

## PFT'S AND THE ICING OF ABG SAMPLES

by Jim Harvey MS, RPFT, RCP



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 ABG samples.

In 1991, I was the co-author of a study here at Stanford which demonstrated that arterial blood gas samples should, under no circumstances or for any length of time, be placed in ice or ice slush or even cooled. This research has been duplicated in at least two other studies and was announced by myself at the AARC Annual meeting in New Orleans in 2004. But amazingly, the AARC Clinical Practice Guidelines still instruct respiratory care practitioner to chill arterial samples, collected in plastic syringes, within fifteen minutes if not immediately analyzed. The research cited below indicates that even though there is no significant change in partial pressure of oxygen, even after 60 minutes at ambient temperature, placing an arterial blood gas sample, collected in a plastic syringe, in ice slush or cooling it can increase the PO<sub>2</sub> by as much as 20 mm Hg.

In our 1991 study, published in *Clinical Chemistry*, Vol. 37, No.7, 1991, we placed whole blood in both plastic and glass syringes and then tonometered them to different partial pressures of oxygen and then stored them either in ambient room air or in water and ice solution. When all samples were analyzed 30, 60, or 90 minutes later, the oxygen partial pressures of the iced samples were up to 20 mm Hg higher than baseline while

the samples stored in room air had no significant changes. In contrast, when tonometered blood is stored in glass syringes, there is no change in partial pressure of oxygen when stored in ice.

Before our study it had been common practice to store arterial blood gas samples in ice while waiting for analysis in order to minimize leukocyte metabolism. But the cooling of the blood has two important effects. First, the solubility coefficient of oxygen in blood doubles and second, there is an increase in the oxygen-hemoglobin affinity which leads to an initial decrease in sample PO<sub>2</sub>, which in turn will increase the atmosphere-to-sample oxygen gradient. This gradient may cause an increased flux of oxygen into the sample if the sample is stored in a semi-permeable container such as a plastic syringe. When the sample is analyzed and heated to 37 degrees centigrade, both the P50 and the solubility coefficient return to their normal original values and the additional oxygen in the sample will now be released resulting in a falsely increased PO<sub>2</sub> measurement. The solubility coefficient of ice slush is extremely high and the ice slush is a great source of oxygen flow into the sample through the plastic.

If an arterial blood sample in plastic is placed in an ice slush for even fifteen minutes, the partial pressure can cause an increase in PO<sub>2</sub> of up to 20 mm of Hg or higher. Any false increase in PO<sub>2</sub> can be critical in pulmonary diagnostic tests or in respiratory care of patients.

It would be nice if the syringe companies could produce arterial blood gas syringes which are not permeable to oxygen. The technology exists. Witness the fact that ketchup is stored in plastic bottles and if oxygen was allowed to pass through the bottle, the ketchup would not last long in storage. But for some reason, the syringe producing companies refuse to make a syringe which would prevent the passage of oxygen, and in the meantime, it is imperative that arterial blood gas samples in plastic be kept at ambient temp.

The Clinical and Laboratory Standard Institute publishes guidelines for handling arterial samples and indicated that an arterial sample should not be cooled if analyzed in less than 30 minutes. But if a sample is likely to be analyzed after 30 minutes, then it should be collected in a glass syringe and then "cooled". The point really should be made here that if the sample is to be analyzed in more than 30 minutes, it should not be collected in a plastic syringe and placed in ice. The American Association of Respiratory Care Clinical Practice Guidelines are definitely incorrect. Section 7.1.7 indicates that since white cell counts may decrease PO<sub>2</sub> very rapidly, "immediate chilling" of the arterial blood gas sample is necessary.

In talking to respiratory care practitioners in the San Francisco Bay Area, it became evident that icing of arterial blood gas samples is still commonly done and even, as we saw above, demanded in department guidelines.

So please inform your pulmonary function and respiratory care departments that arterial blood gas samples in plastic syringes should not be stored in ice slush. I'll contact the AARC and ask them again to make the appropriate change in their Clinical Practice Guidelines.

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