A comparison of methods for determining urea distribution volume for routine use in on-line monitoring of haemodialysis adequacy

Elizabeth J. Lindley¹, Paul W. Chamney², Andreas Wuepper², Helen Ingles¹, James E. Tattersall¹ and Eric J. Will¹

¹Department of Renal Medicine, St James's University Hospital, Leeds, UK and ²Fresenius Medical Care, Research & Development, Bad Homburg, Germany

Abstract

Background. The availability of haemodialysis machines equipped with on-line clearance monitoring (OCM) allows frequent assessment of dialysis efficiency and adequacy without the need for blood samples. Accurate estimation of the urea distribution volume ('V') is required for Kt/V calculated from OCM to be consistent with conventional blood sample-based methods.

Methods. Ten stable HD patients were monitored monthly for 6 months. Time-averaged OCM clearance (KOCM) and pre- and post-dialysis blood samples were collected at each monitored session. The second generation Daugirdas formula was used to calculate the single-pool variable volume Kt/V, (Kt/V)D. Values of V to allow comparison between OCM and blood-based Kt/V were determined from Watson's formula (VWatson), bioimpedance spectroscopy (VBIS), classical urea kinetic modelling (VUKM_C) and a simple computation of V (VUKM_S) from the blood-based Kt/V and KOCM.

Results. Comparison of KOCM/V with (Kt/V)D shows that using VWatson leads to significant systematic underestimation of dialysis dose. KOCM/VBIS agrees with (Kt/V)D to within ±10%. KOCM/VUKM_S is, by definition, identical to (Kt/V)D when initially calculated. However, if a historical value of V is used, agreement between KOCM/V and (Kt/V)D over 6 months varies by 5% for VBIS and 10% for VUKM_S.

Conclusions. When investigating the effect of different treatment strategies on dialysis efficiency, any estimate of V can be used provided it is constant, as K is the relevant parameter. When frequent supervision of actual dialysis dose is required, the greatest consistency between KOCM/V and the reference, Kt/V_D, over time is achieved with VBIS.

Keywords: haemodialysis adequacy; on-line clearance monitoring; urea distribution volume; urea kinetic modelling