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Novel In-Line Hemolysis Detection on a Blood Gas Analyzer and Impact on Whole Blood Potassium Results

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Guest: Dr. Jim Nichols is a Professor of Pathology, Microbiology, and Immunology, and Medical Director of Clinical Chemistry and Point-of-Care Testing at Vanderbilt University Medical Center in Nashville, Tennessee.

Bob Barrett: This is a podcast from *Clinical Chemistry*, a production of the Association for Diagnostics & Laboratory Medicine. I'm Bob Barrett. Pre-analytical errors like sample mislabeling, incorrect collection technique, and inappropriate storage and processing can have a profound impact on clinical laboratory test results. In many cases, these errors generate misleading values that do not reflect the patient's true state of health, increasing the risk of incorrect medical decisions that lead to patient harm. While many forms of pre-analytical error are difficult to detect, hemolysis, the release of red blood cell contents into the surrounding serum or plasma, can be readily identified in clinical laboratories that perform serum or plasma-based testing. This is particularly important when measuring analytes present at high concentrations in red blood cells, such as potassium.

At the point of care, however, where testing is performed using whole blood, it is impossible to differentiate between hemolyzed and non-hemolyzed samples, which puts providers in the difficult position of having to guess whether an elevated potassium level is real or simply an artifact of sample hemolysis. A new research article, appearing in the December 2024 issue of *Clinical Chemistry,* highlights a new blood gas instrument with the ability to detect hemolysis in whole blood samples. How well does this feature work and what does it mean for the future of point-of-care testing? In this podcast, we're pleased to welcome the article's senior author. Dr. Jim Nichols is a Professor of Pathology, Microbiology, and Immunology, and Medical Director of Clinical Chemistry and Point-of-Care Testing at Vanderbilt University Medical Center in Nashville, Tennessee. So Dr. Nichols, let's start with the basics. Why is it so important to detect hemolysis?

Jim Nichols: Sure, hemolysis is really the lysis of red blood cells. As red blood cells burst, usually this is during either traumatic sticks, phlebotomy, difficult draws. When red blood cells lyse, they release hemoglobin into the plasma serum portion of blood as well as the other cellular contents like potassium, lactate dehydrogenase, and other contents. So, the problem with

hemolysis is that it can interfere with chemistry analysis as well as immunoassay analysis, which use spectrophotometric detections.

Bob Barrett: How is hemolysis detected on automated chemistry analyzers?

Jim Nichols: It's detected spectrophotometrically. On the automated chemistry analyzers, they make a dilution of patient's blood, their plasma serum, into a buffer or saline, and they just take a spectrophotometer wavelength to detect the hemoglobin in that sample. Used to be, way back before we had automated chemistry analyzers, technologists would look at every sample visually to detect the amount of redness, red color from the hemoglobin, in the sample, and rank it sort of qualimetrically as mild, moderate, or gross hemolysis. It's important because if you release potassium into the patient's plasma or serum, that's going to elevate potassium levels and can lead to medical mismanagement or change in management decisions. I actually worked with Fred Apple up in Minnesota, and between his institution and ours, we pulled a couple of hundred blood gas samples from acute care ICUs, ORs, emergency department.

We spun down the cells and we ran the plasma through a chemistry analyzer and looked at the H index, the hemolysis index on these. What we found is while most clinicians think an elevated potassium could potentially be due to hemolysis, we actually noted, particularly in emergency room samples, up to one in five samples was hemolyzed in the emergency room between our two institutions. Of those, about 20% or more were actually in the normal range of potassium, and another 10% or 11% were in the hypokalemic range, or the low potassium range. This means that samples with normal and low potassium could go undetected and that could severely affect cardiac function and other functions, muscle function of the patient. So it's important to detect hemolysis.

Bob Barrett: So, point-of-care blood gas testing uses whole blood rather than plasma. Can whole blood samples be processed to separate cells in plasma to assess hemolysis, and is it likely that point-of-care testing personnel will do this?

Jim Nichols: Yeah, so the problem in our chemistry labs and automated laboratories is that we're centrifuging all of the samples before we send them through the analyzers.

So that's how we detect the red color, hemolysis, in plasma or serum. Unfortunately, whole blood samples don't separate, so we have no idea how hemolyzed a whole blood sample would be. The only way that they could detect this at the point of care would be to centrifuge every sample, and that's very unlikely. The blood gas analyzers are a rapid

analysis. They're needed for immediate treatment of the patient, and so we're not going to delay reporting of those results to the clinicians simply to centrifuge the sample, which would add another several minutes.

Bob Barrett: Doctor, what is novel about the GEM7000 blood gas analyzer evaluated in this study?

Jim Nichols: Sure, the GEM7000 analyzer has an acoustofluidic flow cell as part of the integrated line and analysis of the system. That cell can actually impact or take the sample, and through acoustic waves, separate the cells from the plasma and detect hemolysis in real time during the analysis without adding an additional amount of sample requirements. So, within the two minutes of standard blood gas analysis, you also get a hemolysis index that's going to indicate whether that potassium is elevated due to hemolysis or not. And it also gives you a semi-quantitative value to let you know whether it is mild, moderate, or grossly hemolyzed.

Bob Barrett: Well, finally, Dr. Nichols, what is the bottom line here? How will this publication and the new technology described here improve patient care?

Jim Nichols: Well, I think this is one of the most novel developments of engineering in our time. It is going to really impact the quality and assurance of the reliability of those potassium results that we get on blood gas analyzers, simply because we're able to detect hemolysis in a whole blood sample during the actual analysis on this analyzer. So, this is going to assure that clinicians that that value, that potassium value, is real, or it's falsely elevated due to lysed samples.

Bob Barrett: That was Dr. Jim Nichols from Vanderbilt University Medical Center in Nashville, Tennessee. He wrote a new research article on hemolysis detection by blood gas analyzers in the December 2024 issue of *Clinical Chemistry*, and he's been our guest in this podcast on that topic. I'm Bob Barrett. Thanks for listening.