Urea Distribution Volume in Hemodialysis

G.M.		Bosticardo ^a
S.		Alloatti ^b

Nephrology and Dialysis Units, ^aOspedale Civile, Ivrea, and ^bOspedale Regionale, Aosta, Italy

Dott. G.M. Bosticardo, Servizio di Nefrologia e Dialisi, Ospedale Civile di Ivrea, P. za Credenza, 2, I-10015 Ivrea (Italy)

Dear Sir,

We have read with interest the controversy between Maduell and his group [1,2] and Basile [3] regarding the constancy of the urea distribution volume. In previous studies, our group has been concerned with the dialysate collection method for volume determination, and we would therefore like to point out some methodological and mathematical aspects of the question.

In our opinion, the formula used to calculate the urea distribution volume:

(1)

$$V = U / (C_0 - Q)$$

where U = urea collected in the dialysate, C₀ = predialysis BUN and Q = postdialysis BUN, is not sufficiently accurate, because it disregards several factors that may influence the reliability of the result.

A more accurate equation has been suggested by our group [4-6]:

where V₀ = pre-dialysis volume, subscript 2 = before next dialysis; E_{uid} = urinary inter-dialytic urea nitrogen extraction, θ = inter-dialytic time.

Values of urea distribution volume obtained in this way take into account dialysis ultrafiltration, residual renal function, urea generation rate and postdialysis urea rebound. Although the urea generation rate and diuresis during dialysis may be considered negligible in most cases, the relevance of ultrafiltration and urea rebound is significant, and their variability might explain the discrepancy between the results obtained by Maduell [2] and Basile [3].

Furthermore, in our previous studies, we focused on the importance of urea rebound [7-10] and observed an exponential increase in urea distribution volume during the session and a further increase after 30 min of equilibration time (fig. 1). The paradoxically low volumes obtained in the first phase of dialysis may mainly be attributed to trans-compartmental disequilibrium, which during dialysis may explain the difference between measured urea and its corresponding theoretic exponential profile.

$$E + E_{ud} - G(t + 30) - C_{pwo} Q t$$

(2)

$$* - \phi_{wo} \wedge^{pwet}$$

where V_t = post-dialysis volume, E = dialytic urea nitrogen extraction, E_{uci} = urinary intra-dialytic urea nitrogen extraction, G = urea generation rate, t = time, C_{pwo} = pre-dialysis

plasma water BUN, Qf = ultrafiltration coefficient, $C_{pWet} = 30$ min post-dialysis plasma water BUN.

The urea generation rate G is obtained using the following formula, by iteration with volume: 40,000

100 150

Dialysis time (min)

250

G

, $\Delta p_{w02} V_{02} \Delta p_{wet} \cdot t \cdot \frac{1}{8d}$

0-30

(3)

Fig. 1. Urea distribution volume obtained by the dialysate collection method (see text) at various points of the dialysis (n = 6).

KARGER

E-Mail karger@karger.ch Fax + 41 61 306 12 34 <http://www.karger.ch>

© 1997 S. Karger AG, Basel 0028-2766/97/0771-0116\$ 12.00/0

This article is also accessible online at: <http://BioMedNet.com/karger>

References

Maduell F, Siguenza F, Cardia A, Miralles F, Serrato F: Analysis of urea distribution volume in hemodialysis. *Nephron* 1994;66:312-316.

Maduell F: Urea distribution volume is practically constant in hemodialysis patients. *Nephron* 1995;70:135.

Basile C: Urea distribution volume is not constant in hemodialysis patients. *Nephron* 1995; 70:133-134.

Alloatti S, Bosticardo G: Il modello cinetico dell'urea, prescrizione della terapia dialitica. Trattato Italiano di Dialisi. Milano, Wichtig, 1992, vol 13, pp 1-19.

Bosticardo GM, Avasse U, Giacchino F, Molino A, Alloatti S: Accuracy of an on-line urea monitor compared with a urea kinetic model and direct dialysis quantification. *ASAIO J* 1994;40:M426-M430.

Bosticardo GM, Avasse U, Giacchino F, Alloatti S: Comparison of a modified urea kinetic model with direct dialysis quantification and classic urea kinetic modeling. *ASAIO J* 1995; 41:M798-M800.

Alloatti S, Bosticardo GM, Torazza MC, Gaiter AM, Nebiolo PE: Transcellular disequilibrium and intradialytic catabolism limit the reliability of urea kinetic formulas. *Trans ASAIO* 1989;35:328-330.

Alloatti S, Bosticardo GM, Torazza MC, Gabella P, Gaiter A, Nebiolo PE, Bonfant G: Scant reliability of C_c/C_t ratio in urea kinetic formulas. *Int J Artif Organs* 1989;12:642-647.

Alloatti S, Torazza MC, Nebiolo PE, Gaiter AM, Gabella P, Bosticardo GM: Is it rational to use K_t/V to calculate the treatment time for high efficiency dialysis? *Int J Artif Organs* 1989;12(suppl 4):141-144.

10 Bosticardo GM, Alloatti S: Agreement between the classical urea kinetic model and direct dialysis quantification: importance of urea rebound. *Nephron* 1996;74:674-679.

Urea Distribution Volume in Hemodialysis
Nephron 1997;77:116-117
117