1.3. Estimating Creatinine Clearance

Abbreviations

ABW   actual body weight

BW   body weight

BW_{adj} adjusted body weight

CrCl   creatinine clearance

GFR   glomerular filtration rate

IBW   ideal body weight

LBW   lean body weight

MDRD   modification of diet in renal disease

S_{Cr} serum creatinine

Introduction

Creatinine assay standardization by isotope dilution mass spectrometry (IDMS) is now conducted across much of the world. Because of this, population estimate equations that were developed prior to the standardization now tend to result in estimates of creatinine clearance (CrCl) that are about 10% higher than they would have been in the past. Some researchers suggest a modification factor for the older equations. This will not be addressed in the problems.

Self-Assessment Problems

1. What is the physiologic rationale for reducing the estimate of CrCl in women of the same weight and serum creatinine (S_{Cr}) of men (i.e., why multiply the Cockcroft-Gault and other equations by 0.85)? What concerns do you have about using an arbitrary value like this?

2. A. What bodily function is CrCl used to estimate?

    B. Why does CrCl overestimate this bodily function?

3. Which one of the following best explains the rationale for adjusting a low measured S_{Cr} upward (e.g., a measured S_{Cr} of 0.4 mg/dL is altered to 1 mg/dL) for an elderly patient prior to estimating CrCl using an equation like Cockcroft-Gault?

    A. On average, the elderly have a greater percent of body mass that is extracellular fluid.

    B. On average, the elderly have a smaller percent of body mass that is muscle.

    C. On average, the elderly have reduced hepatic function.

    D. On average, the elderly weigh more.

    E. On average, the elderly have reduced renal function.

4. Two male individuals are of the same age and have the same height, weight, and S_{Cr}. Although each would have the same predicted CrCl using the Cockcroft-Gault equation, which one is most likely to actually have a higher glomerular filtration rate (GFR) than predicted?

    A. A muscular individual

    B. An obese individual

5. A 60-kg (IBW), 55-year-old male patient on chronic hemodialysis has a S_{Cr} of 9 mg/dL measured in the hospital. Can you estimate his CrCl from this S_{Cr}?

6. A baby who was born 3 hours ago had an S_{Cr} measured after birth and reported as 1.1 mg/dL. Why should this value not be used to estimate her CrCl?

7. A 110-kg, 6′ tall, 50-year-old, heavily muscled male has a S_{Cr} of 1 mg/dL. A 110-kg, 6′ tall, 50-year-old male with obvious obesity also has an S_{Cr} of 1 mg/dL.

    A. Estimate their CrCl with the Cockcroft-Gault formula using actual body weight (ABW), ideal body weight (IBW), and adjusted body weight BW_{adj}, where $BW_{adj} = IBW + 0.4(ABW - IBW)$.

    B. Estimate their CrCl using the Salazar-Corcoran equation.

    C. Which of the results do you think would be most representative of what a measured CrCl would be in these individuals?

8. Estimate CrCl using the Cockcroft-Gault formula for the following individuals who have an S_{Cr} of 1.4 mg/dL:

    A. A 50-kg, 5′8″ tall, 65-year-old woman

    B. A 110-kg, 5′8″ tall, 80-year-old man. Calculate using the weight determined from the 0.4 factor adjusted body weight formula, where $BW_{adj} = IBW + 0.4(ABW - IBW)$.

    C. A 45-kg, 4′10″ tall, 48-year-old woman.

9. Estimate CrCl in mL/min using the Cockcroft-Gault formula for the following individuals who have an S_{Cr} of 0.6 mg/dL:

    A. A 4-week-old female infant that weighs 7 pounds, is 16″ long, and has a BSA of 0.19 m². Compare results using the formula from **Table 1.3-1** and the formula suggested for use with IDMS calibrated assay in **Table 1.3-2**.

    B. A 3-year-old who weighs 30 pounds, is 30″ tall, and has a BSA of 0.54 m². Calculate using the two possible equations in Table I.3-1.

    C. A 90-year-old male who weighs 65 kg and is 5′7″ tall. Do the calculations with S_{Cr} values of 0.6, 0.8, and 1 mg/dL. Which might best represent his actual CrCl? What impact does the use of a higher S_{Cr} than is actually reported have on dosing predictions?

10. A 78-year-old, 5′4″ African American female weighs 55 kg (note that ABW ~ IBW, so use an ABW of 55 kg) with a BSA = 1.58 m² and an S_{Cr} of 1.5 mg/dL.

    A. Calculate the CrCl (in mL/min) using the Cockcroft-Gault formula.

    B. Calculate the glomerular filtration rate (in mL/min/1.73 m²) using the abbreviated MDRD equation (IDMS calibrated)(See **Appendix 1.3-1**).