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Point of Care Testing Error in the ICU

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Background

Point-of-care testing (POCT) first arose in the 1970s, as self-calibrating blood gas measurement machines moved from the central lab to the ICU. Quality control factors, then as now, are provided as a means to prevent errors: high FiO₂, barotrauma, and hemodynamic instability. These errors increased the risk of oxygen free-radical tissue damage because of high FiO₂. Operator incompetence, nonadherence to procedures, and use of uncontrolled reagents or equipment are common issues. Analysis-stage error can arise from expired test strips in glucose meters, plasma versus whole-blood samples in ABG analysis, and plasma osmolality in hematocrit measurements. These errors are amplified through incorrect regulation, rapid result availability, and immediate clinical implications of the results. We discuss POCT error in the context of two clinical cases.

Case Reports

Patient 1: 46 yo F admitted for peritonitis who underwent abdominal washout and resection of perforated bowel. SIUC course significant for septic shock and difficulty with ventilator weaning. On several POCT ABGs drawn over a few days at different arterial sites, discrepancy was noted between pulse oximetry (SpO₂) values and oxygenation lab values (pao₂ and SatO₂) obtained from POCT ABG (figure 1). At the time care was delivered, the presumption was made that oxygenation as measured by pulse oximetry was less accurate than POCT ABG values, as we rarely have suspicion of ABG values but commonly experience spurious pulse oximetry values. An investigation of potential causes of a falsely elevated SpO₂ was undertaken (figure 2). This failed to reveal any reasonable explanation for the discrepancy between SpO₂ and the POCT ABG pao₂ values. On the 5th day described here, inconsistencies in patient 2’s POCT ABG and SpO₂ were noted. After demonstrating the discrepancy on simultaneous draws from patient 2, patient 1’s care was focused on SpO₂ values and POCT ABGs were no longer used (figure 3).

Patient 2: 59 yo M sustained polytrauma in an encounter with a forklift. On HD3 serial POCT ABGs showed pao₂ in the 50-60 mmHg range while SpO₂ remained at 100% (figure 4). This apparent discrepancy in oxygenation values raised suspicion for error. Potential errors of SpO₂ were eliminated as in figure 2. Because of high vigilance for erroneous POCT ABG values, a single ABG draw was tested simultaneously on several different POCT machines and central laboratory testing, demonstrating a notable difference in oxygenation values between the POCT and central lab, but consistency among the POCT (figure 5). This procedure was repeated with yet another POCT machine and again showed a large discrepancy in oxygenation. At this point oxygenation interventions were made to patient 1 and patient 2 based on pulse oximetry. Central lab use was reserved for repeat ABGs as necessary.

Discussion

In the two cases discussed here, POCT error led to an inappropriately aggressive course of respiratory support. These errors increased the risk of oxygen free-radical tissue damage because of high FiO₂, created a risk of barotrauma and hemodynamic instability with elevated PEEP, and prolonged exposure to intubation and thus increased the risk of ventilator-associated pneumonia. Additionally, a blood transfusion was given per surviving sepsis guidelines based on Svo₂.<0.7 measured during the time of other suspect measurements. In both cases the recognition of error allowed alternative measures to be preferred and changed the direction of care.

This error was reported to our lab and appropriately investigated. All suspect samples came from the same lot number of ABG cartridges. Further investigation was unable to consistenly demonstrate a pattern of errors within a particular lot number, particular POCT devices, or specific operators. Quality control showed the devices in the ICU to be accurate. Cartridges of the suspicious lot number were removed from use. The conclusion was that a consistent operator error such as not allowing cartridges to come to room temperature or simply sporadic cartridge malfunctions within the lot number was responsible.

The serial and low-volume nature of the work makes pattern recognition very difficult, a recognized weakness of POCT versus central lab testing. Detecting POCT errors is typically a matter of using clinical judgment if the values are in question, comparing the patient’s presentation and, perhaps more importantly, planned quality control measures such as operator training, device maintenance, and periodic sample comparison with central lab values.

References


Abbreviations

POCT: Point-of-care testing
ABG: Arterial Blood Gases
SpO₂: Pulse oximetry reading
pH: pH
paCO₂: arterial carbon dioxide partial pressure
paO₂: arterial oxygen partial pressure
Hct: hematocrit
FiO₂: fractional inspired oxygen concentration
SaO₂: arterial oxygen saturation
Svo₂: Central venous oxygen saturation
PEEP: positive end-expiratory pressure
BUN: Blood Urea Nitrogen
Cr: Creatinine
La-CPK: lactate dehydrogenase
Hct: hematocrit
ARMS: analysis range monitoring system