ABG Interpretation 1st Edition

(Acid/Base Classification)

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The interpretation of Arterial Blood Gas results has been a challenging issue for Respiratory Therapy students as far back as I can remember. Even experienced practitioners have some trouble with the results of this very important test. Before you can interpret the result of an ABG you must first classify the acid/base status. Over the years I have developed a method of classifying the acid/base status of ABG results that seems to work well for just about everyone who's tried it. Hopefully it will work for you too…

Before you try to classify the acid/base status of an arterial blood gas you must understand a couple things about them. 1) An Arterial Blood Gas can never be read as if it were a single test. An ABG is a set of separate results (rather separate measurements) with a couple of things in common. They all come from the same place, and they're all focused on the same place. 2) You must understand that oxygenation and ventilation are two entirely different mechanisms, and one doesn't necessarily effect the other. I've also explained this in my presentation titled; Capnography – The "Other" Vital Sign. (The 4th Edition is available for sale on this site - and will soon be available for CEU's).

Classifying an Arterial Blood Gas result is as easy as counting to four. All you have to do is answer four simple questions, one at a time, in order, every time and you'll never interpret an ABG incorrectly again. The only way to answer those questions is to look at the results in order;

1- pH (Ranges: 7.35 – 7.45)
2- P_aCO^2 (Ranges: 30 – 40)
3- HCO^3 (Ranges: 22 – 26)
4- P_aO^2 (Ranges: 80 – 100)

Now let's take a look at those 4 simple questions;

1- What is it?
2- What's the cause?
3- Is it trying to correct itself?
4- Did it correct itself?

If you look at the ABG results the order shown above, AND you answer these four questions one at a time, in order, every single time, you will have no trouble interpreting. Now I will explain the answers behind these questions.

1- What is it? – There are only 2 possible choices to this question. 1) Acid or 2) alkali.
   If the measured pH is below 7.40 then the answer to question-1 is acid (***acidosis***).
   If the measured pH is above 7.40 then the answer to question-1 is alkali (***alkalosis***).
2- What is the cause? – There are only 2 possible choices to this question. The cause of the pH result is either the P_aCO^2 or the HCO^3. This one is a little more complicated to explain but it is still fairly simple.
   a. P_aCO^2 is the respiratory component of the ABG.
      If the P_aCO^2 is above 40 then it is in an acid (***acidosis***) direction.
      If the P_aCO^2 is below 40 then it is in an alkali (***alkalosis***) direction.
   b. The HCO^3 is the metabolic component of the ABG.
      If the HCO^3 is above 24 then it is in an alkali direction.
      If the HCO^3 is below 24 then it is in an acid direction.
   c. If the pH is ***acidosis*** (below 7.40) then just determine which component is in an acid direction;
      i. P_aCO^2 above 40mmHg, or
      ii. HCO^3 below 24mEq/L

   d. If the pH is ***alkalosis*** (above 7.40) then just determine which component is in an alkali direction;
      i. P_aCO^2 below 40mmHg, or
      ii. HCO^3 above 24mEq/L

3- Is it trying to correct itself? – There are only 2 possible choices to this question. Look at the component (P_aCO^2 or HCO^3) that is *not* the cause of an imbalanced pH. If that result is abnormal in the opposite direction of the pH result then the answer is **YES**.
   a. EXAMPLE: If the pH is acidosis (below 7.40) and the cause is the P_aCO^2 (above 40) then look at the HCO^3.
      i. If the result is 24 then the ABG is NOT trying to correct itself.
      ii. If the result of the HCO^3 is alkali (above 24) then the ABG is trying to correct itself, meaning it is trying to **compensate**.
   b. EXAMPLE: If the pH is alkalosis (above 7.40) and the cause is the HCO^3 (above 24) then look at the P_aCO^2.
      i. If the result is 40 then the AB G is NOT trying to correct itself.
      ii. If the result of the P_aCO^2 is acid (above 40) then the ABG is trying to correct itself, meaning it is trying to **compensate**.

4- Did it correct itself? – There are only 2 possible choices to this question; either YES or NO.
   a. If the pH is within the normal range of 7.35 – 7.45 then the ABG is **compensated**.
   b. If the pH is not within the normal range but the ABG is trying to correct itself then the compensation result is **partially compensated**.
   c. If the pH is not in the normal range and the ABG is not trying to correct itself then the compensation result is **uncompensated**.

EXAMPLE ABG's

EXAMPLE #1:

pH:	7.30	Acidosis
P_aCO^2:	50 mmHg	Acid
HCO^3:	24 mEq/L	Normal
P_aO^2:	80 mmHg	Normal

Let's answer the 4 questions to the ABG results shown above:

1- What is it? The pH is below 7.40, making this result acidosis.
2- What is the cause?
    a. The P_aCO^2 is above 40, making this result acid. This is the cause.
    b. The HCO^3 is 24, a normal result. This is NOT the cause.
3- Is it trying to correct itself? Looking at the HCO^3 we can see that it is still normal. That means the answer to this question is no, making this an **uncompensated** *respiratory acidosis*.
4- Did it correct itself?
    a. The pH is still below 7.40. The answer is NO, it did not correct itself.
5- Final Interpretation:
    a. The cause of the acidosis is the P_aCO^2, which is the respiratory component of the ABG results.
    b. The HCO^3 remained 24 so it did not try to correct.
    c. That makes the interpretation of these ABG results is "**uncompensated** *respiratory acidosis*".

EXAMPLE #2:

pH:	7.30	Alkalosis
P_aCO^2:	30 mmHg	Alkali
HCO^3	14 mEq/L	Acid
P_aO^2:	70 mmHg	Mild Hypoxemia

Let's answer the 4 questions to the ABG results shown above:

1- What is it? The pH is below 7.40, making this result acidosis.
2- What is the cause?
    a. The P_aCO^2 is 30, which is in an alkalotic direction. This is NOT the cause.
    b. The HCO^3 is 14, which is in an acidotic direction. The pH is acidosis so this **IS** the cause.
3- Is it trying to correct itself?
    a. We know that the cause of the acidosis is the HCO^3 so we will look at the P_aCO^2.
    b. The P_aCO^2 is 30 which is in an alkalotic direction, opposite of the acidotic direction of the pH and the HCO^3. That makes the answer **YES**, it is trying to correct itself.
4- Did it correct itself?
    a. The pH is still outside of the normal range of 7.35 – 7.45 in an acidotic direction so the answer is **NO**, it did not correct itself.
5- Final Interpretation:
    a. The cause of the acidosis is the HCO^3, which is the metabolic component of the Arterial Blood Gas.
    b. The P_aCO^2 is abnormal in the opposite direction of the cause of acidosis in an attempt to correct, or compensate for, the *metabolic* acidosis.
    c. The final classification of these ABG results is **partially compensated** *metabolic acidosis.*

You'll notice that throughout this entire explanation of ABG interpretation I have not mentioned a word about the P_aO^2. That was intentional. You will remember that oxygenation and ventilation are two entirely different mechanisms and they're not related. The P_aO^2 just happens to come from the same place as the rest of the ABG results; arterial blood, and it is looking at the same thing as the rest of the A BG results; the lungs.

The P_aO^2 is the partial pressure of oxygen dissolved in arterial blood plasma, and is an important component of the ABG. Don't be confused by the fact that the P_aO^2 is with the same results as the acid/base balance results. They do not affect each other. The P_aO^2 refers to the oxygenation status of your patient.

a- P_aO^2: Normal = 80 – 100 mmHg
b- Mild Hypoxemia 60 – 80 mmHg
c- Moderate Hypoxemia

The final interpretation of ABG results are given in 2 parts. The acid base balance (which includes the compensation status) followed by the oxygenation status. From the example above the final interpretation would be as follows:

- A partially compensated respiratory alkalosis, with
- Mild hypoxemia (P_aO^2 between 60 and 80 mmHg)

Interpreting ABG results doesn't have to be complicated. The single most important things to remember is to follow the steps one at a time and in order. If you do that then there is no reason why you cannot interpret ABG results quickly, easily, and accurately.