

Drug Dosing in Special Population

Measurement and Estimation of Creatinine Clearance

** Glomerular filtration rate (GFR) can be estimated using the modified Modification of Diet in Renal Disease (MDRD) equation:

$GFR \text{ (in mL/min / } 1.73 \text{ m}^2) = 186 \cdot S_{Cr}^{-1.154} \cdot Age^{-0.203} \cdot (0.742, \text{ if female}).$
(1.21, if African-American).

** Creatinine clearance rates can be measured by collecting urine for a specified period and collecting a blood sample for determination of serum creatinine at the midpoint of the concurrent urine collection time:

$CrCl \text{ (in mL/min)} = (U_{Cr} \cdot V_{urine}) / (S_{Cr} \cdot T)$

- U_{Cr} is the urine creatinine concentration in mg/dL
- V_{urine} is the volume of urine collected in mL
- S_{Cr} is the serum creatinine collected at the midpoint of the urine collection in mg/dL
- T is the time in minutes of the urine collection.

The most widely used of these formulas for adults aged 18 years and older is the method suggested by **Cockcroft and Gault

For males $CrCl_{est} = [(140 - \text{age}) BW] / (72 \cdot S_{Cr})$

For females $CrCl_{est} = [0.85(140 - \text{age})BW] / (72 \cdot S_{Cr})$

- $CrCl_{est}$ is estimated creatinine clearance in mL/min
- Age is in years
- BW is body weight in kg
- S_{Cr} is serum creatinine in mg/dL.

The Cockcroft-Gault method should only be used in:

- Patients ≥ 18 years old, actual weight within 30% of their ideal body weight
- ❖ $IBW_{males} \text{ (in kg)} = 50 + 2.3(Ht - 60)$
- ❖ $IBW_{females} \text{ (in kg)} = 45 + 2.3(Ht - 60)$ where Ht is height in inches.
- Stable serum creatinine concentrations.

If serum creatinine values are not stable, but increasing or decreasing in a patient, the Cockcroft-Gault equation **cannot be used to estimate creatinine clearance.

In this case, an alternate method must be used which was suggested by **Jelliffe and Jelliffe**.

$$ESS_{\text{male}} = IBW[29.3 - (0.203 \cdot \text{age})]$$

$$ESS_{\text{female}} = IBW[25.1 - (0.175 \cdot \text{age})]$$

- Ess is the excretion of creatinine
- IBW is ideal body weight in kilograms
- Age is in years.

$$ESS_{\text{corrected}} = ESS[1.035 - (0.0337 \cdot Scr_{\text{ave}})]$$

$$E = ESS_{\text{corrected}} - \frac{[4IBW(Scr_2 - Scr_1)]}{\Delta t}$$

$$CrCl \text{ (in mL/min/1.73m}^2\text{)} = E/(14.4 \cdot Scr_{\text{ave}})$$

- Scr_{ave} is the average of the two serum creatinine determinations in mg/dL
- Scr_1 is the first serum creatinine and Scr_2 is the second serum creatinine both in mg/dL
- Δt is the time that expired between the measurement of Scr_1 and Scr_2 in minutes.

** If patients are not within 30% of their ideal body weight, other methods to estimate creatinine clearance should be used. A specific method suggested by **Salazar and Corcoran** for estimating creatinine clearance for **obese patients** has been shown to be generally superior:

$$\text{CrCl}_{\text{est(males)}} = \frac{(137 - \text{age})[(0.285 \cdot \text{Wt}) + (12.1 \cdot \text{Ht}^2)]}{(51 \cdot S_{\text{Cr}})}$$

$$\text{CrCl}_{\text{est(females)}} = \frac{(146 - \text{age})[(0.287 \cdot \text{Wt}) + (9.74 \cdot \text{Ht}^2)]}{(60 \cdot S_{\text{Cr}})}$$

- Age is in years
- Wt is weight in kg
- Ht is height in m
- S_{Cr} is serum creatinine in mg/dL.

**Methods to estimate creatinine clearance for children and young adults are also available according to their age:

- Age 0–1 year, CrCl_{est} (in mL/min / 1.73 m²) = $(0.45 \cdot \text{Ht}) / S_{\text{Cr}}$;
- Age 1–20 years, CrCl_{est} (in mL/min / 1.73 m²) = $(0.55 \cdot \text{Ht}) / S_{\text{Cr}}$
- Ht is in cm and S_{Cr} is in mg/dL.

Determination of Child-Pugh Scores

TABLE 3-2 Child-Pugh Scores for Patients with Liver Disease²⁷

TEST/SYMPTOM	SCORE 1 POINT	SCORE 2 POINTS	SCORE 3 POINTS
Total bilirubin (mg/dL)	<2.0	2.0–3.0	>3.0
Serum albumin (g/dL)	>3.5	2.8–3.5	<2.8
Prothrombin time (seconds prolonged over control)	<4	4–6	>6
Ascites	Absent	Slight	Moderate
Hepatic encephalopathy	None	Moderate	Severe

(Note: This summary is designed only for the lab; it never designed for any exam)

Prepared by:
Assist.lect. Rasha Saadi