isolated intervention
- ART trial (JAMA 2017)
  - MC RCT 1:1 non-blinded, 9 countries (Brazil and South America mostly)
  - <72h of ARDS P/F<200mmHg, lung protective ventilation (LPV) both arms
  - Method changed from stepwise to single step during study
  - Mortality at 28d (55.3% vs 49.3%) and 6m higher in recruitment group P<0.05; similarly higher pneumothorax and barotrauma risk
  - No difference in LOS, 6y for data collection, used static compliance
  - Did not assess PEEP responsiveness, higher than expected mortality for mod-severe ARDS, ?subgroups may benefit (heterogenous population)
- PHARLAP (Am J Resp & Crit Care Med 2019)
  - Permissive Hypercapnoea, Alveolar Recruitment and Low Airway Pressure
  - Phase 2 MC RCT parallel group; ANZICS CTG (Au/NZ)
  - <48h ARDS P/F<200mmHg and <5d mechanically ventilated; staircase vs no RM; both LPV
  - Terminated early due to ART results; 115 of planned 340 patients recruited
  - No difference in entitator free days at 28d (16 vs 14.5) or mortality; similarly no difference in barotrauma. But fewer hypoxaemic adjuvant therapies (nitric, ecmo) in intervention group
  - Overall more adverse events in control group (hypoxia, MOF); but more arrhythmias in intervention arm. Underpowered due to early termination

### Summary (my practice)

- These studies show that RM are not a one-size fits all salvage therapy in moderate-severe ARDS
- I do not believe this to be the end of open lung ventilation or RM in this heterogenous group
- Careful patient selection is key, considering;
  - Those who may benefit; radiological evidence of recruitable lung, PEEP responders
  - Those to whom the risk of harm is high; bullous lung disease, significant CVS instability
- Timing is important;
  - Early rather than late (not a rescue strategy in late disease where fibrotic changes evolving)
  - Try to time it with proning -if patient is being proned (more efficacious)
  - ?Prophylactically once CVS stability reached and repeat if/when PEEP is lost (eg unplanned disconnections, after bronchoscopy or prolonged suctioning)
- Method (patient-dependent);
  - In general I avoid formal stair-case RM as used in ART and PHARLAP. However my usual practice is to assess response to incremental PEEP (looking at a combination of oxygenation and driving pressure) for an individualised approach to setting PEEP. Though similar to a stair-case RM it does not reach as high pressures (reduced barotrauma/pneumothorax risk)
  - I check optimal PEEP regularly and following periods of de-recruitment use a combination of inspiratory hold and/or 40 at 40 (or lower pressure for longer eg P<sub>insp</sub> 30-35...) to re-recruit