USING ESTIMATED GFR TO PREDICT VANCOMYCIN TROUGHS IN PEDIATRIC PATIENTS

Estimated glomerular filtration rate (eGFR) is currently the best tool to assess patient’s kidney function. The degree of renal impairment becomes particularly important when staging chronic kidney disease, and dosing medications where serum levels are crucial to the efficacy. Examples of medications that need to be renally adjusted are: acyclovir, vancomycin, enoxaparin, ranitidine, and cephalosporins. This issue of CLIPS briefly summarizes a retrospective chart review that compares the use of the Schwartz equation and Bedside Chronic Kidney Disease in Children (CKiD) equation to dose vancomycin for hospitalized pediatric patients. If you need further information, please contact the Samford University Drug Information Service at (205) 726-2659.


Background:
- The ideal measure of GFR is inulin clearance; however, inulin measurements are not practical in a clinical setting because of the extended time period necessary for collection and calculation.
- Most facilities estimate GFR through an equation that incorporates serum creatinine (SCr).
- The most common eGFR equations for dosing vancomycin in pediatric patients are the Schwarz and Bedside CKiD equations.
- The Schwartz equation calculates eGFR using the patient’s height, SCr, and a constant determined by the sex and weight.
- The Bedside CKiD equation was created because the Schwartz method tended to overestimate GFR; however, the Bedside CKiD equation has only been proven in patients with chronic kidney disease between the ages of 1 and 16 years.
- The Bedside CKiD equation has previously shown to underestimate GFR and provide better estimates in patient with moderate to severe CKD.

Methods:
- The study was conducted at Le Bonheur Children’s Hospital from January 1, 2010- December 31, 2011.
- Patients were included if they received weight-based vancomycin dosing (60 mg/kg/day ±10%) and had a steady state trough concentration obtained.
- Patients were excluded if they required dialysis, had inappropriate vancomycin levels drawn, or had acute kidney injury (as defined by RIFLE criteria).
- Vancomycin trough levels were used to represent renal function based on the use of nomograms in adult studies that use creatinine clearance.
- If patients were admitted on multiple occasions, their first level drawn on each occasion could be included in the analysis.
- Data collected included: sex, age, race, weight, height, urine output, baseline blood urea nitrogen, admission SCr, SCr prior to vancomycin trough assessment, time dose administered, time trough was collected, and exposure to other nephrotoxic medications.
- Pearson correlations and regression analyses were used to evaluate the differences between the vancomycin trough concentrations and the GFR estimations.

Results:
- There were 142 vancomycin troughs obtained during the two-year period.
- A total of 46 patients met the inclusion criteria and 50 vancomycin troughs were analyzed.
Results (continued):

- Only 3 of the 46 patients included had mild CKD (all stage 2).
- The mean SCr was 0.38±0.1 mg/dL, and was determined within five days prior to the vancomycin trough level acquisition in all patients.
- Most common indications: abscesses/cellulitis (16%), meningitis (16%), pneumonia/empyema (16%).
- The mean vancomycin trough level was 10.7±3.8µg/mL.
- A weak correlation was shown in the mean eGFR calculated from the Schwartz equation and the Bedside CKiD equation (177±46mL/min/1.73m² and 133±34 mL/min/1.73m², respectively).
- Patients had a median number of one additional nephrotoxic medication (range 0-4).
  - The most common examples were: NSAIDS, contrast agents, loop diuretics, aminoglycosides, acyclovir, SMX/TMP
- The statistical analyses did not show a predictive relationship between SCr values and vancomycin trough levels.

Discussion:

- While there was a small association between the Schwartz eGFR, Bedside CKiD eGFR, and SCr values with vancomycin levels, none were closely associated with vancomycin trough levels.
- There were only three patients with mild CKD included in the study so the results only show the relationship between eGFR equations and vancomycin troughs in patients with normal renal function.
- The number of additional nephrotoxic medications loosely affected the vancomycin trough levels.
- Important limitations of this study include: single-center, a small sample size, lack of consistent documentation, and the inclusion of patients with altered pharmacokinetics (traumatic brain injury and cystic fibrosis).

Conclusions:

- Additional studies should be conducted in pediatric patients, including renally impaired patients, in order to develop a GFR-estimating equation that can be used to dose vancomycin.
- An eGFR equation could be cost saving, provide more efficacious care, and help develop an empirical dosing algorithm.
- Future studies should include more patients with renal impairment, have documentation of urine output to further assess kidney function, and have a larger, multicenter population.
- eGFR equations should also be evaluated in other renally adjusted medications to determine their ability to aid in dose adjustments.