Prospective Observational Study of Point-of-care Creatinine Testing in Adult Trauma

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Introduction: Renal function evaluation with creatinine is vital in trauma for guiding resuscitation. Trauma patients are at risk for renal dysfunction from hypovolemia or urologic injury. Contrast-induced nephropathy risk is increased in those with pre-existing renal dysfunction. Unfortunately, laboratory plasma creatinine levels are often available only after contrast has been administered for imaging. To this end, there is a need for rapid point-of-care (POC) creatinine measurements to guide initial resuscitation and workup of stable patients with low energy mechanisms. We evaluated a new whole blood creatinine POC device and compared the analytical performance to clinical laboratory methods. The purpose of this study is to determine the potential clinical impact of POC creatinine measurements in trauma patients presenting in the emergency department.

Methods: One hundred major trauma patients with injury severity scores (ISS) > 15 were enrolled in a prospective observational study. Upon arrival at the Emergency Department, 1.2 microliters of whole blood was aliquoted from routinely collected laboratory specimens for POC creatinine determination POC (StatSensor Creatinine, Nova Biomedical, Waltham, MA). Point-of-care creatinine results were compared to the laboratory (Synchron DxC, Beckman Coulter, Brea, CA). The POC results were not reported for patient care. Analytical performance was compared using paired *t*-test analysis. Time-and-motion analysis was performed to determine the clinical impact of POC creatinine testing on the trauma emergency department workflow. Pre-analytical, analytical, and post-analytical TAT were compared between paired POC versus laboratory creatinine results. Non-value added (NVA) time was also calculated and defined as the total analytical TAT for the laboratory method minus the total analytical TAT for POC method. Patient chart review evaluated cases which may have benefited from POC creatinine measurements including the prevalence of acute kidney injury (AKI) based on the Kidney Disease Improving Global Outcomes (KDIGO) criteria.

Results: Patients (n = 100) were enrolled between December 2014 and December 2015. Mean (SD) age and ISS 34.1 (10.5) years and 13.2 (3.1) respectively. Sixty-four patients were men and 36 patients were women. Point-of-care creatinine values were similar to laboratory methods mean (SD) bias of 0.075 (p=0.27) mg/dL. Analytical correlation was shown to have an $R^2 = 0.95$, with an equation of the line of $y = 1.01x + 0.85$. Mean total analytical TAT's for the POC measurements were significantly faster than the laboratory method (11.0 [9.0] mins vs. 78.0 [27.0] mins, n = 40, $p < 0.001$). Pre-analytical, analytical, and post-analytical TAT results for POC versus laboratory results are summarized in **Table 1**. Mean no-value added time was determined to be 66.9 (18.7) mins. Eleven patent (11%) cases were determined to have abnormally high creatinine values by POC testing at admission received unnecessary computerized tomography contrast agent administration and resulting in subsequent AKI 24 hours later.

Table 1. Time and Motion Results for Pre-Analytical, Analytical, and Post-Analytical Phases of Creatinine Testing

Analytical Phase	POC (mins)	Laboratory (mins)	P-Value
Pre-Analytical	5.7 (2.1)	35.3 (25.1)	<0.001
Analytical	0.5 (0)	10.2 (3.6)	<0.001
Post-Analytical	1.2 (0.5)	8.7 (5.7)	<0.011

Conclusion: The POC device reported similar creatinine values to the hospital laboratory and provided significantly faster results. During this study, POC creatinine testing was successfully implemented into the standard trauma workflow at our institution. The majority of laboratory creatinine results provided no value in this patient population and 11 patients exhibiting impaired renal function at admission received unnecessary CT contrast agent that precipitated AKI. Point-of-care creatinine testing in the trauma emergency department setting may reduce the frequency of unnecessary CT contrast agent usage and quickly identify patients at risk for AKI.