A Little Oxygen Never Hurt Anyone – Or Did It?
Shortness of Breath?

Problem of Oxygenation or Ventilation?
Oxygenation Ventilation
Preventable Death!
Hypoxia?
Oxygen Saturation and Pulse Ox Lag
Hypoxia versus Hypoxemia

<table>
<thead>
<tr>
<th>Classifications</th>
<th>$\text{PaO}_2$ (rule of thumb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>80-100 mm Hg</td>
</tr>
<tr>
<td>Mild hypoxemia</td>
<td>60-80 mm Hg</td>
</tr>
<tr>
<td>Moderate hypoxemia</td>
<td>40-60 mm Hg</td>
</tr>
<tr>
<td>Severe hypoxemia</td>
<td>&lt;40 mm Hg</td>
</tr>
</tbody>
</table>
Oxygen

- Oxygen therapy has always been a major component of emergency care.
- Health care providers believe oxygen alleviates breathlessness.
We began giving oxygen because it seemed like the right thing to do...

Documented benefits:
- Hypoxia
- Nausea/vomiting
- Motion sickness
Effects of sudden hypoxia
(Removal of oxygen mask at altitude or in a pressure chamber)

• Impaired mental function; onset at mean SaO2 64%
• No evidence of impairment above 84%
• Loss of consciousness at mean saturation of 56%
  – absence of breathlessness when healthy resting subjects are exposed to sudden severe hypoxia
  – mean SpO2 of airline passengers in a pressurised cabin falls from 97% to 93% (average nadir 88.6%) with no symptoms and no apparent ill effects

Akero A et al Eur Respir J. 2005;25:725-30
“Normal” nocturnal SpO$_2$

- Healthy subjects in all age groups routinely desaturate to an average nadir of 90.4% during the night (SD 3.1%)\(^*\) (Gries RE et al Chest 1996; 110: 1489-92)

\(^*\)Therefore, be cautious in interpreting a single oximetry measurement from a sleeping patient. Watch the oximeter for a few minutes if in any doubt (and the patient is otherwise stable) as normal overnight dips are of short duration.
The Chemistry of Oxygen

• Oxygen is highly reactive; it has 2 unpaired electrons
• Molecules/atoms with unpaired electrons are extremely unstable and highly-reactive
• Referred to as “free radicals”
Oxidative stress.
Oxygen Free Radicals

• Develop during reperfusion—not during hypoxia (when $O_2$ enters damaged area) Flooding ischemic cells with oxygen worsens oxidative stress (proportionate)
Within 5 minutes of 100% O$_2$ (vs. RA):

- \(\uparrow\) coronary resistance \(\sim 40\%\)
- \(\downarrow\) coronary blood flow (CBF) \(\sim 30\%\)
- Blunted Coronary Blood Flow response to Ach
- Marked \(\downarrow\) NO

Cardiac Arrest Survival
Vanderbuilt Univ – TH post ROSC

• 170 patients - highest PaO$_2$ during 24° TH (32-34°C):
  – Survivors had significantly lower PaO$_2$ (198) vs non-survivors (254)
  – Higher PaO$_2$ ↑ risk death (OR 1.439)
  – Favorable neuro outcomes (CPC 1-2) also linked to lower PaO$_2$
  – Higher PaO$_2$ ↓ neuro outcomes (OR 1.485)

## Stroke

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minor or Moderate Strokes</th>
<th>Severe Strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxygen</td>
<td>Control</td>
</tr>
<tr>
<td>Survival</td>
<td>81.8%</td>
<td>90.7%</td>
</tr>
<tr>
<td>SSS Score</td>
<td>54 (54-58)</td>
<td>57 (52-58)</td>
</tr>
<tr>
<td>Barthel Index</td>
<td>100 (95-100)</td>
<td>100 (95-100)</td>
</tr>
</tbody>
</table>

“Supplemental oxygen should not routinely be given to non-hypoxic stroke victims with minor to moderate strokes.” - AHA 1994

“Further evidence is needed to give conclusive advice concerning oxygen supplementation for patients with severe strokes.”

Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial

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ABSTRACT

Objectives To compare standard high flow oxygen treatment with titrated oxygen treatment for patients with an acute exacerbation of chronic obstructive pulmonary disease in the prehospital setting.

Design Cluster randomised controlled parallel group trial.

Setting Ambulance service in Hobart, Tasmania, Australia.

Participants 143 patients with an acute exacerbation of chronic obstructive pulmonary disease in the prehospital setting were randomised to receive standard high flow oxygen (n=71) or titrated oxygen (n=72).

干预 mean (sd) PaO₂ was 104 (16) mm Hg with standard high flow oxygen and 115 (14) mm Hg with titrated oxygen (P<0.001; n=143). There were significantly fewer patients in the titrated oxygen group who were hypercapnic (PaCO₂ >45 mm Hg; 5/72 (7%) v 16/71 (23%; P<0.001; n=143)). There were no differences between the groups in the median (IQR) oxygen saturation, systolic blood pressure, or heart rate.

Conclusions Titrated oxygen treatment significantly reduced mortality, hypercapnia, and respiratory acidosis compared with high flow oxygen in acute exacerbations of chronic obstructive pulmonary disease. These results provide strong evidence to recommend the routine use of titrated oxygen treatment in patients with breathlessness and a history or clinical likelihood of chronic obstructive pulmonary disease.
405 diff breathers randomized:
  • NRBM (n=226)
  • NC to SpO₂ 88-92% (n=179)

Titrated O₂ reduced mortality:
  • all patients 58%
  • COPD patients 78%
**Trauma Mortality**

- Charity Hospital (1/1 → 9/30/2002):
- 5,549 trauma patients by EMS

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![Bar chart showing oxygen usage in trauma patients.](chart.png)

Neonates

• 1,737 depressed neonates:
  – 881 resuscitated with room air
  – 856 resuscitated with 100% oxygen

• Mortality:
  – Room air resuscitation: 8.0%
  – 100% oxygen resuscitation: 13.0%

• Room air superior to 100% oxygen for initial resuscitation


Oxygen Therapy Summary

AHA 2010 Guidelines: 94-98%

Collaborative Oxygen Protocol: maintain > 95%

Routine administration can be harmful (oximetry 1st)

Hyperoxia may decrease target organ perfusion (when given needlessly) – use lowest level possible

True and Trusted!

40% at 6 LPM
Mission Critical