Biochemical Measurement Aberrations in Extreme Leukocytosis
Ross A. Miller, MD

A new diagnosis of malignancy is difficult for all involved. Those directly and indirectly involved in patient care strive to provide accurate information and optimal treatment. In order to accomplish these goals, physicians need to be aware of possible anomalous laboratory findings. In the case of hematopoietic malignancies, it is important to understand the consequences of extreme leukocytosis with regard to biochemical measurements. In this scenario, serum potassium levels can be fictitiously elevated (pseudohyperkalemia or “reverse” pseudohyperkalemia\(^1,2\)) and blood gas analysis can be inaccurate (spurious hypoxemia or leukocyte larceny\(^3\)).

Classically, pseudohyperkalemia occurs due to in vitro red blood cell hemolysis. Further causes include vigorous arm exercise, tight applications of tourniquets, thrombocytosis, and extreme leukocytosis.\(^4,5\) Keep in mind that potassium is the primary intracellular ion, since a transcellular potassium shift may result in pseudohyperkalemia.\(^2,4\) In laboratories incorporating potassium into the Anion Gap equation ([sodium + potassium] – [bicarbonate + chloride]), a false potassium value may lead to anion gap deviations. The high metabolic activity of leukocytes may explain inaccurate blood gas reporting seen in marked leukocytosis\(^3,4\) as oxygen is quickly consumed within the confines of a test tube. This effect becomes even more pronounced with increased blasts,\(^4\) as cellular immaturity is associated with an increased metabolic demand. The resulting fictitious depression of oxygen may lead the clinician to consider pulmonary embolus, pneumonia, or pulmonary leukostasis\(^3,6,7\)—all of which require specific, and at times, immediate medical attention.

Attempts to achieve accurate potassium measurements in extreme leukocytosis include analysis of manually transported whole blood specimens on blood gas instruments or use of serum in a central lab instrument.\(^2\) When pseudohyperkalemia is suspected, correlating ECG findings and/or LDH levels (increase with cell lysis/membrane damage) may be helpful.\(^1\) Various efforts to minimize spurious hypoxemia include the use of potassium cyanide\(^8\) and sodium fluoride, the substitution of plasma for whole blood, and the immediate placement of the specimen on ice.\(^4\) Continuous blood gas analysis has also been considered to achieve accurate blood gas analysis.\(^9\) Unfortunately, these efforts have proven to be expensive\(^9\) and inconsistent.\(^4\) Using concomitant pulse oximetry can be effective,\(^7\) providing one understands its diagnostic limitations, which include the presence of carboxyhemoglobin, the presence of methemoglobin, the use of intravenous dyes (methylene blue, indocyanine green), the use of dark fingernail polish, and the presence of fluorescent and xenon arc surgical lamps.\(^10\) More recent innovations to combat spurious hypoxemia include the use of point-of-care blood gas instruments, which have been described to yield blood gas results that correlate with clinical findings.\(^3\) Perhaps another consideration would include the reduction of the absolute leukocyte count in the peripheral blood, which can correct the above fictitious biochemical findings and prevent the development of pulmonary leukostasis.

In conclusion, it is important for physicians and laboratory personnel to be aware of testing limitations and the possibility of erroneous potassium and oxygen levels in providing optimal patient care. Always consider careful clinical correlation between test results and patient symptomatology in order to maximize patient outcomes and provide the best possible care.
References


