STRATEGIES FOR MANAGING REFRACTORY HYPOXAEMLIA

MIKE ANDERSON
ROYAL ADELAIDE HOSPITAL
ARDS

- Described in 1967, many progressive refinements
- Defining condition in critically ill.
- Acute inflammatory lung condition, many causes
- Characterised by increased microvascular lung permeability
- Defined by severity of $\text{PaO}_2/\text{FiO}_2$ ratio (<200)
- No precise limit nor critical level of hypoxia associated with harm to organs or patients
- Mortality remains high
### Table 3. The Berlin Definition of Acute Respiratory Distress Syndrome

**Acute Respiratory Distress Syndrome**

<table>
<thead>
<tr>
<th>Timing</th>
<th>Within 1 week of a known clinical insult or new or worsening respiratory symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest imaging</td>
<td>Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules</td>
</tr>
<tr>
<td>Origin of edema</td>
<td>Respiratory failure not fully explained by cardiac failure or fluid overload. Need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factor present</td>
</tr>
<tr>
<td>Oxygenation</td>
<td></td>
</tr>
<tr>
<td><strong>Mild</strong></td>
<td>200 mm Hg &lt; PaO2/FiO2 ≤ 300 mm Hg with PEEP or CPAP ≥ 5 cm H2Oc</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>100 mm Hg &lt; PaO2/FiO2 ≤ 200 mm Hg with PEEP ≥ 5 cm H2O</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>PaO2/FiO2 ≤ 100 mm Hg with PEEP ≥ 5 cm H2O</td>
</tr>
</tbody>
</table>

**MORTALITY**

- 27%
- 32%
- 45%

ARDS Definition Task Force et al. *JAMA.* 2012;307:2526-2533
LUNG PROTECTIVE VENTILATION

- No effective pharmacological therapy
- Low VT with high PEEP (LPV) plus multi-organ supportive care primary management focus
- LPV MV aims are: $P_{\text{plat}} < 30\text{cmH}_2\text{O}$ VT for predicted BW PEEP
- Permissive hypercapnia and hypoxaemia
- Restrictive Fluid Approach

Less is more!
Meta-analysis of Pressure and Volume Limited Ventilation for ALI and ARDS Patients

## Meta-analysis in Patients Treated with High vs. Low PEEP

Briel et al. *JAMA.* 2010;303:865-873

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>No. (%)</th>
<th>Adjusted RR (95% CI)^3</th>
<th>P Value</th>
<th>No. (%)</th>
<th>Adjusted RR (95% CI)^3</th>
<th>P Value</th>
<th>No. (%)</th>
<th>Adjusted RR (95% CI)^3</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher PEEP (n = 1136)</td>
<td>Lower PEEP (n = 1163)</td>
<td></td>
<td>Higher PEEP (n = 951)</td>
<td>Lower PEEP (n = 941)</td>
<td></td>
<td>Higher PEEP (n = 220)</td>
<td>Lower PEEP (n = 220)</td>
<td></td>
</tr>
<tr>
<td>Death in hospital</td>
<td>374 (32.9)</td>
<td>409 (35.2)</td>
<td>.04</td>
<td>324 (34.1)</td>
<td>368 (39.1)</td>
<td>.049</td>
<td>50 (27.2)</td>
<td>44 (19.4)</td>
<td>.07</td>
</tr>
<tr>
<td>Death in ICU^b</td>
<td>324 (28.5)</td>
<td>381 (32.8)</td>
<td>.01</td>
<td>266 (30.5)</td>
<td>344 (35.6)</td>
<td>.004</td>
<td>36 (19.6)</td>
<td>37 (16.8)</td>
<td>.71</td>
</tr>
<tr>
<td>Pneumothorax between day 1 and day 25c</td>
<td>87 (7.7)</td>
<td>75 (6.5)</td>
<td>.24</td>
<td>80 (8.4)</td>
<td>64 (6.8)</td>
<td>.13</td>
<td>7 (3.8)</td>
<td>11 (5.0)</td>
<td>.33</td>
</tr>
<tr>
<td>Death after pneumothorax^c</td>
<td>43 (3.8)</td>
<td>40 (3.5)</td>
<td>.63</td>
<td>41 (4.3)</td>
<td>35 (3.7)</td>
<td>.39</td>
<td>2 (1.1)</td>
<td>5 (2.3)</td>
<td>.34</td>
</tr>
<tr>
<td>Days with unassisted breathing</td>
<td>13 (0 to 22)</td>
<td>11 (0 to 21)</td>
<td>.064</td>
<td>12 (0.21)</td>
<td>7 (0.20)</td>
<td>.122</td>
<td>.004 17 (0.23)</td>
<td>19 (5.5-24)</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>(-0.12 to 1.39)^a</td>
<td></td>
<td>.10</td>
<td></td>
<td>(.39 to 2.05)^a</td>
<td></td>
<td>(-3.60 to 0.11)^e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total use of rescue therapies^d</td>
<td>138 (12.2)</td>
<td>216 (18.6)</td>
<td>.064</td>
<td>.001 130 (13.7)</td>
<td>200 (21.3)</td>
<td>.63</td>
<td>.001 8 (4.4)</td>
<td>16 (7.3)</td>
<td>.60</td>
</tr>
<tr>
<td></td>
<td>(.54 to 0.75)</td>
<td></td>
<td>&lt;.001</td>
<td>(.53 to 0.75)</td>
<td>(.40 to 0.82)</td>
<td></td>
<td>(.25 to 1.43)^g</td>
<td></td>
<td>.25</td>
</tr>
<tr>
<td>Death after rescue therapy^f</td>
<td>85 (7.5)</td>
<td>132 (11.3)</td>
<td>.065</td>
<td>&lt;.001 82 (8.6)</td>
<td>124 (13.2)</td>
<td>.66</td>
<td>&lt;.001 3 (1.6)</td>
<td>8 (3.6)</td>
<td>.37</td>
</tr>
<tr>
<td></td>
<td>(.52 to 0.80)</td>
<td></td>
<td>.001</td>
<td>(.52 to 0.82)</td>
<td>(.52 to 0.82)</td>
<td></td>
<td>(.10 to 1.46)^g</td>
<td></td>
<td>.15</td>
</tr>
<tr>
<td>Use of vasopressors</td>
<td>722 (63.6)</td>
<td>759 (65.3)</td>
<td>.93</td>
<td>.49 627 (65.9)</td>
<td>647 (68.8)</td>
<td>.90</td>
<td>.37 95 (51.6)</td>
<td>111 (50.5)</td>
<td>.92</td>
</tr>
<tr>
<td></td>
<td>(.75 to 1.14)^g</td>
<td></td>
<td></td>
<td>(.72 to 1.13)^g</td>
<td>(.72 to 1.13)^g</td>
<td></td>
<td>(.56 to 1.50)^g</td>
<td></td>
<td>.72</td>
</tr>
</tbody>
</table>

Abbreviations: ARDS, acute respiratory distress syndrome; CI, confidence interval; ICU, intensive care unit; IQR, interquartile range; PEEP, positive end-expiratory pressure; RR, relative risk.

^a Multivariable regression with the outcome of interest as dependent variable; PEEP group, age, probability of dying in hospital derived from prognostic scores at baseline, severe sepsis at baseline, and trial as independent variables; and hospital as a random effect.

^b Patients who died before being discharged from the intensive care unit for the first time up to day 60.

^c Defined as the need for chest tube drainage.

^d Median number of days of unassisted breathing to day 28 after randomization, assuming a patient survives and remains free of assisted breathing for at least 2 consecutive calendar days after initiation of unassisted breathing.

^e Coefficient from a corresponding linear regression model using the same independent variables and random effect as the above-described log-binomial model; for example, a coefficient of 1.22 means that patients in the group treated with higher PEEP have, on average, 1.22 days more of unassisted breathing during the first 28 days compared with patients in the group treated with lower PEEP.

^f As defined in each trial: rescue therapies included in the Assessment of Low Tidal Volume and Elevated End-Expiratory Pressure to Obviate Lung Injury and the Lung Open Ventilation to Decrease Mortality in the Acute Respiratory Distress Syndrome studies: inhaled nitric oxide, prone ventilation, high-frequency oscillation, high-frequency jet ventilation, extracorporeal membrane oxygenation, partial liquid ventilation, and surfactant therapy. Rescue therapies included in the Expiratory Pressure Study: prone ventilation, inhaled nitric oxide, and almitrine bismesylate.

^g Adjusted odds ratio substitutes for relative risk, because the corresponding log-binomial model did not converge.
Rescue Therapies

- Heavy Sedation and Neuromuscular Blockade
- Inhaled (selective) pulmonary vasodilators
- PRONE POSITIONING
- Extracorporeal membrane oxygenation
• Large global observational study of acute severe respiratory failure

• 4 consecutive 2014 winter weeks

• 459 ICUs, 50 countries, 5 continents

• 3022 patients fulfilled ARDS criteria (10% admissions)

• Less than 2/3 had TV \leq 6\text{ml/kg pred BW}

• ARDS unrecognised in 40%
<table>
<thead>
<tr>
<th></th>
<th>Patients of No. (%) [95% CI]</th>
<th>P Value&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n = 2377)</td>
<td></td>
</tr>
<tr>
<td>Neuromuscular blockade</td>
<td>516 (21.7) [20.1-23.4]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>Mild&lt;sup&gt;a&lt;/sup&gt; (n = 498)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34 (6.8) [4.8-9.4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate&lt;sup&gt;a&lt;/sup&gt; (n = 1150)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>208 (18.1) [15.9-20.4]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe&lt;sup&gt;a&lt;/sup&gt; (n = 729)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>274 (37.8) [34.1-41.2]</td>
<td></td>
</tr>
<tr>
<td>Recruitment maneuvers</td>
<td>496 (20.9) [19.2-22.6]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Prone positioning</td>
<td>187 (7.9) [6.8-9.0]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Inhaled vasodilators</td>
<td>182 (7.7) [6.6-8.8]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ECMO</td>
<td>76 (3.2) [2.5-4.0]</td>
<td></td>
</tr>
<tr>
<td>HFOV</td>
<td>28 (1.2) [0.8-1.7]</td>
<td>.347</td>
</tr>
<tr>
<td>None of the above</td>
<td>1431 (60.2) [58.2-62.2]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Esophageal pressure catheter</td>
<td>19 (0.8) [0.4-1.4]</td>
<td>.233</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>309 (13.0) [11.6-14.4]</td>
<td>.034</td>
</tr>
<tr>
<td>High-dose corticosteroids</td>
<td>425 (17.9) [16.4-19.5]</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Pulmonary artery catheter</td>
<td>107 (4.5) [3.7-5.4]</td>
<td>.001</td>
</tr>
</tbody>
</table>

<sup>a</sup> Reference: [17]
The ART Trial

- 120 ICUs, 9 countries, 2011-17
- 1013 ARDS patients randomized to 2 groups:
  - Control: conventional ARDSnet MV
  - Intervention: staircase recruitment manœuvre/compliance targeted PEEP
- Primary Outcome 28 day mortality
- Secondary Outcome
  - death at 6/12
  - MV free days
  - LOS
  - Barotrauma
ART Trial - outcome

Intervention group:
- less MV free days \( p = .03 \)
- more pneumothoraces \( p = .03 \)

CONCLUSIONS AND RELEVANCE: In patients with moderate to severe ARDS, a strategy with lung recruitment and titrated PEEP compared with low PEEP increased 28-day all-cause mortality. These findings do not support the routine use of lung recruitment maneuver and PEEP titration in these patients.
L RM s

• Uncertainty as to which patients, when and how often, and for how long

• PHARLAP study (ANZICS CTG), similar design, ceased recruiting October 2017
Neuromuscular Blockers

- NMB use inseparable from sedation
- Use to provide better adaptation to MV
- NMB use not uncommon (≥25% patients)

Use historically controversial:
- ICU acquired weakness
- risk of awareness (PTSD)
- French 340 patient multicentre RCT in 20 ICUs
- Cisatracurium vs placebo, early ARDS, 48 hrs
- Intubated < 48hrs
- Severe ARDS PaO$_2$/FiO$_2$ < 150
- Cisatracurium =
  * less ventilator, organ failure and ICU days
  * less pneumothoraces
  * NO difference in ICU acquired weakness
ACURASYS

- Underpowered (overestimated mortality)
- Used hospital (not actual) 90d mortality
- Effectiveness of paralysis not determined
- “true’ blinding unlikely
- How was control group dysynchrony managed?
- Cisatracurium specific?
• Renewed interest in use of NMBs

• Early use of NMBs for 48 hours for severe ARDS appears safe

• Beneficial?
• Review 3 French trials (same group)
  • All used 48 hours Cisatracurium

• Concluded short term infusion Cisatracurium:
  * reduces hospital mortality
  * lowers risk of barotrauma
  * no increase ICU acquired weakness
HFOV

- “Unconventional” mode of MV
- Small TVs (1-4ml/kg) @ 3-15Hz
- High Mean Paw used to maintain PaO$_2$
2 multicenter controlled trials which randomly assigned ARDS patients requiring ventilation to either HFOV or standard ventilation strategy
OSCAR - conclusions

- Identical 30 day (41%) mortality both groups
- Unable to demonstrate either benefit or harm from use of HFOV in adult ARDS
- Recommended HFOV **not be used** for routine care
In adults with moderate/severe ARDS, early application of HFOV compared to a ventilation strategy using low TV and high PEEP does not reduce mortality and may be harmful.
Selective Pulmonary Vasodilators

- iNO/inhaled prostacyclin/iloprost
- iNO improved PF ratio (transient), no effect duration MV
- No survival benefit

Adhikari et al BMJ 2007; 334, 779
### 4.1.1 Trials with overall high risk of bias

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>INO Events</th>
<th>INO Total</th>
<th>Control Events</th>
<th>Control Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lundin 1999</td>
<td>28</td>
<td>93</td>
<td>12</td>
<td>87</td>
<td>23.4%</td>
<td>2.18 [1.19, 4.02]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>28</td>
<td>93</td>
<td>12</td>
<td>87</td>
<td>23.4%</td>
<td>2.18 [1.19, 4.02]</td>
</tr>
<tr>
<td>Total events</td>
<td>28</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable
Test for overall effect: Z = 2.51 (P = 0.01)

### 4.1.2 Trials with overall low risk of bias

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>INO Events</th>
<th>INO Total</th>
<th>Control Events</th>
<th>Control Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dellinger 1998</td>
<td>20</td>
<td>120</td>
<td>7</td>
<td>57</td>
<td>17.9%</td>
<td>1.36 [0.61, 3.02]</td>
</tr>
<tr>
<td>Payen 1999</td>
<td>33</td>
<td>98</td>
<td>26</td>
<td>105</td>
<td>47.4%</td>
<td>1.36 [0.88, 2.10]</td>
</tr>
<tr>
<td>Taylor 2004</td>
<td>10</td>
<td>192</td>
<td>6</td>
<td>193</td>
<td>11.3%</td>
<td>1.68 [0.62, 4.52]</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>410</td>
<td>355</td>
<td></td>
<td></td>
<td>76.6%</td>
<td>1.41 [0.98, 2.01]</td>
</tr>
<tr>
<td>Total events</td>
<td>63</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.15, df = 2 (P = 0.93); I² = 0%
Test for overall effect: Z = 1.86 (P = 0.06)

Total (95% CI) 503 442 100.0% 1.59 [1.17, 2.16]

Heterogeneity: Chi² = 1.69, df = 3 (P = 0.64); I² = 0%
Test for overall effect: Z = 2.94 (P = 0.003)
Test for subgroup differences: Not applicable
Selective PVDs

- Further systematic review 2014
- 9 studies with good methodology, 1,142 patients
- No reduction ARDS mortality severe or mild/moderate

No P/F ratio identified for iNO mortality benefit
Selective PVDs

- Use controversial
- Consider as a strategy to “buy time” to implement other intervention(s)?
- Role if concomitant severe RV dysfunction??
Prone Positioning

- Prone positioning used to improve oxygenation in ARDS
- Multiple trials show no improved outcomes despite better oxygenation
- Meta-analyses suggest improved outcomes in those with severe ARDS at time of randomisation

Meta-Analysis of Prone Positioning in ARDS

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 Boulain, 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., Sylvène Rosselli, M.D., Jordi Mancebo, M.D., Ph.D., Michel Sirotot, M.D., Gilles Hilbert, M.D., Ph.D., Christian Bengler, M.D., Jack Richécoeur, M.D., Marc Gainnier, M.D., Ph.D., Frédérique Bayle, M.D., Gael Bourdin, M.D., Véronique Leray, M.D., Raphaëlie Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D.

for the PROSEVA Study Group*
PROSEVA - background

- Prone positioning confirmed by many RCTs to improve oxygenation if ventilated for ARDS

- Previous RCTs of mechanically ventilated ARDS patients failed to show benefit of prone positioning on outcomes

- Meta-analyses suggest improved outcome for severe ARDS (Sud, ICM 2010; Abroug, Crit Care 2011)
PROSEVA - methods

• Multicenter prospective randomized controlled trial
  - 27 ICUs
  - all ICUs > 5 years experience

• 466 patients with severe ARDS defined as:
  - PaO$_2$/FiO$_2$ ratio <150
  - FiO$_2$ ≥ 0.6
  - PEEP >5 cm
  - Vt = 6 ml/kg body weight

• IPPV for **ARDS < 36 hours**: prone within 1 hr of inclusion
  - mandatory period 12-24 hours stabilization prior to inclusion
  - large number of exclusion criteria

• Prone for **minimum 16 consecutive hours/day**
Outcome measures

- **Primary**
  - Mortality at day 28

- **Secondary**
  - Mortality at day 90
  - Rate of successful extubation
  - Length of ICU stay
  - Complications
  - Use of NIV
  - Tracheostomy rate
  - Organ dysfunction free days
• Prone-positioning within 55±55 minutes following randomization
• Average number sessions was 4±4 per patient
• Mean duration per session 17±3 hours

Proseva Group
• 73% of the group’s 22,334 ICU patient hours were spent ventilated prone
## PROSEVA - outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mortality — no. (% [95% CI])</th>
<th>Hazard Ratio or Odds Ratio with the Prone Position (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At day 28</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not adjusted</td>
<td>75 (32.8 [26.4–38.6])</td>
<td>38 (16.0 [11.3–20.7])</td>
<td>0.39 (0.25–0.63)</td>
</tr>
<tr>
<td>Adjusted for SOFA score†</td>
<td>0.42 (0.26–0.68)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td><strong>At day 90</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not adjusted</td>
<td>94 (41.0 [34.6–47.4])</td>
<td>56 (23.6 [18.2–29.0])</td>
<td>0.44 (0.29–0.67)</td>
</tr>
<tr>
<td>Adjusted for SOFA score†</td>
<td>0.48 (0.32–0.73)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td><strong>Successful extubation at day 90 — no./total no. (% [95% CI])</strong></td>
<td>145/223 (65.0 [58.7–71.3])</td>
<td>186/231 (80.5 [75.4–85.6])</td>
<td>0.45 (0.29–0.70)</td>
</tr>
</tbody>
</table>

**Time to successful extubation, assessed at day 90 — days**

<table>
<thead>
<tr>
<th></th>
<th>Survivors</th>
<th>Nonsurvivors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survivors</strong></td>
<td>26±27</td>
<td>24±22</td>
</tr>
<tr>
<td><strong>Nonsurvivors</strong></td>
<td>18±15</td>
<td>21±20</td>
</tr>
</tbody>
</table>

**Length of ICU stay, assessed at day 90 — days**

<table>
<thead>
<tr>
<th></th>
<th>Survivors</th>
<th>Nonsurvivors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survivors</strong></td>
<td>10±10</td>
<td>14±9</td>
</tr>
<tr>
<td><strong>Nonsurvivors</strong></td>
<td>43±38</td>
<td>57±34</td>
</tr>
</tbody>
</table>

**Ventilation-free days**

<table>
<thead>
<tr>
<th></th>
<th>At day 28</th>
<th>At day 90</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pneumothorax — no. (% [95% CI])</strong></td>
<td>10/212 (4.7 [1.9–7.5])</td>
<td>4/228 (1.8 [0.1–3.5])</td>
</tr>
<tr>
<td><strong>Noninvasive ventilation — no./total no. (% [95% CI])</strong></td>
<td>0.36 (0.07–3.50)</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Tracheotomy — no./total no. (% [95% CI])</strong></td>
<td>3/206 (1.5 [0.2–3.2])</td>
<td>4/225 (1.8 [0.1–3.5])</td>
</tr>
<tr>
<td><strong>Tracheotomy</strong></td>
<td>1.22 (0.23–6.97)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**At day 28**

| | 12/229 (5.2 [2.3–8.1]) | 9/237 (3.8 [1.4–6.0]) |
| | 0.71 (0.27–1.86) | 0.37 |

**At day 90**

| | 18/223 (8.1 [4.5–11.7]) | 15/235 (6.4 [3.3–9.5]) |
| | 0.78 (0.36–1.67) | 0.59 |
PROSEVA - survival

![Graph showing cumulative probability of survival over days for Prone and Supine groups. The Prone group shows a higher survival probability compared to the Supine group throughout the 90-day period.](image-url)
PROSEVA - conclusion

- Patients with severe ARDS can benefit from prone treatment
- No increase in adverse events in PP group

What they did:
- selected patients with severe ARDS
- included further 12-24 hour period to confirm severity
- used long prone sessions in a concentrated time frame
- commenced prone positioning early
- set lower Vt target (Pplat < 30cm H₂O)
- all centres highly experienced with prone positioning
Prone (face-down) position for mechanical ventilation of adults with acute respiratory failure

Cochrane  Bloomfield R, Noble DW, Sudlow A

Published: 13 November 2015

Systematic Review: 9 trials, 2165 participants

Conclusions (mortality advantage):
1. Early implementation PP
2. Prolonged adoption of PP
3. Severe hypoxaemia at study entry

Complications:
1. Pressure areas
2. ETT obstruction
A prospective international observational prevalence study on prone positioning of ARDS patients: the APRONET (ARDS Prone Position Network) study


- Prospective international 1 day prevalence study
- Conducted 4 times April 2016-Jan 2017
- Evaluate prevalence of PP in ARDS patients
- Reasons for not applying it
- Related complications
APRONET: results

- Screened 6723 patients, 141 ICUs, 20 countries
- 735 ARDS pts enrolled
- 101 patients had 1 or more proning sessions (13.7%)
- Rate of PP use differed with ARDS severity:
  - mild: 5.9%  moderate: 10.3%  severe: 32.9%
- No PP:  hypoxia not judged severe enough (64%)
  haemodynamic instability (6%)
- Complications in 12 patients  
  - pressure sores (5)
  - hypoxia (2)
**TABLE 1** ABCDEFG of Prone Positioning

<table>
<thead>
<tr>
<th></th>
<th>Before Prone Positioning</th>
<th>After Prone Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Attachments</td>
<td>Reattach the disconnected attachments</td>
</tr>
<tr>
<td>B</td>
<td>Bedding</td>
<td>Check the bedding for any inappropriate item that might hurt, for example, an inappropriate fold in the sheet, bumps, needle caps</td>
</tr>
<tr>
<td>C</td>
<td>Catheters</td>
<td>Check position, reattach infusions</td>
</tr>
<tr>
<td>D</td>
<td>Dependent regions</td>
<td>Padding may get displaced while rotating, ensure position after prone positioning</td>
</tr>
<tr>
<td>E</td>
<td>Endotracheal tube</td>
<td>Confirm position by noting down the mark</td>
</tr>
<tr>
<td>F</td>
<td>Foley Catheter</td>
<td>To attach on either side</td>
</tr>
<tr>
<td>G</td>
<td>Genitals</td>
<td>Genitals need special attention, as these can be an ignored site of pressure sores</td>
</tr>
</tbody>
</table>

Baldi et al, Chest, May 2017
1. **PROCEDURE INTENT**
   
   The procedure describes the evidence, indications, patient selection criteria, and other care for an intubated patient who has moderate to severe Acute Respiratory Distress Syndrome, who may benefit from the early application of prolonged prone positioning.

2. **SCOPE**
   
   This document is aimed at the nursing and medical staff in the Intensive Care Service of the Central Adelaide Local Health Network.

3. **PROCEDURE DETAIL**
   
   3.1 General Principles
   3.2 Patient Selection
   3.3 Contraindications
   3.4 Cautions
   3.5 Duration of proning
   3.6 Medical Order
   3.7 Minimum Staff Requirements
   3.8 Preparation of the patient prior to prone positioning
   3.9 Equipment Required
   3.10 Safe work procedures
   3.11 Installation of the patient in the prone position
   3.12 Nursing Care of the patient in the prone position
   3.13 Discontinuation of prone treatment
   Appendix 1 – Prone positioning checklist
   Appendix 2 – Roho cushion instructions for use
   Appendix 3 – Roho cushion, instructions for cleaning
   Appendix 4 – Safe Work Procedure: Roll to prone position
   Appendix 5 – Safe Work Procedure: Roll to supine position

Clinicians must adhere to the following relevant SA Health policies and guidelines:

- Clinical Handover Guidelines
- Aspetic Technique
- Hand Hygiene Clinical Guideline

Clinicians should refer to additional relevant Work Health and Safety and Infection Control procedures listed at 7.1 and 7.2 of this document.
PP in practice (RAH)
Facial pressure necrosis
Prevention facial PAs

ROHO Mosaic Cushion
Contraindications to PP

- Unstable vertebral fractures
- Raised intracranial pressures

Relative considerations
- Haemodynamic instability
- Facial or ocular injuries
- Recent sternotomy or abdominal incisions
Extracorporeal Membrane Oxygenation for 2009 Influenza A(H1N1) Acute Respiratory Distress Syndrome

The Australia and New Zealand Extracorporeal Membrane Oxygenation (ANZ ECMO) Influenza Investigators*

JAMA. 2009;302(17):1888-1895
68 patients received ECMO for severe refractory ARDS/ 15 ICUs
21% mortality during 3 month study period
Trial undertaken severe ARDS to assess if early initiation of ECMO improved 60 day mortality

Prospective multicenter randomized controlled trial, predominantly French

249 patients randomized, MV < 7 days, severe ARDS

Primary outcome: 60 day mortality, no statistical difference (p=.09)

Secondary outcomes, ECMO group
- less treatment failure (X-over to ECMO 35/125 controls)
- lower risk RRT
- more bleeding, more thrombocytopenia
- less ischaemic stroke
EOLIA

- 28% control group crossed over (more severe ARDS)
- ROUTINE use of ECMO for severe ARDS not superior to utilizing ECMO as a RESCUE
Conclusion

VENTILATE

PRONATE

OSCILLATE

CANNULATE
Inadvertently, Roy dooms the entire earth to annihilation when, in an attempt to be friendly, he seizes their leader by the head and shakes vigorously.