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DO HEMOLYZED POTASSIUM SPECIMENS NEED TO BE REPEATED?

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□ **Abstract—Background: In the emergency department (ED), hyperkalemia in the presence of hemolysis is common. Elevated hemolyzed potassium levels are often repeated by emergency physicians to confirm pseudohyperkalemia and to exclude a life-threatening true hyperkalemia. Objectives: We hypothesize that in patients with a normal renal function, elevated hemolyzed potassium, and normal electrocardiogram (ECG), there may not be a need for further treatment or repeat testing and increased length of stay. Methods: Data were prospectively enrolled patients presenting to the ED from July 2011 to February 2012. All adult subjects who had a hemolyzed potassium level ≥ 5.5 mEq/dL underwent a repeat potassium level and ECG. The incidence of true hyperkalemia in this population was measured. Results: A total of 45 patients were enrolled. The overall median age was 52 years (range 25–83 years); 22 were female (49%). In patients with hyperkalemia on initial blood draw and glomerular filtration rate (GFR) ≥ 60 (n = 45), the negative predictive value was 97.8% (95% confidence interval [CI] 88.2–99.9%). When patients had hyperkalemia on initial blood draw, GFR ≥ 60, and a normal ECG (n = 42), the negative predictive value was 100% (95% CI 93.1–100%). Conclusions: In the setting of hemolysis, GFR ≥ 60 mL/min in conjunction with a normal ECG is a reliable predictor of pseudohyperkalemia and may eliminate the need for repeat testing. In patients with a normal GFR who are otherwise deemed safe for discharge, our results indicate there is no need for repeat testing.** © **2014 Elsevier Inc.**

□ **Keywords—hyperkalemia; pseudohyperkalemia; laboratory; emergency department testing; resource utilization**

INTRODUCTION

Potassium is one of the most frequently analyzed electrolytes (1). Hyperkalemia, defined as a potassium level > 5.5 mEq/dL, is a common electrolyte disorder with potentially life-threatening consequences (2,3). It has been estimated that 60–70% of clinical decisions are based on laboratory results, and potassium is among the 10 most commonly tested analytes (4). Because potassium is one of the 10 most frequently tested analytes in the United States, most laboratories report falsely elevated potassium levels (pseudohyperkalemia) as one of the most common testing errors that occur in the clinical laboratory (5–7). Some estimate that the prevalence of hemolyzed specimens is as high as 3.3% of all samples sent to a clinical laboratory and accounts for nearly 60% of rejected specimens (8).

The kidney is primarily responsible for potassium regulation. Therefore, hyperkalemia is rare in individuals with normal kidney function. Elevated potassium levels are more likely to be seen in individuals with renal failure, trauma, or metabolic disorders. Specific medications may also be associated with hyperkalemia. Excessive

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potassium intake alone is an uncommon cause of hyperkalemia (9).

Hyperkalemia can be difficult to diagnose because signs and symptoms are often nonspecific and patients are frequently asymptomatic. As a result, hyperkalemia is commonly an incidental laboratory finding. The most common complaints are weakness and fatigue. Rarely, paresthesias or paralysis are identified. The primary cause of morbidity and death is potassium's effect on cardiac function (10).

Compared with most laboratory measurements, potassium is extremely prone to preanalytical error so that pseudohyperkalemia, defined as raised serum or plasma potassium concentration despite normal in vivo potassium concentration, is a relatively common occurrence that must be considered in any patient with unexplained hyperkalemia (5).

There are many ways in which pseudohyperkalemia occurs. It is typically caused by hemolysis when the blood is drawn (by either excessive vacuum of the blood draw or by a collection needle that is of too fine a gauge); excessive tourniquet time or fist clenching during phlebotomy (which presumably leads to efflux of potassium from the muscle cells into the bloodstream); delayed analysis; or laboratory error. Pseudohyperkalemia can also occur when K^+ is released from platelets in patients with severe thrombocytosis or from leukocytes in patients with extreme leukocytosis (10).

In the emergency department (ED), hyperkalemia in the presence of hemolysis is common. The physician must be quick to consider true hyperkalemia in patients who are at risk for this disease process. Because hyperkalemia can lead to sudden death from cardiac dysrhythmias, any suggestion of hyperkalemia requires an immediate electrocardiogram (ECG) to ascertain whether electrocardiographic signs of electrolyte imbalance are present. Although a widened QRS may not be seen until serum concentration of potassium approaches 6.5, this is the earliest, objective sign of hyperkalemia (11). Elevated hemolyzed potassium levels are often repeated by emergency physicians to confirm pseudohyperkalemia and to exclude a life-threatening true hyperkalemia (12). The result is potentially unnecessary expenditure, time, and treatment spent on elevated hyperkalemic specimens.

It has been observed that some emergency physicians will forgo repeat testing if patient's renal function was normal on a hemolyzed specimen. However, there is little scientific basis to date to support this practice. We hypothesize that in patients with a normal renal function (defined as glomerular filtration rate [GFR] > 60), elevated hemolyzed potassium, and normal ECG (QRS interval < 0.12 s), there may not be a need for further treatment or repeat testing and increased length of stay (13). We chose GFR as opposed to creatinine because this indicator has been shown to be a more accurate indicator of renal function (14,15).

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was performed. The study was approved by the institutional review board at Staten Island University Hospital. Waiver of informed consent was granted. This study was conducted in the ED at Staten Island University Hospital, a 700-bed, tertiary-care teaching facility in Staten Island. A convenience sample of patients was enrolled from July 2011 to February 2012. Study staff were notified when any ED patient with an initial hemolyzed potassium level $\geq$ 5.5 was identified. Patients were eligible for enrollment if they were $\geq$ 18 years of age and had a hemolyzed potassium level $\geq$ 5.5 mEq/dL.

Interventions

All subjects had a repeat potassium level and ECG performed by the ED staff, as per current hospital practice. The repeat blood draws were performed prospectively prior to initiating any therapy.

Methods and Measurements

Demographic data including age, gender, and ethnicity were recorded. The patient's initial potassium level, degree of hemolysis (if available), GFR, repeat potassium level, presence of QRS prolongation on ECG (if available), treatment, and disposition were recorded on a standardized data sheet by trained research personnel.

All chemistry samples were processed at the Staten Island University Hospital laboratory using a Beckman Coulter DXC analyzer (Beckman Coulter Inc., Brea, CA).

ECGs were performed in the ED with a GE MAC 5500 ECG systems machine (GE Healthcare, Waukesha, WI).

Analysis

Demographic and prevalence data were analyzed with SAS software 9.3 (SAS Institute, Inc., Cary, NC). Negative predictive value of the screening test was computed using exact 95% binomial confidence intervals (CIs).

RESULTS

During the study period, the laboratory processed 407 hemolyzed potassium specimens; 132 patients with hemolyzed potassium specimens were identified by research personnel. Twenty-two patients were excluded due to initial hemolyzed potassium value < 5.5 mEq/dL; 3 patients received treatment for hyperkalemia prior to sending a repeat potassium level, and 1 patient due to inability to calculate GFR. Of the remaining 106 patients, 41