



ARTERIAL BLOOD GAS ACCURACY IN THE PULMONARY LAB

by Jim Harvey MS, RPFT, RCP

When an arterial blood gas is drawn in our pulmonary lab we either analyze the arterial blood sample ourselves with an ISTAT or send it down to the Clinical Laboratory to be analyzed using the large automatic machines. As soon as we send an arterial sample down to the laboratory, we loose control of that specimen and all we can do at our end, is to make sure that it is transported properly so that the results will be accurate. Often it may be obvious that the arterial sample was analyzed incorrectly. Of course accuracy in the pulmonary function lab is very important in blood gas analysis whether it is for routine testing, high altitude simulation studies, exercise studies, or when qualifying a patient for oxygen re-imburement. In the hospital setting the pulmonary function technologist and respiratory therapist are the health care providers who know and understand the most about the collection, transport, and analysis of arterial blood gas. Analyzing an arterial sample involves more than merely reporting the data an

Analyzing an ABG involves more than reporting the data a machine produces, it involves making sure the data makes physiologic sense.

automated machine produces, it involves looking at the data to make sure the data makes physiologic sense. If an arterial sample is sent down to clinical lab for analysis we can not be sure that the sample will be given the same scrutiny for accuracy as we would give.

There are steps we can take to make sure that the accuracy of the arterial blood gas sample is maintained. It is important that the sample be of purely arterial content. Even the smallest amount of venous blood can change the results radically. For example, a not uncommon error is to observe the flash of blood in the hub of the needle and seeing that the blood is a very dark and is probably venous, withdrawing the needle slightly and repositioning and then pushing the needle in again to find the artery. If the artery is then found successfully, although the vast bulk of the syringe volume will be arterial blood, the small amount of venous blood mixed in, will result in significant changes in most of the values, especially PO₂, even if the venous sample volume was very small compared to the arterial sample volume.

Arterial samples should be completely anaerobic. Whatever type of syringe is used, as soon as withdrawing the sample is complete, the syringe should be held upright and the room air bubble should be burped out of the syringe by flicking the syringe with a finger to get the bubble on top in the neck of the syringe and then

pushing the barrel to extrude the bubble into the needle and out into the cap. New syringes have self sealing barrels which seal when contact with blood is made. During the actual blood gas draw, these self sealing barrels allow the sample to rise up into syringe and seal without a risk of aerobic contamination.

Calibration standard of the common brand of arterial blood gas analyzers are documented in the Clinical and Laboratory Standard Institute. For PO₂ and PCO₂ electrodes, gas calibrations should be performed often and quality assurance involves analyzing either manufactures or laboratory tonometered test samples. If calibration and quality assurance is not performed as indicated then blood gas results will be inaccurate and patient safety will be compromised.

It is true that air contamination of arterial blood specimens can alter blood gas values. Room air at sea level has a PO₂ of approximately 150 mmHg and a PCO₂ of near zero.

$$\begin{aligned} P_{iO_2} &= FIO_2 (P_B - 47) \\ &= 0.21 (760 - 47) \\ &= 0.21 (713) \\ &= 149.7 \end{aligned}$$

$$\begin{aligned} P_{iO_2} &= \text{partial pressure of inspired O}_2 \\ FIO_2 &= \text{fractional concentration of inspired O}_2 \\ P_B &= \text{barometric pressure} \\ 47 &= \text{partial pressure of water vapor} \end{aligned}$$

If air bubbles are present in a blood gas sample, equilibrium of gases between the sample and air occurs, but no matter how large the bubble or no matter how much mixing is done, the combined PO₂ and PCO₂ can not exceed 150 mmHg at sea level and at normal barometric pressure. Reporting arterial blood gas results with combined PO₂ and PCO₂ of over 150 mmHg is the most common error in blood gas analysis. When the blood gas results are returned from the laboratory in which they were analyzed and if the sum of PO₂ and PCO₂ exceeds 150 mmHg, then we know that there must have been an error in the machine analysis, since with normal barometric pressures at sea level, the maximum sum can only be 150 mmHg. There just is not enough oxygen in the room air bubble to result in the sum of PO₂ and PCO₂ being higher.

A question was raised in our institution as to whether or not an arterial blood gas sample might see a change in partial pressure of either oxygen or carbon dioxide if the sample is placed into a pneumatic tube system with or without a bubble. The thought is that the sudden increase or decrease in baro-

metric pressure might force oxygen from the air in the bubble present in the sample into solution and result in a change in partial pressure. We have done systematic trials with samples being sent through pneumatic tubes and found that no changes in partial pressure are evident. In any case the laws of physics described in the above paragraph dictate that any bubble, no matter what the barometric pressure change, will not cause any changes in partial pressure of oxygen or carbon dioxide.

We are often advised that arterial blood gas samples should be analyzed within 20 minutes of drawing and if the analysis is delayed, the metabolism of cellular components will draw down oxygen and add carbon dioxide. The fact is that despite the caveats about leukocyte and erythrocyte metabolism, even after one hour, there are no significant changes in either PO₂ or PCO₂.

Also, as discussed in my article published in the March/April 2007 issue of Focus, blood gas samples in plastic syringes should never be placed in ice or in ice slush. If an arterial blood sample in a plastic syringe is placed in ice slush for even fifteen minutes, the partial pressure can cause an increase in PO₂ of up to 20 mmHg or higher. Any false increase in PO₂ can be critical in pulmonary diagnostic tests involving respiratory care patients. An arterial sample kept in a glass syringe in ice slush will not result in an increase in PO₂ since glass is not permeable to oxygen. It is unfortunate that sixteen years after word went out that arterial blood gas samples in plastic syringes should not be stored in ice slush before analysis, many pulmonary function technologists and respiratory therapists are still icing arterial blood gas samples.

The drawing of arterial blood gas samples and their analysis, whether we perform the analysis or not, are very important for patient care and are a crucial component of pulmonary function testing.

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Administering that "Practical" Exam... Continued from previous page

1)agrees to added lab practice, 2)performs the initially assigned procedure correctly and 3)randomly chooses a second procedure to test and pass as well.

Practical testing is very subjective and can be a "land mine" even for the most seasoned educators. Not to mention that the one-on-one and timed nature of the test makes it the most stressful testing experience for the students as well. Practical tests are notorious for bringing students to the brink of anxiety-induced panic attacks. For these and other reasons, the practical test should be reserved for end-of course or end-of- program skills assessment.

Never meant to be all-inclusive, practical tests can only be but one part of a multi-faceted package of student evaluation tools. And even though the process will never be perfect, educators have, since time immemorial, depended on practical testing to provide one reliable assessment of a student's ability to give safe and effective patient care.

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