A GRAPHICAL REPRESENTATION FOR AIDING ARTERIAL BLOOD GAS INTERPRETATION USING NON-RESPIRATORY AND RESPIRATORY pH

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ABSTRACT

Arterial blood gas analyser is one of the most important point of care testing in intensive care unit for the management of critically ill patients. The understanding of arterial blood gas (ABG) analysis and interpretation is challenging and at times an arduous task. The graphical representation will serve as a supporting tool for teaching purposes especially for nursing students, critical care nurses and junior doctors but only few research studies are available for the same. The parameters like pH, pCO₂, bicarbonate and Standard base excess are routinely utilized for interpretation but standard bicarbonate is not commonly utilized and some researchers consider it as an obsolete parameter. The understanding of non-respiratory hydrogen ion concentration plays an essential part in arterial blood gas interpretation, but often it is not discussed in detail due to non-availability of its relationship with other ABG parameters. In a recently published research study, calculation of Non-respiratory hydrogen ion concentration from standard bicarbonate, its relationship with other commonly utilized ABG parameters and its clinical application were discussed with the postulates of the acid-base balance theory. The current research study is the extension of previously published work. The aim of the present study is to increase in depth the understanding of ABG interpretation by graphical representation using the metabolic and respiratory components involved in changing pH. The parameters derived from standard bicarbonate namely non-respiratory and predicted respiratory pH plays a vital role in understanding of acid-base disturbances.

KEYWORDS: Non-respiratory hydrogen ion concentration, predicted respiratory pH.

INTRODUCTION

Arterial blood gas analyser is one of the most important point of care testing in intensive care unit and plays a vital role in management of critically ill patients.[1] The technological innovations has resulted in the development of Point-of-care devices which offer rapid analysis at the patient bed side due to its ease-of-use, short turnaround time and portability which produce quick and accurate results.[1] A rise in patients suffering from chronic diseases like chronic obstructive pulmonary diseases (COPD), asthma, heart failure, kidney failure and uncontrolled diabetes and an increase in the number of patients being treated in intensive care units and emergency department necessitate the increased requirement of blood gas analysers.[2,3] However, complexity involved in the interpretation of blood gas analysis data act as a restraining factor for the same.[1] The understanding of arterial blood gas (ABG) analysis and interpretation is sometimes confusing, challenging and at times an arduous task yet timely management results in life saving in emergency conditions.[4,5]

The graphical representation will serve as a supporting tool for teaching purposes especially for nursing students, critical care nurses and junior doctors for better understanding of the arterial blood gas interpretation.[6] A plenty of theoretical information is available and many methods exist in literature to guide the arterial blood gas interpretation.[4] But only few research articles discuss it in a graphical visualization method. There are only few graphical tools available depicting the respiratory and metabolic acid–base disturbances but are rarely used in clinical setting.[7]

The parameters like pH, pCO₂, bicarbonate and Standard base excess are routinely utilized for interpretation. Base excess is defined as the amount of strong acid that must be added to each litre of fully oxygenated blood to return the pH to 7.40 at a temperature of 37°C and a pCO₂ of 40 mmHg. The normal level for base excess is −2 to +2 mEq/L. A negative base excess indicates the presence of base deficit. Actual base excess is the base excess of the blood, while standard base excess is the base excess of the extracellular fluid at haemoglobin concentration of 5 g/dL.[8]

Standard bicarbonate is not commonly utilized and some researchers consider it as an obsolete parameter.[9]
Standard bicarbonate is the concentration of bicarbonate in the plasma from blood which is equilibrated with a normal \( \text{PaCO}_2 \) (40 mmHg) and a normal \( \text{pO}_2 \) (over 100 mmHg) at a normal temperature (37°C)\(^8\). The actual bicarbonate and the standard bicarbonate concentrations are approximately equal under normal ventilation (at \( \text{pCO}_2 \) 40 mm of Hg) but the two values deviate from each other depending on the changes in the concentration of \( \text{pCO}_2 \). The bicarbonate value is increased in respiratory acidosis and decreased in respiratory alkalosis. The ratio \( (\text{HCO}_3^- - \text{standard HCO}_3)/\text{H}_2\text{CO}_3 \) is greater positive for respiratory acidosis and greater negative for respiratory alkalosis. In a previous research study, based on this concept a four quadrant graphical tool was constructed for ABG interpretation using standard base excess and the ratio \( (\text{HCO}_3^- - \text{standard HCO}_3)/\text{H}_2\text{CO}_3 \) in the two axes that demarcate the various acid base disturbances.\(^7\)

The concept of **non-respiratory hydrogen ion concentration** plays a key role in understanding of ABG interpretation yet often it is not discussed in detail during ABG interpretation because it is not routinely applied at the clinical practice due to the lack of simple formulae to calculate the same and non-availability of its interrelationship with the other acid-base parameters.\(^9\) In the recently published research study, calculation of Non-respiratory hydrogen ion concentration from standard bicarbonate, its relationship with other commonly utilized ABG parameters were discussed with the postulates of the acid-base balance theory.\(^1(1)\)

The predicted respiratory \( \text{pH} \) is usually calculated by \( \text{pCO}_2 \) variance. This calculation is slightly different for higher(>40 mm of Hg) and lower(<40 mm of Hg) \( \text{pCO}_2 \) levels. The \textit{difference between} the predicted respiratory \( \text{pH} \) and the measured \( \text{pH} \) reflects the \textit{metabolic pH change}.\(^2\) In the current research study, the predicted respiratory \( \text{pH} \) is calculated by using a newly derived formulae which is common for all \( \text{pCO}_2 \) values.

The aim of the current research study is to aid for ABG interpretation by graphical representation using non-respiratory and respiratory \( \text{pH} \) for better understanding of the metabolic and respiratory components involved in the changes in total \( \text{pH} \). The present research study is the extension of my previously published work.

**MATERIALS AND METHODS**

188 arterial blood gas sample data’s were utilized. Strict precautions were taken to avoid pre-analytical errors and the consistency of the ABG report was checked by using the Modified Henderson Equation.\(^1(3)\) The main parameters like measured \( \text{pH} \), \( \text{pCO}_2 \), \( \text{HCO}_3^- \), Standard \( \text{HCO}_3^- \) and Standard base excess values were noted. Carbonic acid concentration was calculated from \( \text{pCO}_2 \). The difference between bicarbonate and standard bicarbonate was calculated. The ratio \( (\text{HCO}_3^- - \text{Standard HCO}_3)/\text{H}_2\text{CO}_3 \) was calculated.\(^7\)

**Calculation of NRH** (Non-Respiratory hydrogen ion concentration)

The 'non-respiratory' hydrogen ion concentration is calculated by the given formulae which is recently published.\(^1(1)\)

\[
\text{NRH}^+ = 960 / \text{Std HCO}_3
\]

**Calculation of ARpH (pH-NRpH)**

The formulae to calculate the changes in \( \text{pH} \) due to respiratory influence is given below.\(^1(1)\)

\[
[pH - NRpH] = 1.6 + \log \left( \frac{(\text{HCO}_3^- / \text{Std HCO}_3) / \text{pCO}_2}{} \right)
\]

Where NRpH denotes the non-respiratory \( \text{pH} \).
\[
\text{pH} = 9 - \log [H^+];
\]

\[
\text{NRpH} = 9 - \log [\text{NRH}^+];
\]

\[
\text{pH} - \text{NRpH} = 9 - \log [H^+] - 9 + \log [\text{NRH}^+]
\]

\[
= \log [\text{NRH}^+] / [H^+] - \log [H^+] / [\text{NRH}^+]
\]

The magnitude and direction (positive or negative) of the changes in the parameter ARpH (pH-NRpH) denotes the respiratory influence in causing changes in \( \text{pH} \). The value is negative for acidic effect and positive for alkaline effect. At \( \text{pCO}_2 40 \text{ mm of Hg}, \text{pH} - \text{NRpH} \) is zero.\(^1(4)\)

**Net changes in total \( \text{pH} \)**

The net changes in total \( \text{pH} \) (Actual \( \text{pH} \)) includes both the changes in respiratory and nonrespiratory (metabolic component affecting the \( \text{pH} \)).\(^1(1,4,15)\)

\[
\Delta \text{pH} = \Delta \text{RpH} + \Delta \text{NRpH}
\]

\[
\text{pH} - 7.4 = \Delta \text{RpH} + \Delta \text{NRpH} - 7.4
\]

Where \( \Delta \text{NRpH} (\text{NRpH} - 7.4) \) denotes the changes in \( \text{pH} \) due to metabolic component.\(^1(1,5)\)

**Predicted Respiratory \( \text{pH} \)**

\[
\text{pH} = 7.4 + \Delta \text{RpH} + \Delta \text{NRpH}
\]

\[
7.4 + \Delta \text{RpH} - \text{pH} = - \Delta \text{NRpH}
\]

\[
\text{Pr RpH} - \text{pH} = - \Delta \text{NRpH} \quad \text{Pr RpH (Predicted respiratory \( \text{pH} \)) = 7.4 + \Delta \text{RpH}}
\]

The predicted respiratory \( \text{pH} \) is the \( \text{pH} \) at which the changes in \( \text{pH} \) due to metabolic component is zero. \( \Delta \text{NRpH} \text{ is zero} \).

The difference between the predicted respiratory \( \text{pH} \) and actual \( \text{pH} \) denotes the changes in \( \text{pH} \) due to metabolic component.\(^1(2)\) The magnitude and direction (positive or negative) of the changes in the parameter \( \Delta \text{NRpH} \) (\( \text{NRpH} - 7.4 \)) is due to the accumulation of acids other than carbonic acid or bases. The value is negative for acidic effect and positive for alkaline effect. This is one of the postulates of the acid-base balance theory recently published.\(^1(1)\) If the actual \( \text{pH} \) is less than the predicted Respiratory \( \text{pH} \), \( \Delta \text{NRpH} \) is negative. If the actual \( \text{pH} \) is greater than the predicted Respiratory \( \text{pH} \), \( \Delta \text{NRpH} \) is positive.
NRPH-7.4
NRPH – 7.4 = 9 – log [NRH\(^+\)] - [9- log [40]
= 9-log [NRH\(^+\)] - 9 + log [40]
= log [{40}/ [NRH\(^+\)] Or - log [{[NRH\(^+\)]/[40]}]

7.4 + ΔRpH
7.4 + ΔRpH = [9- log [40] + 9 – log [H\(^+\)] - 9 + log [NRH\(^+\)]

NRPHΔ = log [{[NRH\(^+\)]/[H\(^+\)]}]

Pr Resp Ph related to [NRH\(^+\)]/[H\(^+\)]

RESULTS

Table 1: Non-respiratory and Respiratory components (newly derived from standard bicarbonate) of ABG and their significance.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameter</th>
<th>Clinical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NRH(^+): Non-respiratory hydrogen ion concentration NRH(^+) = 960 / Std HCO(_3)</td>
<td>↑ in Metabolic acidosis and ↓ in Metabolic alkalosis</td>
</tr>
<tr>
<td>2.</td>
<td>(40 * NRH(^+))/40: = 1- {([NRH(^+))/40]}</td>
<td>This value is positive for base excess and negative for base deficit.</td>
</tr>
<tr>
<td>3.</td>
<td>NRPH: Non-respiratory pH NRPH = 9 – log [ NRH+]</td>
<td>↑ in Metabolic acidosis and ↓ in Metabolic alkalosis</td>
</tr>
<tr>
<td>4.</td>
<td>ΔRpH (pH-NRPH): Delta respiratory pH ΔRpH = 1.6 + log {(HCO(_3)/ Std HCO(_3)) / pCO(_2)}</td>
<td>↓(negative) in Respiratory acidosis and ↑(positive) in Respiratory alkalosis</td>
</tr>
<tr>
<td>5.</td>
<td>[NRH(^+)]/[H(^+)]</td>
<td>↓(&lt;1) in Respiratory acidosis and ↑(&gt;1) in Respiratory alkalosis</td>
</tr>
<tr>
<td>6.</td>
<td>[ARH(^+)/H(^+)]: (H(^+) - NRH(^+))/ H(^+) or 1- [[NRH(^+)]/[H(^+)]</td>
<td>positive for respiratory acidosis and negative for respiratory alkalosis</td>
</tr>
<tr>
<td>7.</td>
<td>Pr RpH: Predicted Respiratory pH Pr RpH = 7.4 + ΔRpH</td>
<td>pH at which the changes in pH due to metabolic component is zero</td>
</tr>
<tr>
<td>8.</td>
<td>ΔNRpH (NRPH-7.4): Delta non respiratory pH Pr RpH - pH = - ΔNRpH</td>
<td>Changes in pH due to metabolic component. negative for acidic effect and positive for alkaline effect</td>
</tr>
</tbody>
</table>

Table 2: Examples of ABG data showing metabolic and respiratory components involved in net changes in total pH. [Δ pH(pH - 7.4) = ΔRpH (pH-NRPH) + ΔNRpH(NRPH - 7.4)].

<table>
<thead>
<tr>
<th>S.NO</th>
<th>pH</th>
<th>pCO(_2)</th>
<th>HCO(_3)</th>
<th>Std HCO(_3)</th>
<th>PH-7.4</th>
<th>ΔRpH</th>
<th>ΔNRpH</th>
<th>NRPH-7.4</th>
<th>Pr RpH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>7.26</td>
<td>31</td>
<td>13.9</td>
<td>15.5</td>
<td>-0.14</td>
<td>0.06</td>
<td>-0.20</td>
<td>7.46</td>
<td>7.46</td>
</tr>
<tr>
<td>2.</td>
<td>7.5</td>
<td>37</td>
<td>28.9</td>
<td>29.2</td>
<td>0.1</td>
<td>0.03</td>
<td>0.07</td>
<td>7.43</td>
<td>7.43</td>
</tr>
<tr>
<td>3.</td>
<td>7.48</td>
<td>43</td>
<td>32</td>
<td>30.9</td>
<td>0.08</td>
<td>-0.02</td>
<td>0.10</td>
<td>7.38</td>
<td>7.38</td>
</tr>
<tr>
<td>4.</td>
<td>7.41</td>
<td>37</td>
<td>23.5</td>
<td>24.3</td>
<td>0.01</td>
<td>0.02</td>
<td>-0.01</td>
<td>7.42</td>
<td>7.42</td>
</tr>
<tr>
<td>5.</td>
<td>7.39</td>
<td>38</td>
<td>23</td>
<td>23.6</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.02</td>
<td>7.41</td>
<td>7.41</td>
</tr>
<tr>
<td>6.</td>
<td>7.02</td>
<td>61</td>
<td>15.8</td>
<td>12.5</td>
<td>-0.38</td>
<td>-0.08</td>
<td>-0.30</td>
<td>7.32</td>
<td>7.32</td>
</tr>
<tr>
<td>7.</td>
<td>7.5</td>
<td>57</td>
<td>44.5</td>
<td>39.3</td>
<td>0.1</td>
<td>-0.10</td>
<td>0.20</td>
<td>7.30</td>
<td>7.30</td>
</tr>
<tr>
<td>8.</td>
<td>7.4</td>
<td>74</td>
<td>44.6</td>
<td>36.1</td>
<td>0</td>
<td>-0.17</td>
<td>0.17</td>
<td>7.23</td>
<td>7.23</td>
</tr>
</tbody>
</table>

Comment: changes in net pH(acidic) is mainly due to metabolic component, partly opposed by respiratory component (alkaline effect).

Comment: changes in net pH(alkaline) is mainly due to metabolic component.

Comment: changes in net pH(acidic) is mainly due to metabolic component and partly due to respiratory component.

Comment: changes in net pH(alkaline) is mainly due to metabolic component, partly opposed by respiratory component (acidic effect).

Comment: changes in net pH is zero. The changes in pH due to metabolic and respiratory component is equal and opposite. So, it is cancelled out each other and the net change is zero.
### Table 3: Comparison of Predicted Respiratory pH calculation (one by previous method using pCO$_2$ variance and the other by newly derived formulae).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>pCO$_2$&gt; 40 mm of Hg</th>
<th>pCO$_2$&lt; 40 mm of Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>pCO$_2$ Variance</td>
<td>(pCO$_2$-40)/100</td>
<td>(40- pCO$_2$)/100</td>
</tr>
<tr>
<td>Predicted Respiratory pH</td>
<td>7.4 - (pCO$_2$ variance)/2</td>
<td>7.4 + (pCO$_2$ variance)</td>
</tr>
</tbody>
</table>

**Predicted Respiratory pH calculation using newly derived formulae**

\[
\Delta \text{RpH} = [\text{pH} - \text{NRpH}] = 1.6 + \log \left( \frac{\text{HCO}_3^- / \text{Std HCO}_3^-}{\text{pCO}_2} \right)
\]

**Predicted Respiratory pH**

\[
7.4 + \Delta \text{RpH}
\]

**Figure 1:** X: axis NRpH VS Y: axis pCO$_2$.

**Figure 2:** X: axis NRpH VS Y: axis NRH/40.
Figure 3: X: axis 7.4-NRpH VS Y: axis NRH/40.

Figure 4: X: axis NRpH-7.4 VS Y: axis (40-NRH)/40.

Figure 5: X: axis STD BASE EXCESS VS Y: axis (40-NRH)/40.
Figure 6: X: axis pCO₂ VS Y: axis [NRH]/[H].

Figure 7: X: axis ∆ RpH VS Y: axis [NRH]/[H].

Figure 8: X: axis ∆ RpH VS Y: axis 1 - {[NRH]/[H]}.
Figure 9: X: axis (pCO₂ – 40 mm Hg) VS Y: axis 1- {[NRH]/[H]}.

Figure 10: X: axis [NRH]/[H] VS Y: axis (HCO₃⁻ Standard HCO₃) /H₂CO₃.

Figure 11: X: axis Predicted Respiratory pH VS Y: axis [NRH]/[(40)°[H]].
Figure 12: X: axis Predicted Respiratory pH VS Y: axis HCO$_3$/Std HCO$_3$.

Figure 13: X: axis Predicted Respiratory pH VS Y: axis pCO$_2$.

Figure 14: X: axis [NRH]/([40]*[H]) VS Y: axis pCO$_2$. 
DISCUSSION

The understanding of non-respiratory hydrogen ion concentration (NRH\(^+\)) plays a central role in ABG interpretation.\(^{[10,11]}\) The calculation of NRH\(^+\) from standard bicarbonate and its interrelationship with other commonly utilized ABG parameters was discussed in the previous research study which enumerates the postulates of the acid-base balance theory. The first two postulates of this theory relates the net changes in pH and the sum total changes in the hydrogen ion concentration to their individual changes in respiratory and non-respiratory (metabolic) component respectively.\(^{[11]}\) Non-respiratory and Respiratory components derived from standard bicarbonate are tabulated with their clinical significance in arterial blood gas interpretation in table 1. In the current study, 188 sample data’s were utilized for the construction of various figures(graphs) representing the relationship between the respiratory and non-respiratory components involved in changing pH with other commonly used ABG parameters. In table 2, ABG data citing with 11 examples are given. The net changes in total pH is compared with the individual changes in pH due to respiratory and non-respiratory components. This will help in understanding the alterations in pH in different acid-base disturbances. The magnitude of the changes in pH and its acidic or alkaline effect due to the respiratory, metabolic or both components can be easily assessed.

From the figure 1, it is very clear that there is no correlation between non-respiratory pH(NRpH) and pCO\(_2\) values because NRpH is calculated for pCO\(_2\) value of 40 mm of Hg. The relation between changes in the non-respiratory hydrogen ion concentration(NRH\(^+\)) and its pH(NRpH) is shown in the figures 2,3 and 4. The relation ship between standard base excess and changes in the non-respiratory hydrogen ion concentration is shown in the figure 5.

From these graphs, it is easy to observe that NRH\(^+\) is increased in Metabolic acidosis and decreased in Metabolic alkalosis. Similarly, NRpH is decreased in Metabolic acidosis and increased in Metabolic alkalosis.

The relationship of the changes in pH due to respiratory influence is clearly shown in the figures 6,7,8,9 and 10. It is very easy to observe that the parameter [NRH\(^+\)]/[H\(^+\)] is decreased (<1) in Respiratory acidosis and increased (>1) in Respiratory alkalosis. The parameter NRH/H denotes the changes in pH due to respiratory influence. The parameter ΔRpH (pH-NRpH) is decreased (negative) in Respiratory acidosis and increased (positive) in Respiratory alkalosis. At pCO\(_2\) 40 mm of Hg, bicarbonate and standard bicarbonate value is same so the value of the ratios namely HCO\(_3\)/Std HCO\(_3\) and [NRH]/[H] is one. The relation between pCO\(_2\) and the ratio ΔRH\(^+/\)H\(^+\) is clearly shown in the figure 9. It is positive for respiratory acidosis and negative for respiratory alkalosis. In this graph central zero point denotes pCO\(_2\) of 40 mm of Hg because the parameter (pCO\(_2\) – 40 mm of Hg) is taken in the x: axis.

ΔRH\(^+/\)H\(^+\) = [H\(^+\) - NRH\(^+/\)]/ [H\(^+\)] or 1 – ([NRH\(^+/\)]/[H\(^+\)])

From the figures 11,12,13 and 14, the relationship of predicted Respiratory pH is obviously seen. At Predicted Respiratory pH value of 7.4, the value of the parameter [NRH]/([40]*[H]) is 0.025.(because the ratio [NRH]/[H] is one at pH 7.4 and the value of 1/40 is 0.025.

The Comparison of Predicted Respiratory pH calculation one by previous method using pCO\(_2\) variance and the other by newly derived formulae is
shown in the table 3. Their graphical relationship is clearly shown in the figure 15.

The formulae to calculate the predicted respiratory pH is as follows.

\[
Pr \text{ R}pH (\text{Predicted Respiratory pH}) = 7.4 + \DeltaRpH \\
\text{Where } \DeltaRpH (\text{pH-NRpH}) = 1.6 + \log \left\{ \frac{(\text{HCO}_3^-/ \text{Std} \text{HCO}_3^-)}{\text{pCO}_2} \right\}
\]

In the newly derived formulae, pCO2, bicarbonate and standard bicarbonate values are included but in the other method only pCO2 values are considered. The actual bicarbonate and the standard bicarbonate values are more or less similar, but in the presence of respiratory disturbances, the two values will deviate from each other. Hence, the alteration in these two values due to the respiratory influence has to be corrected. Also, this newly derived formulae is very simple because it can be used for all the pCO2 values compared to other method which is different for higher (>40 mm of Hg) and lower (<40 mm of Hg) pCO2 values.

In a previous study, a novel four quadrant graph method was developed using standard base excess in x: axis and the ratio (HCO3− Standard HCO3− /H2CO3) values in y: axis. This newer graphical tool may provide a rough guide and help in easier and quicker interpretation of ABG reports. A minor drawback of this graphical tool is that, as the pCO2 increases, ratio (HCO3− Standard HCO3− /H2CO3 also increases and afterwards the curve flattens. This may not clearly demarcate the different higher levels of pCO2 values. Although the ratio (HCO3− Standard HCO3− /H2CO3 differentiate the respiratory acidosis and respiratory alkalosis, it may not clearly differentiate the different pCO2 levels. But this can be corrected (rectified) in 3-dimensional graph if pCO2 values are included in the third axis (z:axis). The parameter (pCO2− 40 mm of Hg) should be taken in the third axis, because the ratio (HCO3− Standard HCO3− /H2CO3 is zero at pCO2 40 mm of Hg, so that the zero central point is common to all the 3 parameters of the three axes. Alternatively, a similar 4 quadrant graph method can be constructed by the same concept but using different parameter the ratio (H⁺ - NRH')/ H⁺. This ratio is positive for respiratory acidosis and negative for respiratory alkalosis which is similar to the ratio (HCO3− Standard HCO3− /H2CO3).

Although, standard bicarbonate value is not routinely utilized for ABG interpretation, the parameters derived from standard bicarbonate plays a vital role in the understanding of acid-base disturbances. The application of these newly derived parameters may serve as a supporting tool for teaching purposes, when properly correlated with clinical conditions and other ABG parameters results in better understanding and quicker interpretation of ABG reports.

CONCLUSION

Arterial blood gas analysis test is one of the most commonly employed point of care testing in intensive care units, yet the understanding of acid-base disturbances and interpretation of ABG reports is sometimes a challenging task especially for critically ill patients with multiorgan failure. The graphical relationship between the metabolic and respiratory components of the net changes in pH and the total changes in hydrogen ion concentration with other ABG parameters like Standard Base excess, bicarbonate, standard bicarbonate and pCO2 will help in better understanding of the Arterial Blood gas interpretation which results in proper, quicker and better management of the patient’s critical conditions.

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