A retrospective analysis of the incidence of hemolysis in type and screen specimens from trauma patients

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BACKGROUND: Hemolysis of blood samples has been a concern in hospitals. Currently, residents and nurses have replaced traditional teams of skilled phlebotomists for both routine and 'stat' blood draws. Although this leads to a decreased operating cost for institutions, the lack of skill and experience leads to a higher percentage of hemolyzed specimens.

OBJECTIVE: To determine the incidence of hemolyzed 'type and screen' blood samples at Staten Island University Hospital (SIUH) (New York, USA).

METHODS: The study group comprised 615 consecutive trauma patients at SIUH between July 2006 and June 2007. Patients were

treated according to the Advanced Trauma Life Support protocol. The primary survey for a trauma patient consists of 'airway', 'breathing' and 'circulation'. The primary objective of 'circulation' is to establish vascular access and collect blood samples for analysis. The SIUH in-house laboratory provided all of the reports.

RESULTS: Of the 615 samples collected, 155 samples (25.2%) were hemolyzed.

CONCLUSIONS: The hemolysis rate of 25.2% for type and screen samples is higher than previously reported in the literature. The data suggest that the high rate of hemolysis in these trauma patients is due to the residents' lack of experience and skills required to obtain an adequate blood draw.

Key Words: Collection techniques; Hemolysis; Intravenous catheter collection; Venipuncture

Hemolysis is the breakage of red blood cell membranes, causing the release of hemoglobin and other internal components into the surrounding fluid. Hemolysis can be visually detected by a pink to red tinge in the serum or plasma. Hemolysis may be caused in vivo, in disease conditions such as autoimmune hemolytic anemia or transfusion reaction, or in vitro, from improper specimen collection, processing or transport (1,2).

During the initial evaluation of a trauma patient, blood is sent for a 'type and screen' (T&S). Blood typing identifies blood group antigens from the ABO blood group system. Antibody screening is used to detect atypical antibodies in the serum that may have been formed in the past from a blood transfusion or pregnancy. The T&S is routinely performed on all trauma patients, in anticipation that a blood transfusion may be necessary. The T&S is followed by the compatibility test (cross-match). In many institutions, such as Staten Island University Hospital (SIUH) (New York, USA), it is the job of either the surgical or emergency room resident to draw blood for the test.

METHODS

The present study retrospectively evaluated 615 consecutive trauma patients who entered the emergency department and met the criteria for a designated trauma patient from July 2006 to June 2007. All patients were examined and treated at SIUH. The institutional review board at SIUH approved the present study. During the primary survey, blood was collected by a resident in the emergency room. Residents collected samples via a peripheral blood draw, usually from the vein located in the antecubital fossa. The T&S specimens were immediately sent to the SIUH laboratory, where they centrifuged for 10 min. A

blood sample was deemed hemolyzed if the laboratory technician noticed any pink or red colour in the serum after centrifugation.

The present project was conducted as an observational study and no comparison groups were involved; therefore, all statistical analyses were descriptive.

RESULTS

For the present study, only T&S blood samples were used to determine whether hemolysis was present. Of the 615 samples collected, 155 samples (25.2%) were hemolyzed. No confounding variables were examined, such as how the blood was drawn, how it was transported, the elapsed time before samples reached the laboratory or the patient's medical history.

DISCUSSION

Obtaining blood samples from patients is a common and necessary part of treatment. As institutions look to streamline their budgets, residents are being called on to perform this common task. However, many residents lack the skill and experience to collect a viable blood sample. In the trauma setting, it becomes even harder to obtain blood from a patient. Usually, there are multiple health care workers attending to the patient. That, combined with a patient who is scared and in pain, can make drawing blood a difficult task.

Specimen collection is affected by many factors, including the venipuncture site, prolonged tourniquet time, cleansing of the site and needle size. An improper choice in the venipuncture site, such as drawing from a site distal to the antecubital region of the arm rather than drawing from an antecubital site, has been shown to result in more hemolysis (3,4). A prolonged

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tourniquet time causes interstitial fluid to leak into the tissue, resulting in hemolysis. Cleansing the venipuncture site with alcohol and not allowing the site to dry may also cause hemolysis (5-7). An improper venipuncture, indicated by a slow blood flow, may indicate occlusion due to the lumen of the needle being too close to the inner wall of the vein, thereby causing hemolysis. The use of a small-bore needle, resulting in a large vacuum force being applied to the blood, may cause shear stress on the red blood cells, causing them to rupture. Thus, a higher rate of hemolysis is found if 22-gauge or smaller intravenous (IV) catheters are used, making the blood sample useless for a T&S determination (8). This phenomenon is not seen in other laboratory studies, when blood samples are drawn using 18- to 22-gauge needles.

IV catheters, which are primarily used at SIUH, are noted to have higher hemolysis rates. Several studies have noted that when blood is drawn from a peripheral IV catheter, a higher incidence of hemolysis occurs due to blood frothing from a loose connection in the collection assembly (9). Specimen processing, such as vigorous mixing or shaking, may account for hemolysis. Finally, specimen transport can affect hemolysis rates. Mechanical trauma during transport may occur with the use of a pneumatic tube system.

CONCLUSION

Obtaining an optimal blood sample from a trauma patient can be challenging. Factors such as damaged skin, and peripheral vasoconstriction secondary to hypovolemia or shock make obtaining vascular access difficult. An improper choice in the venipuncture site, unsuitable technique, prolonged tourniquet time, residual alcohol at the venipuncture site, the use of a small-bore needle, transportation of the specimen, specimen processing technique and lack of experience by the resident all affect the rate of hemolysis (10).

In summary, our rate of hemolysis in trauma patients was found to be more than double the rates at other institutions (1,11,12). At SIUH, it is the job of a junior resident to obtain vascular access and collect blood. Due to their inexperience, it is feasible to assume that this may account for the high rate of hemolysis. In addition, our residents are not given a formal phlebotomy course, compared with other institutions in which nurses and trained phlebotomists collect blood. We believe that practice for the residents in obtaining IV access, as well as better handling techniques to collect and transport blood samples, will reduce the rate of hemolysis. Additionally, nurses and ancillary staff members can be called on to assist residents with blood collection during trauma situations.

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