Dialysis

Acceptance onto Dialysis

3. Measurement of renal function in the chronic renal failure patient

CARI Guidelines

Patients with chronic renal failure should have regular estimation of glomerular filtration rate performed every three months from a value of 30ml/min/1.73m2 and monthly from a GFR < 10 ml/min/1.73 m2 (level C evidence).

A valid estimate of GFR should be used to monitor renal function. The recommended method is the mean of urea and creatinine clearances which provides more accurate estimate of glomerular filtration than calculated creatinine clearance alone (level B evidence).

What is the evidence?

OUT OF DATE

Renal function is most often quantified by measurement of glomerular filtration rate. The 'gold standard' technique is measurement of inulin clearance, however, this method is cumbersome and not practical for routine clinical use. Alternate filtration markers include 125I-iothalamate, 99mTc-diethylenetriaminepenta-acetic acid (DTPA) and 51Cr-ethylenediaminetetra-acetic acid (EDTA). These techniques have been useful in clinical trials in which serial estimates of GFR in large numbers of patients with impaired renal function have been used to measure the rate of decline of renal function. However, the availability of these techniques may be limited and they are not applicable to the routine clinical management of the majority of patients with chronic renal failure in whom frequently repeated measurements of GFR are required.

In clinical practice creatinine clearance is the most common method used to estimate GFR. Creatinine is not an ideal filtration marker because it undergoes tubular secretion as well as glomerular filtration (16), and therefore measurement of creatinine clearance tends to overestimate GFR in patients with renal impairment. The Cockcroft-Gault equation is widely used in clinical practice to estimate renal function from serum creatinine (17). However, this equation was designed to provide a means of calculating creatinine clearance from serum creatinine and it also overestimates GFR in patients with renal impairment (18). Some investigators have advocated the use of medications such as cimetidine, which block the tubular secretion of creatinine, in order to improve the accuracy with which creatinine clearance estimates GFR (19). While there is evidence that cimetidine loading improves the accuracy with which creatinine clearance estimates GFR, there is still some uncertainty about the appropriate dose and frequency of cimetidine required to achieve adequate blockade of tubular secretion of creatinine (19 -21).

In contrast to creatinine, urea undergoes net tubular reabsorption and the urea clearance usually underestimates GFR (18). The use of the arithmetic mean of urea and creatinine clearance has been proposed as a more accurate estimate of GFR than creatinine clearance alone. The validity of this approach has recently been confirmed by analysis of data from the MDRD study in which simultaneous measurements of GFR (iothalamate clearance), creatinine clearance and urea clearance were undertaken in a large cohort of subjects with varying degrees of CRF (18). The mean of urea and creatinine clearance remained highly correlated with direct measures of GFR in patients with significant renal impairment. This approach can be readily implemented in clinical practice as measurements of urea and creatinine clearance can be derived from a single blood sample and 24 hour urine collection.

Residual renal function may also be expressed as Kt/V, which provides a basis for comparing

residual renal function to measures of adequate dialysis. In predialysis patients, daily Kt/V ratio may be calculated using the following parameters (22):
K = residual urea clearance (KRU) from a 24 hour urine collection expressed as ml/min
t = number of minutes per day
V = 1000 x (2.447 - 0.09516 x age (years) + 0.1074 x height (cm) + 0.3362 x weight (kg)) in males
V = 1000 x (-2.097+ 0.1069 x height (cm) + 0.2466 x weight (kg)) in females (23)
V may also be estimated as 0.58 x body weight

What do the other guidelines say?

DOQI: In patients with chronic renal disease, progression of renal failure should be monitored by following total weekly renal urea nitrogen clearance (Krt urea) normalised to urea volume of distribution (V), ie., Krt/Vurea. The knowledge of Krt/Vurea is especially important when glomerular filtration rate (GFR) falls below 25 to 50 ml/min, at which time spontaneous decrease in dietary protein intake is commonly observed. The blood urea nitrogen (BUN) and serum creatinine value should not be used to monitor progression of renal failure, particularly in patients with diabetes. BUN may be low secondary to low protein intake and may not adequately reflect the degree of renal functional impairment. Serum creatinine may be low due to decreased muscle mass as seen in some women, the elderly, and in malnourished patients. Hence, serum creatinine concentration may not adequately reflect the degree of the renal functional impairment.

BRA: (Measurement of GFR in patients on dialysis): Renal tubular secretion of creatinine accounts for a substantial fraction of renal creatinine clearance, and this proportion increases with renal failure; thus a more accurate estimate of GFR should be used than creatinine clearance alone. This is simply achieved by averaging the value of renal urea and renal creatinine clearances, or alternately (and perhaps preferably) using creatinine clearance following 400mg cimetidine bd beginning 12 hours before the start of the 24 hour urine collection.

CSN: measure renal function at least every three months. Measure renal function using a valid estimate of GFR corrected to a body surface area of 1.73 m2. The recommended method is the mean of urea and creatinine clearance.

Implementation and Audit

ANZDATA collection of entry GFR for all new patients commencing dialysis

Suggestions for Future Research

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