Arterial Blood Gases

Oxygenation

**Normal ABG's:**

<table>
<thead>
<tr>
<th></th>
<th>Normal (at sea level)</th>
<th>Venous (at sea level)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PaO₂</strong></td>
<td>90 - 95 mm Hg</td>
<td>40 mm Hg</td>
</tr>
<tr>
<td><strong>SaO₂</strong></td>
<td>&gt; 95 %</td>
<td>60 - 80 %</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>7.35 - 7.45</td>
<td>7.36</td>
</tr>
<tr>
<td><strong>PaCO₂</strong></td>
<td>35 - 45 mm Hg</td>
<td>40 - 50 mm Hg</td>
</tr>
<tr>
<td><strong>HCO₃⁻</strong></td>
<td>22 - 26 mEq/L</td>
<td>22 - 26 mEq/L</td>
</tr>
</tbody>
</table>

**PaO₂:**
1. PaO₂ is the oxygen dissolved in plasma.
2. At sea level, breathing room air, with a normal PaCO₂ & normal lungs, PaO₂ should be 90 - 95 mm Hg. But what should you expect the PaO₂ to be at different altitudes or on a higher FiO₂?
3. How much will dissolve in the plasma depends on:
   a. the use of supplemental oxygen
   b. the barometric air pressure
   c. the patient’s PaCO₂
   d. the water vapor in the airways
4. Use the alveolar air equation to determine the partial pressure of O₂ dissolved in the Alveoli (PAO₂).

\[
\text{PAO₂} = \left(\text{Barometric - Water Vapor}\right) \times \text{FiO₂} \times \frac{\text{PaCO₂}}{\text{Resp quotient}}
\]

If breathing at sea level (barometric pressure = 760 mm Hg), and breathing normal room air (FiO₂ = 21 %), with a normal water vapor pressure (47 mm Hg), have a normal PaCO₂ (45 mm Hg), and a normal respiratory quotient (0.8), then

\[
\text{PAO₂} = (760 \text{ mm Hg} - 47 \text{ mm Hg}) \times 0.21 \times 45/0.8
\]

\[
\text{PAO₂} = 713 \times 0.21 - 50
\]

\[
\text{PAO₂} = 100 \text{ mm Hg}
\]

On room air, the PaO₂ should be 5-10 mm Hg below the PAO₂. On 100 % FiO₂, the PaO₂ should be 50 mm Hg below the PAO₂.

5. A quicker way to determine what the PaO₂ should be is to use the "rule of 5." Multiply your patient’s FiO₂ by 5 (this is not exact, but it will give you a general idea). For example:

\[
\text{FiO₂} \times 5 = \text{What the PaO₂ should be}
\]

\[
70 \% \times 5 = 350 \text{ mm Hg}
\]

**SaO₂:**
1. SaO₂ is the percentage of hemoglobin that is saturated with O₂.
2. How saturated the hemoglobin will be with oxygen depends on:
   a. The PaO₂ in the pulmonary capillary
   b. The affinity of hemoglobin for oxygen.
     The affinity is ↑ by: hypothermia, alkalosis, ↓ 2,3 DPG
     The affinity is ↓ by: hyperthermia, acidosis, ↓ PaCO₂
   c. The oxyhemoglobin curve describes:
     How a low PaO₂ will result in a low SaO₂:
     How a falling capillary PO₂ will prompt hemoglobin to desaturate as blood flows through the tissues.

\[
\begin{array}{c|c|c}
\text{SO₂ (% O₂ Saturation)} & \text{PO₂ (mm Hg)} & \text{Then SO₂ will be:} \\
\hline
25 & 20 & 100 mm: 99 % \\
75 & 40 & 90: 95 % \\
50 & 60 & 70: 93 % \\
30 & 80 & 60: 90 % \\
85 & 50 & 50: 85 % \\
70 & 70 & 40: 85 % \\
60 & 60 & 30: 75 % \\
50 & 50 & 20: 60 % \\
40 & 40 & 10: 50 % \\
30 & 30 & \text{Resp 9}
\end{array}
\]