Simplified approaches to calculate Kt/V

Sir,

Movilli [1] recently highlighted the range of Kt/V values obtained with various simplified equations which approximate to a full 3-sample (3S) solution and called for standardization. These equations are based on either the natural logarithm of pre-/post-dialysis serum urea (Ln(Con/Co)) or the percentage urea reduction ratio (URR), and the latter perform badly at extreme Kt/V values. Apart from this qualification the author did not recommend a 'best' equation.

Even without consideration of 2-pool kinetics, there are other aspects to be considered if an informed judgement is to be made. If urea generation rate (G) and fluid volume removed (UF) from the urea distribution volume (V) during dialysis are zero, then for a constant set of dialysis conditions in an individual patient, Ln(Con/Co) but not URR is independent of the value of Co and Ln(Con/Co) = Kt/V. These effects (G, UF) are not negligible and must be corrected for in any simplified equation and should apply to the full range of possible dialysis conditions.

Equations derived by regression of URR or Ln(Con/Co) against a rigorous solution [2-4] do not allow for variation in G, K or UF/V and the constants may only 'best fit' the range of dialysis conditions (clearance, ultrafiltration, duration, frequency, nutrition) of the patients studied. Those derived by simplifying the relationship between Kt/V and Co, Ct, G, K and UF/V [5,6] allow the use of factors to account, to some degree, for individual or patient group conditions. Smye et al. [5] used the equation: (1) Kt/V = Ln(Con/Co) + G/K(1/Ct-1/Co)+UF/V.

An equation used in this department is:

(2) Kt/V = (1 + UF/V)*Ln((Co-G/K)/(Ct-G/K)) + UF/V.

Applying these equations to data from 140 3S analyses (range: Kt/V 0.7-2.55; nPCR 0.43-1.40; dialysis 2 and 3 per week) with the approximations G = 0.180 mmol/min, K = 0.180 l/min, V = 0.6 (dry weight) and UF = measured weight loss, G/K becomes 1 for (SI units only) and the errors (method difference; equation—3S: mean, SD, upper, lower range limits) for equations 1 and 2 were -0.03, 0.05, 0.11, -0.19 and 0.00, 0.04, 0.15, -0.07 respectively. With Smye’s approximations: UF/V = 0.042, G/K = 0.92 the errors were slightly greater (F test: P < 0.05). Errors from empirical equations based on URR were: Jindal et al. [2] (0.17, 0.09, 0.36, -0.23) and Basile et al. [3] (-0.02, 0.17, 0.11, -0.81), and from those based on Ln(Con/Co) were: Keshaviah et al. [4] (0.01, 0.06, 0.16, -0.16) and Daugirdas and Depner [6] (0.06, 0.05, 0.29, -0.04). The main contributory factors to the errors were analysed by multiple stepwise regression. The URR equations cited by Movilli gave gross errors in some cases, all gave some absolute errors >0.2 and the main source of error was the non-linear relationship between URR and Kt/V. Equations 1 and 2 and that of Keshaviah gave no errors greater than 0.2, confirming the analysis of Smye. Keshaviah’s equation, Kt/V = 1.16 Ln(Con/Co), is the most simple with main errors related to UF, but it may not perform as well with other patient populations. Equations 1 and 2 allow adaptation to extreme values of G, their principal source of error, which may be estimated if necessary [6]. Although not necessary clinically, the use of algorithms (unpublished data) to estimate G from the predialysis interval significantly reduced errors with equation 2 (F test, P < 0.05).

Basile claimed that his equation performed better than that of Jindal because it was derived from the narrow Kt/V range of target values which were of ‘clinical interest’. I suggest that the values of greatest clinical interest are those outside the target range because they suggest a change of prescription. If a standard equation for Kt/V is adopted it should not be based on URR because of the inherent non-linearity. I recommend that the equation should allow for (1) individual volume changes during dialysis, and (2) the use of specific factors which may be estimated as a representative patient-group mean or, if necessary, a patient-specific value. The need to consider, and reassess, such factors may serve to emphasise that patients should be considered individually for deviations from the general rule and that the equations are only as good as the data, so that care must be taken to ensure the validity of all measurements.

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5. Smye SW, Lewis D, Will E, Bartlett C. Comparison of approximate and iterative methods to calculate the efficiency of haemodialysis as Kt/V. Int J Artif Organs 1994; 17: 531-536

Protein intake does not depend on the Kt/V

Sir,

We are very interested in the recent paper by Panzetta [1] (Protein intake does not depend on the dose of dialysis delivered—provided Kt/V is adequate).

The author demonstrates that if the dialysis dose is adequate, protein intake is a dialysis-independent or patient-dependent variable. These data contradict those by Lindsay [2].

In 1989 Lindsay showed that low levels of Kt/V corresponded with low levels of nPCR and found a direct correlation between the two parameters.

Our data agree with those by Panzetta [1] and Movilli [3]. In fact from June 1988 to May 1994 we studied 134 uraemic