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Glucose Meter Accuracy

The introduction of tight glycemic control protocols in hospitals has increased the need for more accurate bedside glucose meters. In 1987, the American Diabetes Association (ADA) recommended that glucose meters should have a total error (analytic plus user) of <10% at glucose concentrations between 30 to 400 mg/dL. More recently, ADA urged manufacturers to further decrease total error to 5%. Currently available meters do not meet these performance goals. Recent proficiency testing results from the College of American Pathologists demonstrate that glucose meters have much more instrument to instrument variability than chemistry analyzers in central laboratories. For example, the interlaboratory precision at a glucose value of 400 mg/dL ranged from 4.1% to 13.7% for glucose meters compared to 1.6% to 2.8% for chemistry analyzers.

The laboratory often receives questions concerning the disparity between a glucose result obtained with a glucose meter and a subsequent result performed on a chemistry analyzer in the laboratory. In most instances, the glucose meter result has been incorrect. The most common causes of erroneous results obtained with glucose meters include:

- Under or overfilling of the glucose strip
- Contamination or dilution of the sample, especially if drawn from a line
- Clotting of the sample due to delayed testing

ACIP Confusion

The Acute Cardiac Injury Profile (ACIP) is offered as an ordering convenience. Once this profile is ordered a series of three samples is automatically drawn at 0, 3 and 6 hours for the measurement of troponin I and CK-MB. However, sometimes the laboratory receives confusing orders such as ACIP x3 or ACIP q6 hours. In the first example, the order may be misinterpreted to mean that 3 sets of ACIP should be ordered, for a total of 9 measurements. In the second example, the order may be misinterpreted to indicate that a second ACIP

should be collected six hours after completion of the first ACIP for a total of 6 measurements. To avoid this confusion, physicians should simply order ACIP.

Outcomes of Transfusion Safety Initiative

Nationally, 1 in 38,000 red cell units is transfused to the wrong patient. When the wrong unit of blood is given, it is ABO-incompatible 1 in 3 times. Two thirds of these erroneous transfusions are caused by a clerical or management error in identifying the patient, blood sample or blood component and one third are due to an error in the transfusion service. Of these ABO-incompatible transfusions, about 10% are associated with a fatal hemolytic transfusion reaction. Mislabelled samples for blood bank testing may also result in the failure to administer Rh immune globulin resulting in hemolytic disease of the newborn.

In order to eliminate these errors a transfusion safety initiative was introduced at Saint Luke's Hospital on January 3, 2006. This policy required that a patient have two blood types on file before ABO specific blood components would be issued. Review of the 2006 data revealed that 10,391 units of red blood cells were transfused and the new policy prevented 16 blood typing errors from occurring. Clearly, this initiative has improved patient safety.

Underestimation of Plasma Cells by Flow Cytometry

A study published this month in Archives of Pathology and Laboratory Medicine (2007;131:951-55) showed that flow cytometry may considerably underestimate the percentages of plasma cells in bone marrow specimens compared to morphologic evaluation of aspirate smears.

In an effort to characterize the accuracy of flow cytometry in detecting and quantitating neoplastic plasma cells, researchers from the Department of Pathology at the University of Utah analyzed 30 bone marrow specimens from patients with plasma

cell dyscrasias and compared plasma cell percentages determined by flow cytometry to those obtained by morphologic evaluation of aspirate smears. In all but 2 cases plasma cell percentages determined by flow cytometry were markedly decreased compared to diagnostic aspirate specimens. A sample of plasma cell dyscrasia cases from Saint Luke's Hospital during the past year showed similar results as seen in the following table.

Case	Morphologic % Plasma Cells	Flow Cytometry % Plasma Cells
1	49	19
2	46	30
3	35	1
4	17	5
5	15	1
6	12	3
7	11	2
8	9.5	2

Hemodilution of flow cytometry specimens is often cited as the primary cause for underestimation of plasma cells by flow cytometry. However, the University of Utah article suggests that the ammonium chloride solution used to lyse red blood cells may also destroy plasma cells. Further study is warranted.

Although it appears that quantitation of plasma cells by flow cytometry is not completely reliable, the authors of this study maintain that flow cytometry is still useful for determining plasma cell clonality and for providing a lower limit estimate of plasma cell percentages. These applications are particularly valuable in cases submitted for evaluation of residual disease.

Reducing the Risk of TRALI

Transfusion-related acute lung injury (TRALI) is a clinical syndrome that presents as acute hypoxemia and noncardiogenic pulmonary edema within 6 hours after completion of a transfusion of one or more plasma containing blood components, which is not temporally related to another cause of acute lung injury such as pneumonia, gastric aspiration, toxic inhalation, sepsis, shock, and cardio-pulmonary bypass. Today, TRALI is the most frequent cause of transfusion-related death reported to the FDA. Recent data from two studies

suggest that the incidence of TRALI is approximately 1 in 1300 components transfused.

Substantial circumstantial evidence indicates that the majority of cases of TRALI are caused by transfusion of plasma containing leukocyte antibodies. Many recipients who develop TRALI have received a donor unit containing antibodies directed against an antigen present on their leukocytes. Such antibodies may be directed against HLA Class I or Class II antigens or non-HLA neutrophil antigens (HNA). The highest frequency of leukocyte antibodies is found in female donors who have previously been pregnant. Overall, about 15 to 20% of female donors have HLA antibodies compared to <1% of male donors.

Several years ago, investigators from the United Kingdom (UK) Serious Hazards of Transfusion (SHOT) system determined that the rate of TRALI occurrence was 5 to 7-fold greater for blood components that contained high volumes of plasma such as FFP and platelets than for packed red blood cells. This data also showed that the majority of TRALI cases involved a leukocyte antibody-positive female donor. On the basis of the SHOT analysis, the UK adopted a policy to minimize the transfusion of FFP and platelets from female donors. Since the implementation of this policy in October 2003, the number of TRALI cases has decreased from 20 per year to 3.

Recently, the American Red Cross analyzed cases of fatal TRALI reported between 2003 and 2005. Retrospective review of fatalities revealed 38 cases of probable TRALI, the majority of which (24 of 38) followed plasma transfusion. A female leukocyte antibody-positive donor was involved in 75% of cases involving plasma and in 60% of cases involving apheresis platelets.

As a result of this compelling data, the American Association of Blood Banks (AABB) has recommended that all blood collecting facilities take steps to minimize the preparation of high plasma-volume components from donors known to be at increased risk of leukocyte alloimmunization. Accordingly, blood centers have begun supplying FFP from only male donors. They also must develop a plan to provide apheresis platelets from male donors by March 2008 and implement it by November 2008.