12
Alveolar Gas Equation (AGE)

Description

This program uses the alveolar gas equation to compute various pulmonary gas exchange indices. These are:

1. Alveolar-arterial oxygen tension gradient (A - aP02)
2. Arterial/alveolar oxygen tension ratio (a/AP02)
3. Respiratory index (RI)
4. Arterial P02 to FIO2 ratio

These are discussed in the following paragraphs.

A - aPO2

The alveolar arterial oxygen tension gradient (A - aPO2) is the difference between the calculated alveolar oxygen tension (using the alveolar gas equation) and the arterial oxygen tension (usually measured from a sample of arterial blood). The calculated arterial oxygen tension from the alveolar gas equation is given by

\[ PA02 = FIO2 \times (PB - PH2O) - PaC02 \times (FIO2 + (1 - FIO2)/R) \]

where

- \( FIO2 \) = fraction of inspired oxygen
- \( PB \) = barometric pressure (typically 760 mmHg)
- \( PH2O \) = water vapor pressure at 37 degrees Celsius (typically 47 mmHg)
- \( PaC02 \) = arterial blood carbon dioxide tension
- \( R \) = respiratory quotient (ratio of carbon dioxide production to oxygen consumption, typically 0.8)

The upper limit of normal for the A - aPO2 on room air is frequently given as 15 mmHg, but even in healthy people the A - aPO2 depends on so many
factors (eg, age, FIO2) that a normal range for all circumstances is difficult to establish. References [1] and [2] provide useful clinical information on the topic.

Respiratory Index

The respiratory index (RI) is the alveolar-arterial oxygen tension gradient (A - aPO2) divided by the arterial blood oxygen tension (PaO2):

\[
RI = \frac{A - aPO2}{PaO2}
\]

One advantage of the respiratory index is that it is less influenced by the inspired oxygen concentration (FIO2) than the A - aPO2. Its upper limit of normal is sometimes given as 0.37 [3]. References [4] and [5] provide further information.

a/APO2

The arterial/alveolar oxygen tension ratio is another index of gas exchange with a reduced dependence on FIO2. Its lower limit of normal is sometimes given as 0.8 [6, 7].

\[
\begin{align*}
\text{ALVEOLAR GAS EQUATION} \\
\text{D. John Doyle MD PhD}
\end{align*}
\]

**INPUT DATA**

<table>
<thead>
<tr>
<th>BAR. PRESSURE (MMHG) = 760</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIO2 (%) = 21</td>
</tr>
<tr>
<td>ARTERIAL PO2 (MMHG) = 55</td>
</tr>
<tr>
<td>ARTERIAL PCO2 (MMHG) = 34</td>
</tr>
</tbody>
</table>

**DERIVED DATA**

<table>
<thead>
<tr>
<th>ALVEOLAR PO2 (MMHG) = 109</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA PO2 DIFFERENCE (MMHG) = 54</td>
</tr>
<tr>
<td>AA RATIO = 0.5</td>
</tr>
<tr>
<td>RESPIRATORY INDEX = 0.98</td>
</tr>
<tr>
<td>P02/FI02 RATIO = 262</td>
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</tbody>
</table>

**Figure 12.1.**