Creative Ways to Teach Arterial Blood Gas Interpretation

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Abstract:

There are many creative ways to teach arterial blood gas interpretation. This article illustrates the use of the stepwise approach, tables, figures, case studies, illustrations, computer-based learning modules, and the tic-tac-toe approach. The authors recommend making several approaches available so students and new critical care nurses can choose the ones that work best for them.

Keywords: ABG interpretation | arterial blood gases | creative teaching

Article:

Arterial blood gas (ABG) interpretation can be a difficult and daunting concept for students and new critical care nurses to grasp. Although ABG interpretation can be arduous, it is essential that critical care nurses master this skill, because accurate interpretation can be life determining. Fortunately, with the numerous technological advances that are available, ABG interpretation can be less cumbersome and more entertaining to students as well as the preceptors, staff development instructors, and nursing professors who teach them.

Nursing students and nurses in practice have many different learning styles, and there are many styles or ways of interpreting gases. The key is to decide which methods work best for a particular individual in obtaining an accurate analysis. This article describes some different ways to interpret ABGs to help students and nurses find the best methods for themselves.

The key to decide which methods work best for a particular individual is in obtaining an accurate analysis.

The most common method used in teaching students to interpret ABGs is the stepwise approach shown in Table 1. Using a figure to interpret the results may create a clearer visual representation for some nurses, and the stepwise approach is also illustrated in Figure 1. In Figure 1, the nurse starts with the pH. In Figure 2, the nurse starts with the $PaCO_2$. Making all 3 of these approaches available shows nurses that there are many valid ways to interpret ABGs. Still another way to teach is to list the abnormalities, common causes, and treatments in a table.Table 2 illustrates this approach.

Another approach is the case study approach. Articles frequently include case studies. Some nurses and students may learn best by starting with a case study then referring to the abnormal ABGs, rather than first learning the normal ABG values and then discussing the patient problems that led to the abnormal ABGs. Thus, an instructor might say, "A patient who has chronic obstructive pulmonary disease will retain (carbon dioxide) CO_2," and then illustrate this with an ABG that shows CO_2 is high and the patient is acidotic and thus has respiratory acidosis. A patient who is in pain, anxious, and hyperventilating may be "blowing off" CO_2; then the instructor can show an ABG where the CO_2 is low and pH is higher, which indicates respiratory alkalosis. A patient who has severe diarrhea is "pooping out base" and has a low bicarbonate (HCO_3) and metabolic acidosis. A patient "throwing up acid" has a high HCO_3 and thus has metabolic alkalosis. Starting with these short scenarios may help some students visualize that ABGs change prior to seeing the laboratory values. Visualizing the patient and the change together may help the abnormal value to "pop" out for new learners. Then, in the future, when nurses see an abnormal value, it will be easier to use the same approach as in the case study with the patient in front of them. Using the case study approach also focuses the nurse on treating the abnormal value, which is the desired outcome of interpreting the ABG. For example, the priority for a patient in respiratory acidosis is for the nurse to start oxygen (O_2).

Another method of interpreting ABGs is known as the "tic-tac-toe" method. Several videos on YouTube teach this method and provide examples for practice. The videos are entertaining and make learning easy. Simply go to YouTube, and type in "ABG tic-tac-toe" method.

Wallace [1] recommends using color to simplify ABG interpretation. In this approach, blue depicts base, red is used for acid, and black signifies neutral. The use of color may not only help students and new nurses learn, but also aid experienced nurses to rapidly recognize the ABG abnormality.

Table 1. Stepwise Approach to Interpreting ABGs

	Normal	Acidosis	Alkalosis
pH	7.35-7.45	<7.35	>7.45
HCO3	22-26 mm Hg	<22 mm Hg	>26 mm Hg
PaCO2	35-45 mm Hg	>45 mm Hg	<35 mm Hg
Step 1. Determine from pH if acidosis (<7.35) or alkalosis (>7.45)			
Step 2. Look at $Paco_2$; can it cause the pH problem? Is it too much acid or too little acid?			
Step 3. Look at the HCO_3, can it cause the pH problem? Is it too much base or too little base?			

Step 4. If acidosis,	if the HCO_3 is low, it is metabolic
	if the CO^2 is high, it is respiratory
If alkalosis,	if the HCO_3 is high, it is metabolic
	if the CO_2 is low, it is respiratory
Step 5. Is it partially or fully compensated?	
Is the pH abnormal and…	
Are the $PaCO_2$ and HCO_3 abnormal?	
If yes to both, partial compensation	
Is the pH normal and…	
Are the $PaCO_2$ and HCO_3 abnormal?	
If yes to both, full compensation	
(Remember, body does not compensate past a pH midline of 7.40)	

Abbreviations: ABG, arterial blood gas; HCO3, bicarbonate

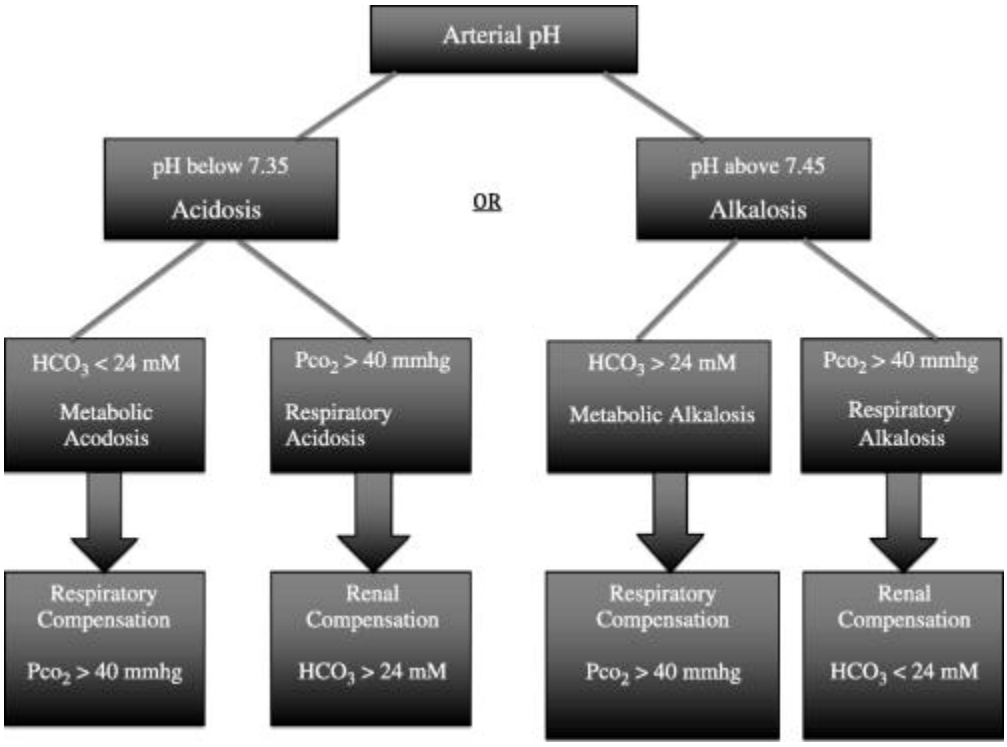

Figure 1. Stepwise approach to interpreting ABGs starting with pH. Abbreviations: ABGs, arterial blood gases; HCO3, bicarbonate.

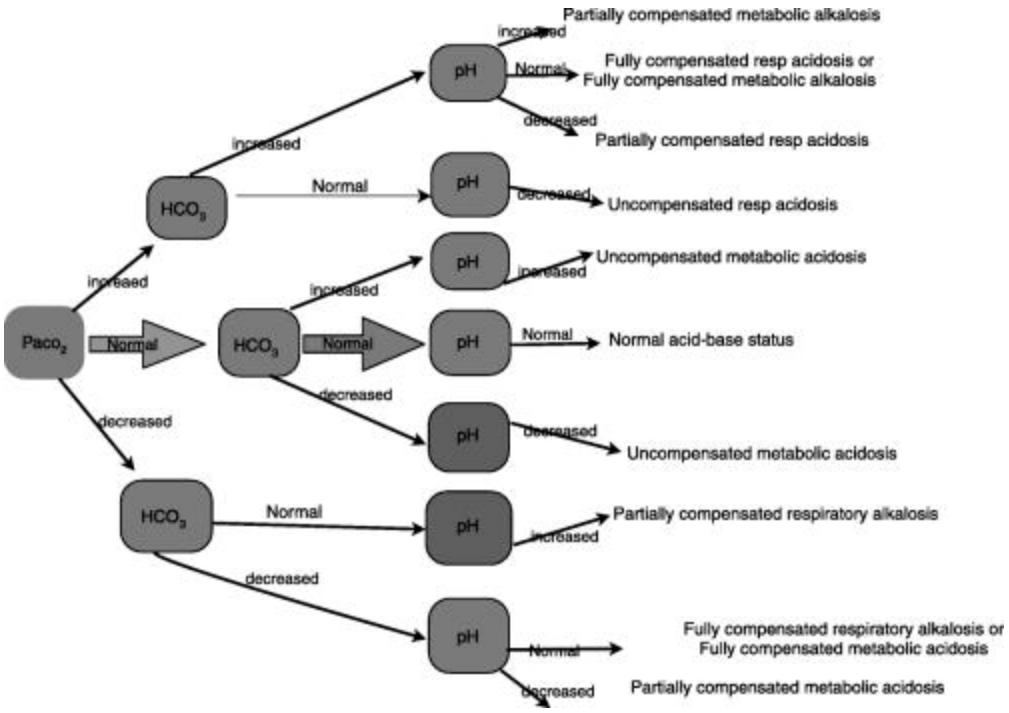

Figure 2. Stepwise approach to interpreting ABGs starting with pH. Abbreviations: ABGs, arterial blood gases; HCO3, bicarbonate.

The use of color may not only help students and new nurses learn, but also aid experienced nurses to rapidly recognize the ABG abnormality.

Some critical care nurses may prefer to learn the physiology of acid-base balance and the pathophysiology of ABG disorders using a pathophysiology textbook. Making textbooks available for these nurses may be all they need. Others may learn best from a nursing journal article, which may combine several approaches, and a quick search will likely find several such as the ones cited here.[2-6]

Table 2. Method of Interpreting ABGs

Acid-Base Imbalance	**Examples of Causes/Etiology**
Respiratory acidosis	
pH is low	Respiratory depression
$PaCO_2$ is high	Chronic lung disease
Metabolic acidosis	
pH is high	Diarrhea (poop out base)
HCO_3 is low	Diabetic ketoacidosis
Respiratory alkalosis	
pH is high	Hyperventilating - due to pain or anxiety
$Paco_2$ is low	
Metabolic alkalosis	
pH is high	Vomiting (throwing up acids)

HCO_3 is low	Nasogastric suctioning

Abbreviations: ABGs, arterial blood gases; HCO_3, bicarbonate. Please modify and use this table as you wish. This basic table includes only a few examples of causes - readers are encouraged to adapt this table in order to make it meaningful for your own clinical practice. When used with prelicensure students, it may be helpful to add columns for ‘‘clinical manifestations’’ and ‘‘interventions.’’ Students could complete the table as an assignment to help them see the differences between the disorders. Normal values: pH = 7.35-7.45; PaCO2 = 35-45 mm Hg; HCO3 = 22-26 mm Hg.

Finally, there are Web-based resources to help learners. In a recent study, Schneiderman et al[7] showed that computer-based learning modules were effective in teaching ABGs for those who wished to design their own computer-based learning module. There are multiple sites that offer tutorials. For example, in addition to showing students an illustration of pH levels, the Wisc-Online Web site (http://www.wisc-online.com/Objects/ViewObject.aspx?ID=NUR302) shows a man balancing on a tightrope, as his pH changes from in balance to being out of balance; at first, he “wavers,” and then he “falls off” the tight rope. This is an entertaining way to teach this “balance.” Wisc-Online, also has several short Web tutorials on fluid and electrolytes and acid-base balance.

Conclusion

Our recommendation is that instructors make several methods available for nursing students and new critical care nurses to choose from, including pathophysiology textbook reading, an article or two explaining the traditional 4-step interpretation, tic-tac-toe videos, tables, and figures. Rather than teaching in a classroom setting, take the classroom time to expose the new nurse or student to the multiple learning strategies that are available and then give all the nurses an opportunity to choose the ones that work best for them.

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