CAPILLARY BLOOD GASES

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Though most hospitals that treat infants and children rely on capillary blood gases as a clinical management tool, a controversy still exists as to the accuracy, correlation to arterial blood gases and usefulness of the results.

Capillary blood gases are generally obtained from a warmed, "arteriolized" area of the patient, most commonly the heel of the foot. Fingers and earlobes are also used, though much less frequently. Warming of the site increases blood flow, especially arterial blood flow, to the area. Increased blood flow equates to higher oxygen content compared to venous blood samples. Warming procedures can vary, with some using heated wet gauze, diapers soaked in hot water or commercially available chemical heat packs. It is imperative that caution is taken not to use anything too hot in order to prevent burns. McLain, et. al, however, suggest that warming does not improve the accuracy of the results. Techniques for specimen collection may vary as well, though most require much less technical expertice than arterial sampling. Lancets, sclapels and commercially available devices are used to break the skin and start the flow of blood. This is collected in a pre-heparinized capillary tube made of glass or plastic. Most blood gas analyzers require 90 to 150 microliters of blood for an accurate specimen result.

A controversy exists, though. Do the results of capillary blood gas specimens adequately represent the patient's true acid-base, ventilation and oxygenation status? Several studies have looked into answering this question. Murphy and colleagues compared pH, PCO2 and bicarbonate levels resulting from arterial and capillary blood samples of patients with acute exacerbation of chronic obstructive pulmonary disease (COPD). They found reliable assessment of the patient's ventilatory status with the results of the capillary blood gases, but found that oxygenation was less accurate. Harrison and his group also compared arterial and capillary blood gases of patients in the pediatric intensive care unit. They, too, found strong correlation in pH and PCO2. In addition, they found that neither pain, intubation, neuromuscular blockade nor vasoactive drug therapies affected capillary blood gas results or accuracy. Begin et.al. did a similar study with patients with acute respiratory distress without circulatory shock and found that capillary blood gas results were valid depictions of the patient's aci-base balance. McGillivray's group compared capillary blood gases with venous blood gases in pediatric patients as to whether the specimen source affected interpretation and clinical management. They found very little difference in the well-perfused patient.

Adversely, Courtney's group found a poor correlation between post-ductal arterial blood gas results and capillary blood gases in neonates and Salli et. al. came to a similar conclusion in neonates with moderate birth asphyxia.

Speciman collection and handling also affect capillary blood gas results. Poor site selection, milking of the site, and delay in analysis with the specimen on ice or at room temperature changes gas tensions. A colleague of mine and I presented a poster and abstract at the American Association of Respiratory Care International Forum in 2001 that showed significant fluctuation in values with different sample handling techniques. Kost noted significant fluctuations of transcutaneous PCO2 levels during capillary blood gas specimen collection.

Does this mean that the use of capillary blood gas results to aid clinical patient management is a "crap shoot"? With consistent technique, results should, at least, be useful in trending, but ventilator management? How important is an approximation of arterial blood gases in order to have clinical usefullness? Most of the studies cited show minimal, though statistically significant differences in the results between arterial and capillary samples. Are these differences CLINICALLY significant? In addition, patient "behavior", such as crying or moving during specimen collection can alter any result.

Remembering the slight differences in "normal" values, capillary blood gas results can be a very useful tool, especially in the neonatal patient population. This is especially true because of the ease of access and collection. Those of us that work with ventilated neonates can anecdotally state with conviction that capillary blood gases are an important part of our arsenal of clinical weaponry. Institutuions that have an inter-hospital transport system in place frequently utilize capillary blood gas results as a diagnostic tool, as well as a means to fine-tune treatment. This is an easier and safer way to obtain pertinent results than placing an arterial line, umbilically or peripherally. In addition, the quantity of blood needed for qualitative analysis is much less for capillary samples than either arterial or venous samples. Keeping in

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mind that oxygenation is much better monitored by pulse oximetry, acid-base status can be adequately determined using capillary blood gas results. Using "normal" levels, pH should be in the range of 7.30 to 7.40 and PCO2 should be in the 45 to 55 torr range. PO2 levels are usually in the 40 to 50 torr range, though, as stated, is much less reliable.

Another quandry recently looked at consists of the use of plastic versus glass blood gas specimen collection tubes. Many issues arise therein, such as the safety factor when using glass and any distortion of results with glass versus plastic. Plastic capillary tubes are safer to use because they will not break during or after specimen collection.

Does the composition of the collection tube alter results? Looking at blood gas syringes, Knowles, et. al. reported significant changes in PO2 and PCO2 in specimens stored for up to 30 minutes at various temperatures from 0 to 22 degrees C in plastic as opposed to glass syringes. Can this be extrapolated to capillary blood gases? It is an interesting finding but probably lacks significance with capillary samples due to the fact that analysis is, or at least should be, performed as soon as possible after collection. Any delay in analysis can easily cause specimen clotting, which, in itself, drastically changes results and causes major difficulties with the blood gas analyzers themselves. Plastic specimen collection devices have been scrutinized a great deal. Plastic is a porous material, much moreso than glass. This leads to greater gas diffusion. The degree of gas diffused is dependent upon the amount of time the specimen resides within the collection device.

Do we abandon the practice in order to follow evidence-based medicine? I'd like to hear from the clinical community on their opinions and practices.

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You're a control freak.

Your calendar is used as a model for demonstrating what a Palm Pilot can do. You believe that if it's worth doing, it's worth doing perfectly. You had your car washed on the way to work after a snow storm. You sometimes overwhelm your boss with your singlemindedness and judgments on good work versus bad. Your co-workers don't dislike you, but they don't report to you and hope they never will. You may be one of the best doers in the department but nothing you've done so far indicates you have the least aptitude for motivating others.

You're pretentious.

You? Yes. Weren't you the one talking about your child's near perfect score on the SAT? Everyone knows - because you've told them - that your spouse's career is through the stratosphere. Your boss has tried asking you to "tone it down." He/she has even cut you off in mid-sentence when you were extolling the virtues of a $47 bottle of Merlot but you didn't get it. Your boss tolerates you because you do very good work but promoting you would ruffle a lot of feathers.

If you saw even a partial truth in any of these situations, you need to think about your ambitions and your possibilities. even if you beg your boss for the truth, it's unlikely you'll get it. You need outside evaluation. Find a peer in another company and tell your story. If you provide enough facts you'll get an answer truthful enough to shed some light on your problem. Undesirables can become desirables. We've given the formula often. What matters is how strongly you want what isn't presently available. Only you know the answer to that.

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