Protective ventilation in ALL patients from OR to ICU

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Kiev – Ukraine – April 2018

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Conflicts of Interest

I declare
NO conflicts of interest

Pelosi P for the PROVE Network (www.provenet.eu)
To prevent or cure acute respiratory distress syndrome: that is the question!

Paolo Pelosi\textsuperscript{a} and Patricia R.M. Rocco\textsuperscript{b}

Curr Opin Crit Care 2014, 20:1–2
Mechanisms of Ventilator Induced Lung Injury


Pelosi P for the PROVE Network (www.provenet.eu)
Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

Protective ventilation includes:

- mild – mild moderate ARDS
- severe moderate and severe ARDS

Ventilation in Intensive Care Unit—patients with Uninjured Lungs

Protective ventilation includes:

Ventilation During General Anesthesia for Surgery

Protective ventilation includes:
Intraoperative Use of Low $V_T$ Benefits Surgery Patients without ARDS


- 2,127 surgery patients from 15 studies of intraoperative ventilation
- outcome: PPC

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
LAS VEGAS – Practice of Ventilation in ORs Worldwide

The LAS VEGAS Investigators - Eur J Anaesthesiol 2017; 34:492–507

- international observational study
- 8,241 patients
- 8.1 [7.2–9.1] mL/kg PBW
- $V_T > 8$ ml/Kg in 40% of patients

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Ventilation During General Anesthesia for Surgery

Protective ventilation includes:

Tidal volume size 6-8 ml/kg predicted body weight
Evidence comes from 3 RCTs and 2 meta-analyses

Ventilation in Intensive Care Unit–patients with Uninjured Lungs

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Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

Protective ventilation includes:

mild – mild moderate ARDS

severe moderate and severe ARDS

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Use of Lower Tidal Volumes Benefits Patients without ARDS


- 2,184 ICU patients without ARDS from 7 studies - outcome: duration of ventilation

[Graphs showing probability of pulmonary complications and proportion of patients with different tidal volumes over follow-up days.]

Pelosi P for the PROVE Network (www.provenet.eu)
Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
PRoVENT – Practice of Ventilation in ICUs Worldwide


- international observational study
- 1,022 patients without ARDS
- $7.9 \ [6.8 - 9.1] \ mL/kg \ PBW$
- $V_T > 8 \ mL/Kg$ in 40% of patients

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
PReVENT – Low vs. Intermediate $V_T$ in Patients without ARDS

Simonis F for the PReVENT investigators. TRIALS 2015; 16:266

• superiority RCT
• $V_T$ 4-6 vs 8-10 ml/Kg PBW
• 950 non–ARDS patients
• 5 Dutch ICUs
• VFD–28
• enrolment complete
Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

Ventilation in Intensive Care Unit—patients with Uninjured Lungs

Ventilation During General Anesthesia for Surgery

Protective ventilation includes:

- Tidal volume size
- 6-8 ml/kg predicted body weight
- Evidence comes from 3 RCTs and 2 meta-analyses

Protective ventilation includes:

- Tidal volume size
- 6-8 ml/kg predicted body weight
- Evidence comes from 2 RCTs, 1 meta-analysis and 2 IPD meta-analyses

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- Mild - mild moderate ARDS
- Severe moderate and severe ARDS

Protective ventilation includes:

Pelosi P for the PROVE Network (www.provenet.eu)
Use of Lower Tidal Volumes Benefits Patients with ARDS


- 1,297 patients with ARDS from 6 RCTs
- Pplat 28-30 cmH₂O
- Outcome: hospital death

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Low $V_T$ at similar PEEP</th>
<th>High $V_T$ at similar PEEP</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brochard</td>
<td>116</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Brower</td>
<td>52</td>
<td>13/26</td>
<td>12/26</td>
<td>1.17 [0.39 – 3.47]</td>
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<tr>
<td>Brower</td>
<td>861</td>
<td>134/342</td>
<td>171/429</td>
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<tr>
<td>Stewart</td>
<td>120</td>
<td>30/60</td>
<td>28/60</td>
<td>1.14 [0.56 – 2.34]</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>0.75 [0.58 – 0.96]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Low $V_T$ + high PEEP</th>
<th>High $V_T$ + low PEEP</th>
<th>Odds ratio</th>
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<tbody>
<tr>
<td>Amato</td>
<td>53</td>
<td>13/29</td>
<td>17/24</td>
<td>0.33 [0.11 – 1.05]</td>
</tr>
<tr>
<td>Villar</td>
<td>95</td>
<td>17/50</td>
<td>24/45</td>
<td>0.41 [0.18 – 0.94]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.38 [0.20 – 0.75]</td>
</tr>
</tbody>
</table>

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
LungSafe – Practice of Ventilation in ICUs Worldwide
Bellani G JAMA. 2016 Feb 23;315(8):788-800

- international observational study
- 2,396 patients with mild, moderate or severe ARDS
- $V_T > 8 \text{ ml/Kg}$ in 40% of patients

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Ventilation During General Anesthesia for Surgery

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Ventilation in Intensive Care Unit—patients with Uninjured Lungs

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Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

- Mild—mild moderate ARDS
  - Protective ventilation includes:
    - Tidal volume size 6-8 ml/kg predicted body weight
    - Evidence comes from 2 RCTs and 1 meta-analysis
  - Evidence comes from 2 RCTs and 1 meta-analysis
- Severe moderate and severe ARDS
  - Protective ventilation includes:
    - Tidal volume size 6-8 ml/kg predicted body weight
    - Evidence comes from 2 RCTs and 1 meta-analysis

Pelosi P for the PROVE Network (www.provenet.eu)
Intraoperative protective mechanical ventilation and risk of postoperative respiratory complications: hospital based registry study

Ladha K et al. BMJ 2015;351:h3646

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
LAS VEGAS – Practice of Ventilation in ORs Worldwide

The LAS VEGAS Investigators - Eur J Anaesthesiol 2017; 34:492–507

- international study
- 8,241 patients
- Pplat 15.5 [13.0-18.5] cm H₂O
- Ppeak 17.5 [15.0-21.0] cm H₂O
- Ppeak > 20 cm H₂O (Pplat > 18 cmH₂O) in 25-30% of patients

Pelosi P for the PROVE Network (www.provenet.eu)
Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

Ventilation in Intensive Care Unit–patients with Uninjured Lungs

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Protective ventilation includes:

- Tidal volume size 6-8 ml/kg predicted body weight
evidence comes from 3 RCTs and 2 meta–analyses

- Pplat < 17 cmH₂O
suggestion comes from observational studies

Pelosi P for the PROVE Network (www.provenet.eu)
Factors associated with ARDS

1) Higher (>17 cmH₂O) plateau pressure
   (odds ratio 1.12, 95% CI interval 1.04 to 1.21)

Factors associated with ICU acquired pneumonia

1) Higher tidal volume
   (odds ratio 1.003, 95% CI 1.0003 to 1.01)

2) Higher (>5 cmH₂O) applied PEEP levels
   odds ratio 0.89, 95% CI 0.80 to 0.99)

Pelosi P for the PROVE Network (www.provenet.eu)
PRoVENT – Practice of Ventilation in ICUs Worldwide


- international observational study
- 1,022 patients without ARDS
- Pplat 15.0 [13.0-20.0] cm
- Pplat > 17 cmH₂O in 30-40% of patients

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
Ventilation During General Anesthesia for Surgery

Protective ventilation includes:

- Tidal volume size: 6-8 ml/kg predicted body weight
- Evidence comes from 3 RCTs and 2 meta-analyses

- Pplat < 17 cmH₂O
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Paolo Pelosi P for the PROVE Network (www.provenet.eu)

Ventilation in Intensive Care Unit–patients with Uninjured Lungs

Protective ventilation includes:

- Tidal volume size: 6-8 ml/kg predicted body weight
- Evidence comes from 2 RCTs, 1 meta-analysis and 2 IPD meta-analyses

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

Protective ventilation includes:

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- Evidence comes from 2 RCTs and 1 meta-analysis

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

mild – mild moderate ARDS

- Tidal volume size: 6-8 ml/kg predicted body weight
- Evidence comes from 2 RCTs and 1 meta-analysis

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

severe moderate and severe ARDS

- Tidal volume size: 6-8 ml/kg predicted body weight
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Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Lung Safe – Practice of Ventilation in ICUs Worldwide

Bellani G JAMA. 2016 Feb 23;315(8):788-800

Pplat and Mortality in ARDS

- international observational study
- 2,396 patients with mild, moderate or severe ARDS
- Higher Plat – Higher Mortality

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Lung Safe – Practice of Ventilation in ICUs Worldwide

Bellani G JAMA. 2016 Feb 23;315(8):788-800

- international observational study
- 2,396 patients with mild, moderate or severe ARDS
- 40% of patients with Plat > 27 cmH₂O

Pelosi P for the PROVE Network (www.provenet.eu)
### Ventilation During General Anesthesia for Surgery

**Protective ventilation includes:**
- Tidal volume size 6-8 ml/kg predicted body weight
- Evidence comes from 3 RCTs and 2 meta-analyses
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### Ventilation in Intensive Care Unit—patients with Uninjured Lungs

**Protective ventilation includes:**
- Tidal volume size 6-8 ml/kg predicted body weight
- Evidence comes from 2 RCTs, 1 meta-analysis and 2 IPD meta-analyses
- Pplat < 17 cmH₂O
- Suggestion comes from observational studies

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### Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

- **mild** – mild moderate ARDS
  - Tidal volume size 6-8 ml/kg predicted body weight
  - Evidence comes from 2 RCTs and 1 meta-analysis
  - Pplat < 27 cmH₂O
  - Suggestion comes from observational studies

- **severe moderate and severe** ARDS
  - Tidal volume size 6–8 ml/kg predicted body weight
  - Evidence comes from 2 RCTs and 1 meta-analysis
  - Pplat < 27 cmH₂O
  - Suggestion comes from observational studies

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Pelosi P for the PROVE Network ([www.provenet.eu](http://www.provenet.eu))

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Driving Pressure (ΔP,rs) & PPCs

Ladha K et al. BMJ 2015;351:h3646

HIGHER DRIVING PRESSURES INCREASE THE RISK OF PPCs

(2.679 pts. from 15 RCTs)

(69.265 pts. from observational trials)

ΔP,rs > 12 cmH₂O
Higher risk of PPCs

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
Las Vegas - Practice of Ventilation in ORs Worldwide

The LAS VEGAS Investigators - Eur J Anaesthesiol 2017; 34:492–507

- international study
- 8,241 patients
- $\Delta P \geq 12.0 \ [10.0-15.0]$ cm H$_2$O
- $\Delta P > 12$ cm H$_2$O in 50% of patients

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

mild – mild moderate ARDS

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Tidal volume size
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Pplat < 27 cmH₂O
suggestion comes from
observational studies

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Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
PRoVENT – Practice of Ventilation in ICUs Worldwide


- international observational study
- 1,022 patients without ARDS
- Driving pressure associated with mortality

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
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- 1,022 patients without ARDS
- $\Delta P$ 10.0 [6.0-13] cm H$_2$O
- $\Delta P > 12$ cmH$_2$O in 30-40% of patients

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• 2,396 pts with mild, moderate or severe ARDS

Paolo Pelosi for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018
• 653 patients from 12 studies
• RR for hospital death
• median settings in the first 3 days
• $\Delta P$ is associated with mortality

### Table: RR [95%–CI] ($p$–value) for hospital death

<table>
<thead>
<tr>
<th>Measure</th>
<th>ALL N = 653</th>
<th>ECMO N = 545</th>
<th>ECCO$_2$R N = 108</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_t$, ml/kg PBW</td>
<td>0.97 [0.87–1.08] ($p = 0.602$)</td>
<td>0.94 [0.83–1.06] ($p = 0.294$)</td>
<td>1.03 [0.80–1.32] ($p = 0.817$)</td>
</tr>
<tr>
<td>PEEP, cm H$_2$O</td>
<td>0.97 [0.92–1.02] ($p = 0.249$)</td>
<td>0.97 [0.91–1.03] ($p = 0.323$)</td>
<td>0.92 [0.83–1.02] ($p = 0.125$)</td>
</tr>
<tr>
<td>Pplat, cm H$_2$O</td>
<td>1.03 [0.97–1.09] ($p = 0.298$)</td>
<td>1.03 [0.97–1.10] ($p = 0.308$)</td>
<td>0.94 [0.81–1.10] ($p = 0.454$)</td>
</tr>
<tr>
<td>$\Delta P$, cm H$_2$O</td>
<td>1.07 [1.02–1.12] ($p = 0.004$)</td>
<td>1.06 [1.01–1.12] ($p = 0.029$)</td>
<td>1.19 [1.04–1.35] ($p = 0.009$)</td>
</tr>
</tbody>
</table>

adjusted for risk of death, age and severity of ARDS

**IPD Metaanalysis of studies in ARDS–patients receiving ELS**

Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

- Protective ventilation includes:
  - Tidal volume size 6–8 ml/kg predicted body weight
    - evidence comes from 3 RCTs and 2 meta–analyses
  - Pplat < 17 cmH₂O
    - suggestion comes from observational studies
  - Driving Pressure < 13 cmH₂O
    - suggestion comes from observational studies

- Protective ventilation includes:
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    - suggestion comes from observational studies
  - Driving Pressure < 13 cmH₂O
    - suggestion comes from Observational several studies and 1 IPD meta–analysis

Pelosi P for the PROVE Network (www.provenet.eu)
Dose–Response Relationship Between PPCs and PEEP during Surgery

PEEP DOES NOT REDUCE PPCs (2,127 patients)

Pelosi P for the PROVE Network (www.provenet.eu)
• international study
• 8,241 patients
• PEEP 4.0 [0–5] cm H$_2$O
• PEEP 0 and 5 cm H$_2$O most frequently used
• FiO$_2$ 50 [45–70]%
• SatO$_2$ 99 [98–100]%

Paolo Pelosi P for the PROVE Network (www.provenet.eu)
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  - suggestion comes from observational studies
- Driving Pressure < 13 cmH₂O
  - suggestion comes from observational studies
- PEEP < 5 cmH₂O
  - suggestion comes from RCTs and IDP meta-analysis

Ventilation in Intensive Care Unit—patients with Uninjured Lungs

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Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

mild – mild moderate ARDS

Protective ventilation includes:

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  - suggestion comes from observational studies

severe moderate and severe ARDS

Protective ventilation includes:

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- Pplat < 27 cmH₂O
  - suggestion comes from observational studies
- Driving Pressure < 13 cmH₂O
  - suggestion comes from observational studies and 1 IPD meta-analysis

PEEP < 5 cmH₂O
- suggestion comes from RCTs and IDP meta-analysis

Pelosi P for the PROVE Network (www.provenet.eu)

Paolo Pelosi. 10-й Британско-Український Симпозіум. Київ, 2018
Associations between PEEP and outcome of patients without ARDS at onset of ventilation: a systematic review and meta-analysis of randomized controlled trials


### Low PEEP = 2.0 ± 2.8 cmH₂O  High PEEP = 9.7 ± 4.0 cmH₂O

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>High PEEP</th>
<th>Total</th>
<th>Low PEEP</th>
<th>Total</th>
<th>Weight</th>
<th>Risk Ratio (M-H, Random, 95% CI)</th>
<th>Year</th>
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<tbody>
<tr>
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<td>Events</td>
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<tr>
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<td>16</td>
<td>45</td>
<td>17</td>
<td>34</td>
<td>25.5%</td>
<td>0.71 [0.42, 1.19] 1979</td>
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<tr>
<td>Pepe PE</td>
<td>13</td>
<td>44</td>
<td>18</td>
<td>48</td>
<td>21.8%</td>
<td>0.79 [0.44, 1.41] 1984</td>
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</tr>
<tr>
<td>Nelson LD</td>
<td>5</td>
<td>20</td>
<td>6</td>
<td>18</td>
<td>9.5%</td>
<td>0.75 [0.28, 2.04] 1987</td>
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<tr>
<td>Carroll GC</td>
<td>6</td>
<td>22</td>
<td>1</td>
<td>28</td>
<td>2.6%</td>
<td>7.64 [0.99, 58.85] 1988</td>
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<tr>
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<td>0</td>
<td>22</td>
<td></td>
<td>Not estimable</td>
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<tr>
<td>Manzano F</td>
<td>19</td>
<td>64</td>
<td>16</td>
<td>63</td>
<td>22.7%</td>
<td>1.17 [0.66, 2.06] 2008</td>
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</tr>
<tr>
<td>Lesur O</td>
<td>9</td>
<td>30</td>
<td>14</td>
<td>33</td>
<td>17.8%</td>
<td>0.71 [0.36, 1.39] 2010</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>246</td>
<td>246</td>
<td><strong>100.0%</strong></td>
<td></td>
<td></td>
<td><strong>0.87 [0.62, 1.21]</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td>68</td>
<td></td>
<td>72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Risk Ratio (M-H, Random, 95% CI)**

- Test for overall effect: Z = 0.82 (P = 0.41)
- Heterogeneity: $\tau^2 = 0.04$; $\chi^2 = 6.74$, df = 5 (P = 0.24); $I^2 = 26$

**High PEEP: No effect on duration of MV – Lower rate of ARDS (high I²)**

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018

Pelosi P for the PROVE Network (www.provenet.eu)
PRoVENT – Practice of Ventilation in ICUs Worldwide

- international observational study
- 1,022 patients without ARDS
- PEEP > 5 cmH$_2$O in 60-40% of patients
- FiO$_2$ 50 [40–70]%
- PaO$_2$/FiO$_2$ 261 [165–100]
Ventilation During General Anesthesia for Surgery

Protective ventilation includes:

- Tidal volume size: 6-8 ml/kg predicted body weight
  - Evidence comes from 3 RCTs and 2 meta–analyses

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

- Driving Pressure < 13 cmH₂O
  - Suggestion comes from observational studies

- PEEP < 5 cmH₂O
  - Suggestion comes from 3 RCTs and IDP meta-analysis

Ventilation in Intensive Care Unit–patients with Uninjured Lungs

Protective ventilation includes:

- Tidal volume size: 6-8 ml/kg predicted body weight
  - Evidence comes from 2 RCTs, 1 meta–analysis and 2 IPD meta–analyses

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

- Driving Pressure < 13 cmH₂O
  - Suggestion comes from observational studies

- PEEP < 5 cmH₂O
  - Suggestion comes from 6 RCTs and IDP meta-analysis

Ventilation in Intensive Care Unit–patients with the Acute Respiratory Distress Syndrome (ARDS)

Protective ventilation includes:

- Tidal volume size: 6–8 ml/kg predicted body weight
  - Evidence comes from 2 RCTs and 1 meta–analysis

- Pplat < 17 cmH₂O
  - Suggestion comes from observational studies

- Pplat < 27 cmH₂O
  - Suggestion comes from observational studies

- Driving Pressure < 13 cmH₂O
  - Suggestion comes from observational studies and 1 IPD meta–analysis

PEEP < 5 cmH₂O
- Suggestion comes from observational studies and 1 IPD meta–analysis

Pelosi P for the PROVE Network (www.provenet.eu)
Effect of Lung Recruitment and PEEP on mortality in Patients With ARDS: updated metaanalysis

<table>
<thead>
<tr>
<th>Studies</th>
<th>Estimate (95% C.I.)</th>
<th>Ev/Trt</th>
<th>Ev/Ctrl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amato</td>
<td>0.252 (0.079, 0.800)</td>
<td>11/29</td>
<td>17/24</td>
</tr>
<tr>
<td>Villar</td>
<td>0.412 (0.179, 0.948)</td>
<td>16/50</td>
<td>24/45</td>
</tr>
<tr>
<td>Subgroup TV (I^2=0 % , P=0.498)</td>
<td>0.348 (0.177, 0.684)</td>
<td>27/79</td>
<td>41/69</td>
</tr>
<tr>
<td>Brower</td>
<td>1.146 (0.783, 1.676)</td>
<td>76/276</td>
<td>68/273</td>
</tr>
<tr>
<td>Talmor</td>
<td>0.317 (0.095, 1.053)</td>
<td>5/30</td>
<td>12/31</td>
</tr>
<tr>
<td>Mercat</td>
<td>0.851 (0.623, 1.161)</td>
<td>107/385</td>
<td>119/382</td>
</tr>
<tr>
<td>Subgroup PEEP (I^2=55.98 % , P=0.103)</td>
<td>0.871 (0.572, 1.326)</td>
<td>188/691</td>
<td>199/686</td>
</tr>
<tr>
<td>Meade</td>
<td>0.833 (0.634, 1.094)</td>
<td>135/475</td>
<td>164/508</td>
</tr>
<tr>
<td>Huh</td>
<td>1.333 (0.451, 3.940)</td>
<td>12/30</td>
<td>9/27</td>
</tr>
<tr>
<td>Hodgson</td>
<td>1.714 (0.219, 13.406)</td>
<td>3/10</td>
<td>2/10</td>
</tr>
<tr>
<td>Kacmarek</td>
<td>0.783 (0.410, 1.496)</td>
<td>22/99</td>
<td>27/101</td>
</tr>
<tr>
<td>Cavalcanti</td>
<td>1.271 (0.992, 1.628)</td>
<td>277/501</td>
<td>251/509</td>
</tr>
<tr>
<td>Subgroup PEEP and RM (I^2=35.93 % , P=0.182)</td>
<td>1.021 (0.780, 1.335)</td>
<td>449/1115</td>
<td>453/1155</td>
</tr>
<tr>
<td>Xi</td>
<td>0.530 (0.241, 1.166)</td>
<td>16/55</td>
<td>24/55</td>
</tr>
<tr>
<td>Subgroup RM (I^2=NA , P=NA)</td>
<td>0.530 (0.241, 1.166)</td>
<td>16/55</td>
<td>24/55</td>
</tr>
<tr>
<td>Overall (I^2=56.26 % , P=0.011)</td>
<td>0.826 (0.643, 1.061)</td>
<td>680/1940</td>
<td>717/1965</td>
</tr>
</tbody>
</table>

Odds Ratio (log scale)
Ventilation During General Anesthesia for Surgery

Ventilation in Intensive Care Unit—patients with Uninjured Lungs

Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

Protective ventilation includes:

**Tidal volume size**
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**Pplat**
- < 17 cmH₂O
- Suggestion comes from observational studies

**Driving Pressure**
- < 13 cmH₂O
- Suggestion comes from observational studies

**PEEP**
- < 5 cmH₂O
- Suggestion comes from 3 RCTs and IDP meta-analysis

**mild – mild moderate ARDS**

**Tidal volume size**
- 6–8 ml/kg predicted body weight
- Evidence comes from 2 RCTs, 1 meta–analysis and 2 IPD meta–analyses

**Pplat**
- < 17 cmH₂O
- Suggestion comes from observational studies

**Driving Pressure**
- < 13 cmH₂O
- Suggestion comes from observational studies

**PEEP**
- < 10 cmH₂O
- Suggestion comes from 4 RCTs and IDP meta-analysis

**severe moderate and severe ARDS**

**Tidal volume size**
- 6–8 ml/kg predicted body weight
- Evidence comes from 2 RCTs and 1 meta–analysis

**Pplat**
- < 27 cmH₂O
- Suggestion comes from observational studies

**Driving Pressure**
- < 13 cmH₂O
- Suggestion comes from observational studies and 1 IPD meta–analysis

**PEEP**
- < 10 cmH₂O
- Suggestion comes from 4 RCTs and IDP meta-analysis
Ventilation in Intensive Care Unit—patients with the Acute Respiratory Distress Syndrome (ARDS)

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- PEEP < 5 cmH₂O
  - suggestion comes from 3 RCTs and IDP meta–analysis

PEEP < 10 cmH₂O
  - suggestion comes from 4 RCTs and IDP meta–analysis

PEEP 10–15 cmH₂O
  - suggestion comes from

Driving Pressure < 13 cmH₂O
  - suggestion comes from observational studies and 1 IPD meta–analysis

PEEP < 10 cmH₂O
  - suggestion comes from 4 RCTs and IDP meta–analysis

PEEP 10–15 cmH₂O
  - suggestion comes from

Driving Pressure < 13 cmH₂O
  - suggestion comes from observational studies and 1 IPD meta–analysis

PEEP < 5 cmH₂O
  - suggestion comes from 3 RCTs and IDP meta–analysis

Pelosi P. Paolo Pelosi for the PROVE Network (www.provenet.eu)
Close the lungs and keep them rested!


Expiration

Inspiration

LOW V_T
LOW P_{P_{Plat}}
LOW PEEP
LOW DP

LOW V_T
HIGH P_{P_{Plat}}
MODERATE PEEP
LOW-MODERATE DP

LOW V_T
HIGH P_{P_{Plat}}
HIGH PEEP
LOW-MODERATE DP

Paolo Pelosi. 10-й Британсько-Український Симпозіум. Київ, 2018

Pelosi P for the PROVE Network (www.provenet.eu)
Protective Mechanical Ventilation
In ALL patients!

“Less is More”

JUST DO IT!

Pelosi P for the PROVE Network (www.provenet.eu)