Measurement of dialysis dose normalized with liver volume (Kt/LV) and high metabolic rate organ mass(Kt/HMRO Mass) and evaluation of their correlation with dialysis dose normalized with urea distribution volume(Kt/V)in hemodialysis patients

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Objectives:

Hemodialysis (HD) is the most commonly used option for dialysis(1) . In HD patients, adequate HD is important because is related to reduced morbidity and mortality associated with CRF(2) . Individualizing the hemodialysis prescription based on monthly assessment of single-pool Kt/V would be a useful and practical tool to provide a safe and cost-effective hemodialysis treatment(3).Antropometric V doesn't show directly a biologic variable and However, uremic toxins produced by visceral organs may be explain an inverse relation between relative risk of mortality and urea distribution volume in dialysis patients(4). In fact, the reports of differential survival of small and large patients on HD increased debate over whether scaling based on Watson volume (V) is the best normalization of dialysis dose(5). Alternative scaling factors such as liver volume (LV) and high metabolic rate organ mass (HMRO) have been suggested has been advocated, but the implications of such rescaling have not been determined(6). Therefore In this study, we determined the dialysis dose (Kt) based on LV and HMRO and evaluated their correlation with dialysis dose normalized with urea distribution volume (V) in hemodialysis patients. Kt/
V urea has long been a standard means of assessing the
delivered dose of dialysis. However, the use of V urea has
been questioned in very recent papers (4-6).

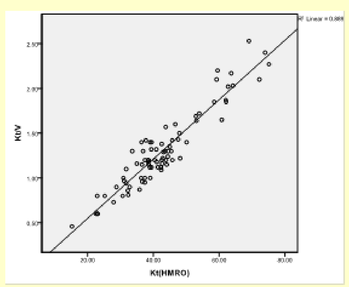
Methods:

At first Single-pool Kt/V (spKt/V) was computed using urea kinetic modeling in 80 patients undergoing hemodialysis, then Kt(LV), Kt(HMRO) and Kt(V) were obtained by Kt/V multiply with LV,HMRO and V, respectively. HD was performed for 4 hours three times a week, using synthetic dialyzer and the bicarbonate- based dialysate. Blood flow rate, dialysate flow rate and ultrafiltration rate were 250 to 300 cc /min, 500cc/min and zero or 1 to 3 liters, respectively. Blood sampling for BUN was done immediately before and after the dialysis session. Blood samples were collected from the arterial line immediately before a mid-week single dialysis session before heparin administration in a fasting state and again after the end of the hemodialysis session. We used the following equation to estimate the KT/V from the percent reduction in urea (PRUKt/V=- Ln (R - 0.008 × t)+(4 – 3.5 × R) × UF/W, where Ln is the natural logarithm, R is the ratio between post-dialysis blood urea nitrogen (BUN) and pre-dialysis BUN, t is the dialysis session length in hours, UF is the ultrafiltration volume in liters, and W is the patient's post-dialysis weight in kilograms.
HMRO (kg) was derived from the Gallagher et al. formula [12]:
HMRO (kg) = 1.223 − (0.008 × age) + (0.801 × H) + (0.016 × W) + 0.305 × gender (males = 1; females = 0)
where H is in m and W (post-dialysis body weight in HD patients) in kg.
LV (ml) was derived from the Johnson et al. formula [13]:
LV (ml) = 722 × BSA1. BSA was derived from Haycock et al. formula [10]:
BSA (m2) = W0.5378 × H0.3964 × 0.024265
where H is in cm and W (post-dialysis body weight in HD patients) in kg.
Vurea was derived from the Watson et al. formulae [2]:
TBW in men = 2.447 − 0.09516 × age + 0.1074 × H + 0.3362 × W
TBW in women = −2.097 + 0.1069 × H + 0.2466 × W
where age is in years, H in cm and W (post-dialysis body weight in HD patients) in kg.
Pearson`s correlation analysis was used for determining correlation between variable

Results:

A total of 80 patients (39 males and 41females) with age of 47.02 ± 17.07 years were included in this study. The mean length of hemodialysis treatment was 46.34 ± 48.33 months. The mean ± standard deviation of Kt/V ,LV and HMRO were1.29 ± 0.43,3.28 ± 0.36 and 1317.01 ± 190.29 respectively.There were a significant positive correlation between V with LV and HMRO and a reverse correlation between Kt/V with LV and HMRO. Pearson`s Corelation analysis showed a significant positive corelation between Kt/Vwith Kt (V) , Kt(HMRO), Kt(LV). By sex, In women, we found no significant correlation between Kt/V with HMRO(P = 0.27 , r = -0.17)and LV (P = 0.11 , r = -0.25) but in men there was a significant reverse correlation between Kt/V with HMRO(P = 0.0001 , r = -0.57) and LV (P = 0.0001, r = -0.56).

A



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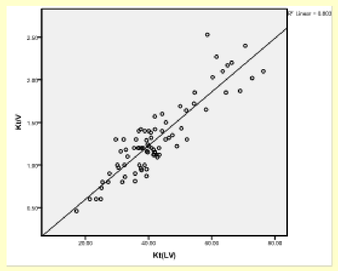

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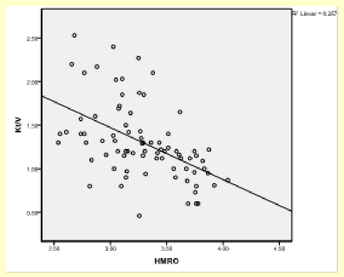

D

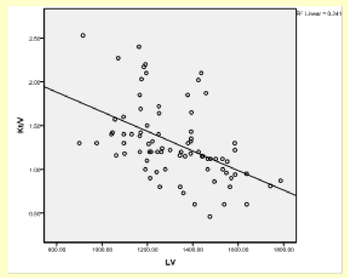

Fig 1:Scatter plots illustrating bivariate correlations :A: Kt/V and Kt(HMRO), B:Kt/V and Kt(LV),C: Kt/V and D: HMRO Kt/V and LV

Conclusions:

Efforts have been made to determine a parameter of dialysis adequacy independent of urea distribution urea(7). We explore possible mechanisms leading to a higher mortality in smaller patients(8). We have hypothesized that delivery of dialysis based on visceral cell mass, which could be the appropriate representation of uremic toxin generation or waste product generation (estimated by HMRO) would be more logical than the current practice(9). The results of our research showed a significant direct correlation between V with LV and HMRO and a significant inverse correlation between Kt/V with LV and HMRO. Based on our results, which permit the calculation of scaling equations between the Kt and LV or HMRO , we propose that dialysis dose might be normalized to waste product generation (estimated by HMRO) and liver volume.Maduell et al. proposed body surface area (BSA) Kt as a more demanding parameter than Kt/V and to establish an adequate dose of dialysis(10) . Our results showed an inverse correlation between LV and HMRO with dialysis dose in males, indicating that smaller individuals probably require proportionately "more" dialysis than larger persons. HMRO are most likely to be the prime source of uremic toxins(11). In addition, the average uremic toxin concentration in larger patients may be lower because of the larger distribution volume(12). One additional, focusing hypothesis might be that the main organ contributing uremic toxins is specifically the liver, as this is where compounds are detoxified and solubilized, and this is a major site of metabolism of nitrogenous compounds(13). Uremic toxin generation thus may be a function of visceral mass and organ metabolic rate(14).However, additional research may be required about rescaling of dialysis dose to HMRO and LV.

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