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The description of a method to accurately measure creatinine clearance in acute kidney injury

Background: Acute kidney injury (AKI) is a common and serious condition encountered in hospitalized patients. The severity of kidney injury is defined by the RIFLE, AKIN and KDIGO criteria which attempts to establish the degree of renal impairment. The KDIGO guidelines state that the creatinine clearance should be measured whenever possible in AKI and that the serum creatinine concentration and creatinine clearance remain the best clinical indicators of renal function. Neither the RIFLE, AKIN, nor KDIGO criteria estimate actual creatinine clearance. Furthermore, there are no accepted methods for accurately estimating creatinine clearance in AKI.

Study Design: The present study describes a unique method for estimating K in AKI using urine creatinine excretion over an established time interval (E), an estimate of creatinine production over the same time interval (P), and the estimated static glomerular filtration rate (sGFR), at time zero, utilizing the CKD-EPI formula. Using these variables estimated creatinine clearance (Ke)=E/P*sGFR.

Setting & Participants: The method was tested for validity using simulated patients where actual creatinine clearance (Ka) was compared to Ke in several patients, both male and female, and of various ages, body weights and degrees of renal impairment. These measurements were made at several serum creatinine concentrations in an attempt to determine the accuracy of this method in the non-steady state. In addition, E/P and Ke was calculated in hospitalized patients, with AKI, and seen in nephrology consultation by the author. In these patients the accuracy of the method was determined by looking at the following metrics; E/P>1, E/P<1, E=P in an attempt to predict progressive azotemia, recovering azotemia, or stabilization in the level of azotemia respectively. In addition, it was determined whether Ke<10 ml/min agreed with Ka and whether patients with AKI on renal replacement therapy could safely terminate dialysis if Ke was greater than 5 ml/min.

Outcomes & Results: In the simulated patients, there were 96 measurements in 6 different patients where Ka was compared to Ke. The estimated proportion of Ke within 30% of Ka was 0.907 with 95% exact binomial proportion confidence limits. The predictive accuracy of E/P in the study patients was also reported as a proportion and the associated 95% confidence limits: 0.848 (0.800, 0.896) for E/P<1; 0.939 (0.904, 0.974) for E/P>1 and 0.907 (0.841, 0.973) for 0.9<E/P<1.1. Ke<10 ml/min correlated very well with Ka, while Ke>5 ml/min accurately predicted the ability to terminate renal replacement therapy in AKI.

Limitations: This includes the need to measure urine volume accurately. Furthermore, the precision of the method requires accurate estimates of sGFR, while a reasonable measure of P is crucial for estimating Ke.

Conclusions: the present study provides the practitioner with a new tool to estimate real time K in AKI with enough precision to predict the severity of the renal injury, including progression, stabilization, or improvement in azotemia. It is the author's belief that this simple method improves on RIFLE, AKIN and KDIGO for estimating the degree of renal impairment in AKI and allows a more accurate estimate of K in AKI.

Biography

John Mellas, MD, has been practicing nephrology for thirty years in St. Louis, Missouri. He is the Senior Partner in the largest nephrology practice in St. Louis. He is also Chairman of the Nephrology Division at St. Mary's Health Center where he is actively involved in teaching internal medicine trainees. He has developed a method to measure creatinine clearance in acute kidney injury and has been using it in his practice for the last several years. A detailed description of the method was published in Mathematical Biosciences in March 2016, titled, "The Description of a Method to Accurately Measure Creatinine Clearance in Acute Kidney Injury". His talk will describe the logic behind the derivation of the method with patient examples provided to illustrate its use in the evaluation of the patient with acute kidney injury.

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