Chronic Kidney Disease:
Measuring the Risk

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Terminology

The term chronic renal failure has been replaced by chronic kidney disease (CKD). This was first proposed in 2002 by the CKD Work Group of the National Kidney Foundation.[1] The label was changed because chronic renal failure indicated that all patients suffering from the disease progressed to end stage. Other descriptors, such as renal impairment and dysfunction, have a more negative connotation.[1,2]

Measuring renal function

Serum creatinine alone is not a sufficient marker of the extent of kidney damage.[3] The ideal method for the measurement of glomerular filtration rate is insulin clearance; however, it is impractical as it requires an intravenous infusion for a patient and then a timed collection of urine. Other exogenous substances used to measure glomerular filtration are:

- iohexol and
- iodine 125-iothalamate.[3]

Due to the degree of patient inconvenience and expense, more user-friendly methods have been acquired like that of derived equations, such as the Modification of Diet in Renal Disease[4] study and the Cockcroft-Gault formula (Table 1).[5]

Twenty-four-hour urine collections for creatinine clearance may be used in subjects of low BMI and for those who are obese, as the validity of the equations in Table 1 are questionable in these populations.[3]

Shelley's case

Shelley, 71, is sent to you for hypertension management by anesthesia because she is planning to undergo an elective cholecystectomy. Her past medical history includes:

- hypertension for 30 years,
- bilateral cataract surgery and
- a remote hysterectomy.

Medical examination

Shelley's medical exam reveals the following:

- BP: 190/80 mmHg sitting in the right arm
- Heart rate: 80 bpm
- Weight: 65 kg
- No renal bruits
- Kidneys were not palpable

Laboratory investigations

Laboratory results reveal:

- Hemoglobin: 110 g/L
- Serum sodium: 138 mmol/L
- Serum potassium: 4.2 mmol/L
- Chloride: 100 mmol/L
- HCO3: 24 mmol/L
- Urea: 9 mmol/L
- Serum creatinine: 139 umol/L
- Urine albumin to creatinine ratio: 10 mg/mmol

Questions

1. What is the extent of loss of Shelley's kidney function?
2. How would you measure her kidney function?
3. How would you manage Shelley? What specific strategies can help to minimize further damage to the kidney and the associated complications with chronic kidney disease?

For a discussion on Shelley's case, look to page 81.

Table 1

Measuring renal function by modification of diet and Cockcroft-Gault equations

Modification of Diet in Renal Disease (MDRD)[4]

- Glomerular filtration rate (GFR) = 186 x (serum creatinine [mg/dL]$^{-1.154}$) x (age$^{-0.203}$) x 1.212 (if black) x 0.742 (if female)

Cockcroft-Gault[5]

- In men
  - Creatinine clearance = (140 - age) x weight in kg/(50 x serum creatinine [umol/L])
- In women
  - Creatinine clearance = (140 - age) x weight in kg/(0.85 x serum creatinine [umol/L])

Table 2

Stages of chronic kidney disease*

Stage	Description	GFR (mL/minute/1.73 m^2)
1	Kidney damage with normal or elevated GFR	≥ 90
2	Kidney damage with mild decrease in GFR	60 to 89
3	Moderate decrease in GFR	30 to 59
4	Severe decline in GFR	15 to 29
5	Kidney failure	< 15

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The prevalence of CKD in North America is 8% to 11%.[6,7] A single measurement of kidney function is not adequate to determine the degree of kidney disease. At least three measurements separated over three months to six months is sufficient to make the diagnosis.[8] The glomerular filtration rate (GFR) can be used to stage CKD as shown in Table 2.[1] Staging of CKD allows for consistency in reporting and stratification of the patient's risk profile.[9]

Importance of measuring kidney function

High-risk populations, such as patients with a diagnosis of hypertension, diabetes and from special populations, such as the First Nations, should be considered for kidney disease screening.[8] Screening involves:

- serum creatinine,
- estimated GFR and
- albumin/creatinine ratio, or
- protein/creatinine ratio.

Even though only a very small proportion of those with CKD progress to end-stage renal disease, it is important to identify those at-risk, as kidney disease is a strong predictor of cardiovascular (CV) mortality.[9,10]

CV risk factor modification

Given the increased risk of CV disease in CKD, one must target risk factors of vascular disease.

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Shelley's case cont'd...

Discussion

1. By looking at the serum creatinine, the renal function does not appear to be very normal. With Shelley's age and body size, the serum creatinine can be misleading.

2. Given Shelley's age, the Cockcroft-Gault equation would be reasonable to estimate creatinine clearance, but one can use MDRD as well for the estimation of GFR. Shelley's calculated GFR is 33 ml/min by Cockcroft-Gault. Also, a single measurement is not adequate to make a diagnosis of chronic kidney disease. It is recommended to repeat the measurement in three months. Shelley has evidence of microalbuminuria, which again needs to be repeated to confirm the diagnosis.

3. The cardiovascular risk factors need to be addressed, including:
   - hypertension,
   - hyperlipidemia,
   - dietary restriction and
   - lifestyle modifications.

   Remember to avoid nephrotoxic agents such as radiocontrast dye and certain medications, such as aminoglycosides. Also, when there is a decrease in GFR, certain medications, which have a significant portion cleared through the kidneys, must have their doses adjusted (*e.g.*, digoxin).

These include:
- hypertension,
- smoking cessation,
- life-style modification with physical activity,
- salt restriction and
- lipid-lowering agents.[8]

According to The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP and the Canadian Diabetes Association guidelines, the target BP should be < 130 mmHg systolic and 80 mmHg diastolic among those with CKD and diabetes.[11,12] Reasonable choices for BP management include:
- angiotensin-converting enzyme (ACE) inhibitors,
- angiotensin receptor blockers (ARBs),
- ß-blockers,
- diuretics and
- calcium channel blockers.

ACE inhibitors and ARBs would be first choice for those who have overt proteinuria.[13] Among patients with diabetes mellitus, optimal glycemic control is also important to prevent the development of microvascular disease and the progression of CKD.[12]

Referring to nephrology

Once renal protective measures have been taken, the next step is deciding when (and according to which indications) to refer to a nephrologist. The Canadian Society of Nephrology proposes the following:[8]

1. Acute renal failure
2. Estimated GFR < 30 ml/min/1.73 m^2
3. Progressive loss in kidney function
4. Persistent proteinuria on dipstick, or quantified protein to creatinine ratio > 100 mg/mmol or urine albumin to creatinine ratio of > 60 mg/mmol. Persistent proteinuria is defined as present on two urine samples out of three urine samples; this indicates proteinuria of significant degree requiring investigation
5. When/if the practitioner is unable to achieve treatment targets for BP Dx

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For references, please contact **diagnosis@sta.ca.**

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