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

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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 (K_{OCM}) 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 (V_{Watson}), bioimpedance spectroscopy (V_{BIS}), classical urea kinetic modelling (V_{UKM_C}) and a simple computation of V (V_{UKM_S}) from the blood-based Kt/V and $K_{OCM}t$.

Results. Comparison of $K_{OCM}t/V$ with $(Kt/V)_D$ shows that using V_{Watson} leads to significant systematic underestimation of dialysis dose. $K_{OCM}t/V_{BIS}$ agrees with $(Kt/V)_D$ to within $\pm 10\%$. $K_{OCM}t/V_{UKM\_S}$ is, by definition, identical to $(Kt/V)_D$ when initially calculated. However, if a historical value of V is used, agreement between $K_{OCM}t/V$ and $(Kt/V)_D$ over 6 months varies by 5% for V_{BIS} and 10% for V_{UKM_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 $K_{OCM}t/V$ and the reference, Kt/V_D, over time is achieved with V_{BIS}.

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

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