Covid-ARDS Update 2020

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Ventilator Quick Tips

1. For hypoxemia you can increase PEEP or increase FIO2 but address underlying causes

2. For hypercapnia you can increase RR or Vt (or applied pressure) but consider your goal PaCO2

Notes:
ALWAYS look for underlying causes
Check lots of blood gases if available
Consider off target effects e.g. PEEP can reduce preload and afterload,
In general as a beginner make small changes and see what they do
Take Home Messages

• 1. Low tidal volume mechanical ventilation is standard of care in ARDS
• 2. Low driving pressure is useful but not in isolation
• 3. Patients with Covid ARDS are quite recruitable in some cases
• 4. Prone positioning has mortality benefit in ARDS with LTV
• 5. There are no proven therapies for CovidARDS and off label has risk
ARDSNET

6 cc/kg ideal body weight

40% vs. 30% mortality comparing 12 cc/kg vs. 6cc/kg

Lower is better

Goal is to do no mechanical harm with ventilator

NEJM 9/07
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Plateau pressure minus PEEP predicts mortality in lots of different trials. The trials were designed for the most part to fix tidal volume so the lack of predictive value of Vt is not surprising (i.e. the number 6). Amato report corroborated by LungSafe study (Crouch, Bates JAMA).
Driving Pressure for Ventilation of Patients with Acute Respiratory Distress Syndrome

Angela Meier, M.D., Ph.D., Rebecca E. Sell, M.D., Atul Malhotra, M.D.

Fig. 1. A schematic diagram of an inspiratory waveform delivered during typical volume cycled ventilation. Pplat is based on an end-inspiratory hold. The driving pressure can be seen as the difference between the Pplat and the PEEP, but can also be calculated as the ratio of

**Tidal volume** = $V_t$

**Resistance** = $\frac{(PIP - P_{plat})}{flow}$

**Compliance** = $\frac{V_t}{P_{plat} - PEEP}$

**Driving Pressure** = $\frac{V_t}{compliance}$
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Cytokine Release Following Recruitment Maneuvers*

Daniel Talmor, MD, MPH, FCCP; Todd Sarge, MD; Anna Legedza, ScD; Carl R. O’Donnell, ScD; Ray Ritz, RRT; Stephen H. Loring, MD; and Atul Malhotra, MD, FCCP

• Homogeneous lung may help to reduce shear forces which occur at junctions of normal and abnormal lung

Before recruitment

After recruitment

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Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D., Arnaud Gacouin, M.D., Thierry Boullain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D., M. D., Ph.D., Michel Sirodot, M.D., Gilles Hilbert, M.D., Ph.D., P. M., Marc Gaminier, M.D., Ph.D., Frédérique Bayle, M.D., Raphaële Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D., for the PROSEVA Study Group*
**Systematic Review**

**Prone positioning reduces mortality from acute respiratory distress syndrome in the low tidal volume era: a meta-analysis**


**Risk ratio and 95% CI**

<table>
<thead>
<tr>
<th>Group by Study name</th>
<th>Statistics for each study</th>
<th>Risk ratio and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Gattinori, 2001</td>
<td>1.106 (0.900 - 1.360)</td>
</tr>
<tr>
<td>High</td>
<td>Guerin, 2004</td>
<td>1.020 (0.862 - 1.207)</td>
</tr>
<tr>
<td>High</td>
<td>Mancebo, 2006</td>
<td>0.788 (0.551 - 1.120)</td>
</tr>
<tr>
<td>High</td>
<td>Tacone, 2008 (mod)</td>
<td>0.852 (0.757 - 0.962)</td>
</tr>
<tr>
<td>High</td>
<td>Tacone, 2008 (mod)</td>
<td>0.956 (0.858 - 1.132)</td>
</tr>
<tr>
<td>Low</td>
<td>Voggenreiter, 2005</td>
<td>0.304 (0.235 - 2.659)</td>
</tr>
<tr>
<td>Low</td>
<td>Fernandez, 2008</td>
<td>0.724 (0.362 - 1.446)</td>
</tr>
<tr>
<td>Low</td>
<td>Tacone, 2009 (sev)</td>
<td>0.814 (0.568 - 1.128)</td>
</tr>
<tr>
<td>Low</td>
<td>Guerin, 2013</td>
<td>0.534 (0.384 - 0.724)</td>
</tr>
<tr>
<td>Low</td>
<td>Guerin, 2013</td>
<td>0.655 (0.499 - 0.860)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>0.834 (0.683 - 1.017)</td>
</tr>
</tbody>
</table>

**Favors Prone**

**Favors Supine**

Prone benefits seen primarily with open lung protective ventilation

Covid patients look responsive (AJRCCM In press)

**PEEP titration during prone positioning for acute respiratory distress syndrome**

ICM 2014, Crit Care 2015
Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome


ECMO for Severe ARDS

C. Corey Hardin, M.D., Ph.D., and Kathryn Hibbert, M.D.
CONCLUSIONS
Among patients with very severe ARDS, 60-day mortality was not significantly lower with ECMO than with a strategy of conventional mechanical ventilation that included ECMO as rescue therapy. (Funded by the Direction de la Recherche Clinique et du Développement and the French Ministry of Health; EOLIA ClinicalTrials.gov number, NCT01470703.)

Table 2. End Points.13

<table>
<thead>
<tr>
<th>End Point</th>
<th>ECMO Group (N=124)</th>
<th>Control Group (N=125)</th>
<th>Relative Risk or Difference (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary end point: mortality at 60 days — no. (%)</td>
<td>44 (35)</td>
<td>57 (46)</td>
<td>0.76 (0.55 to 1.04)</td>
<td>0.09</td>
</tr>
<tr>
<td>Key secondary end point: treatment failure at 60 days — no. (%)</td>
<td>44 (35)</td>
<td>72 (58)</td>
<td>0.62 (0.47 to 0.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other end points</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality at 90 days — no. (%)</td>
<td>46 (37)</td>
<td>59 (47)</td>
<td>-10 (-22 to 2)</td>
<td></td>
</tr>
<tr>
<td>Median length of stay (interquartile range) — days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the ICU</td>
<td>23 (13–34)</td>
<td>18 (8–33)</td>
<td>5 (-1 to 10)</td>
<td></td>
</tr>
<tr>
<td>In the hospital</td>
<td>36 (19–48)</td>
<td>18 (5–43)</td>
<td>18 (6 to 25)</td>
<td></td>
</tr>
</tbody>
</table>

Take Home
ECMO might work
We are using the same indications for non-Covid ARDS
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Increasing nasal cannula oxygen increasing from 1lpm to 5lpm increases dispersion to 1 meter

Even nasal cannula is not “safe”

This was simulator so maybe worse with coughing human

PPE for safety
For me personally I recommend nasal cannula or intubate ideally

**HFNC during SARS was compared to open face mask; sprays droplets**

During MERS NIV failed and led to contamination

In general NIV for viral pneumonia does not work well

Risk of contamination in a coughing patient even with a ‘good seal’

**However, nasal cannula also spreads so the PPE is more important than patient factors**
Take Home

I am now comfortable using HFNC and NIV in Covid patients with the providers have adequate protection
Risk of Using off label drugs

1. Medications have side effects
2. We will never learn the truth
3. Malaria and other Plasmodia kill 500K per year which was a considerable improvement over last 20 years
   supplies of chloroquine and hydroxychloroquine are depleted
   I predict/fear more people will die of malaria spike than Covid

UCSD PCCSM discourages off label drug use
Caveats with steroids in Covid-ARDS:
1. The Dexa-ARDS (LRM 2020) did not complete enrollment after 5-6 years
2. Varying etiologies of ARDS may respond differently; studies have variable results
3. Chinese reports of tetraplegic myopathy and superinfection (?)
4. We are seeing 20% coinfections as opposed to 2-3% from Wuhan; bad outcomes w/ H1N1
5. We are not bronching re: superinfections (Meduri); lymphopenia
6. Controversy with steroid use in myocarditis

Dr. Cao: for rescue of Covid-ARDS consider 1-2 mg/kg methylpred for 4-5 days
Conclusions

1. Good critical care is here to stay
2. There are no proven therapies for Covid 19
3. Stay calm and wash your hands
**Driving Pressure for Ventilation of Patients with Acute Respiratory Distress Syndrome**

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**How can we lower driving pressure: increase PEEP or reduce plateau**

<table>
<thead>
<tr>
<th>Lung Pathology/Physiology</th>
<th>Strategy to Decrease Driving Pressure</th>
<th>Result</th>
</tr>
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<tr>
<td>Compressed, recruitable alveoli (for example fluid)</td>
<td>Increase PEEP</td>
<td><img src="image" alt="Normally expanded, optimized alveoli" /></td>
</tr>
<tr>
<td>Compressed, non-recruitable alveoli (for example fluid)</td>
<td>Increase PEEP</td>
<td>Collapsed and overdistended alveoli</td>
</tr>
<tr>
<td>Optimized alveoli</td>
<td>Decrease Plateau Pressure (decrease TV)</td>
<td>Underfilled alveoli</td>
</tr>
<tr>
<td>Overdistended alveoli</td>
<td>Decrease Plateau Pressure (decrease TV)</td>
<td><img src="image" alt="Normally expanded, optimized alveoli" /></td>
</tr>
</tbody>
</table>

*Take Home: do not use driving pressure in isolation*  
*Anesthesiology 2020*