

## Letters to the Editor

# Body composition influences the elimination of protein-bound uraemic toxins in online haemodiafiltration<sup>☆</sup>

## La composición corporal influye en la eliminación de toxinas urémicas unidas a proteínas en la hemodiafiltración online

To the Editor:

Postdilution online haemodiafiltration (OL-HDF) with high convection volumes improves the survival of patients on haemodialysis<sup>1</sup> and achieves greater elimination of medium-large molecules and protein-bound uraemic toxins.<sup>2,3</sup> Just as Kt/V is used to standardise the dose of diffusion to the needs of the patient,<sup>4</sup> we have used weight, body surface or body surface area or total body water to adjust the efficiency of convective transport in OL-HDF.<sup>5</sup> In this study, we analyse the data in the article by Abad et al., "Protein-bound toxins: added value in their removal with high convective volumes" (Nefrología 2016;36:637-42) to evaluate the effect of body composition on the efficacy of OL-HDF in the elimination of medium-large molecules and protein-bound toxins.

Demographic data, weight and height were collected from the 13 patients included in the study. In addition a body composition analysis was performed by bioimpedance spectroscopy (Body Composition Monitor<sup>®</sup>, FMC), predialysis, before a second weekly session during the last 3 months. Data from the 40 OL-HDF sessions were collected and the association between the percentages of reduction and the different body composition parameters was analysed. The convective volume was adjusted to these parameters to evaluate the relationship between the elimination of molecules and the standardised convection dose.

The age was  $39.4 \pm 26$  years, 87% men, weight  $75.3 \pm 13.5$  kg, and  $1.86 \pm 0.2$  m<sup>2</sup> and  $26.1 \pm 4.6$  kg/m<sup>2</sup>. The bioimpedance spectroscopy data were: overhydration  $0.9 \pm 1$  L; Total body water (TBW)  $42.3 \pm 9.8$  L; extracellular water (ECW)  $18.7 \pm 3.4$  L;

intracellular water (ICW)  $23.5 \pm 6.8$  L; lean tissue  $51.3 \pm 18.3$  kg ( $17.5 \pm 5.1$  kg/m<sup>2</sup>); fatty tissue  $16.7 \pm 13.3$  kg ( $8.1 \pm 6.8$  kg/m<sup>2</sup>); adipose tissue  $22.2 \pm 18.1$  kg; cell mass  $30.3 \pm 12.7$  kg.

It was found a significant negative correlation between the reduction of medium-large molecules (beta-2 microglobulin, myoglobin and prolactin) and weight, BMI, surface area, TBW, ECW and ICW. The reduction of p-cresyl sulphate and indoxyl sulphate was negatively correlated with weight, surface, TBW, ECW, ICW, lean tissue and cell mass. The reduction of interleukin-6 and homocysteine was not related to any body composition parameter.

The convective volume ( $28.3 \pm 5.1$  L) was adjusted to the surface area ( $26.8 \pm 6.8$  L/1.73 m<sup>2</sup>), weight ( $0.4 \pm 0.16$  L/kg), TBW ( $0.72 \pm 0.26$  L/L), ECW ( $1.59 \pm 0.51$  L/L) and ICW ( $1.34 \pm 0.55$  L/L), being the parameters associated with efficiency in the reduction of molecules. Table 1 shows the correlation between the convective volumes (adjusted and not adjusted to body composition) and the reduction percentages.

By adjusting the convection dose to body composition, we obtained a more accurate picture of the elimination of medium molecules and protein-bound toxins, such as p-cresyl sulphate and indoxyl sulphate. The strongest correlations between the reduction of beta-2 microglobulin, myoglobin and prolactin were with the convective volume adjusted for ECW, weight or body surface. The convective volume adjusted for ECW was the index with the highest correlation with indoxyl reduction and p-cresyl sulphate.

Other studies find ECW to be the best parameter to adjust the dose of convective transport in OL-HDF to predict the elimination of medium size molecules, while TBW or surface

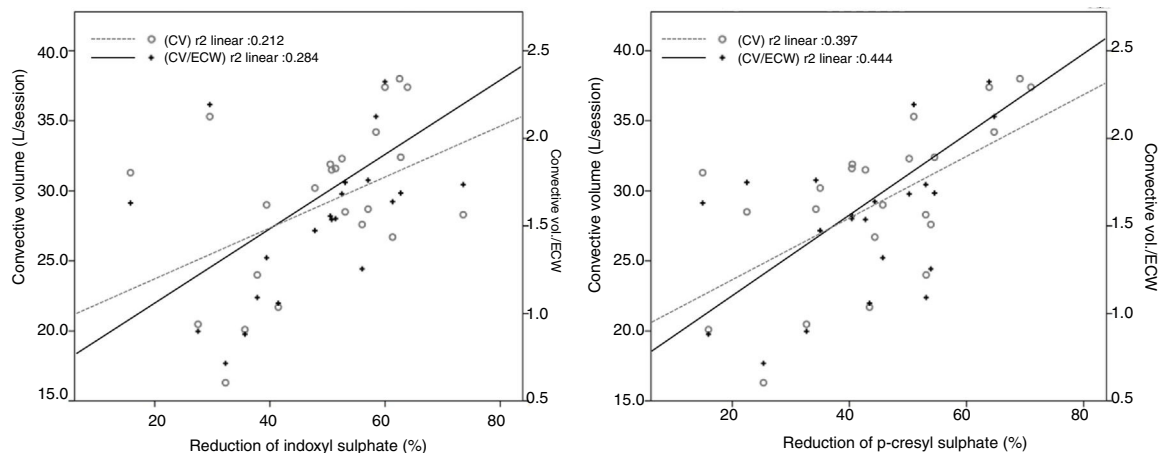
DOI of original article:

<https://doi.org/10.1016/j.nefro.2018.09.004>

<sup>☆</sup> Please cite this article as: Macías N, Abad S, Aragoncillo I, Hernández A, Torres E, Santos A, et al. La composición corporal influye en la eliminación de toxinas urémicas unidas a proteínas en la hemodiafiltración online. Nefrología. 2019;39:434-436.

<b>Table 1 – Correlations between standardised/non-standardised convective volume and percentage reduction of medium-large molecules and protein-bound toxins.</b>														
Molecules (molecular weight)	Beta-2 microglobulin (11.8 kDa)		Myoglobin (17 kDa)		Prolactin (22 kDa)		Interleukin-6 (26 kDa)		Homocysteine (135 Da)		p-Cresyl sulphate (187 Da)		Indoxyl sulphate (212 Da)	
Reduction percentages	81.3 ± 6.4		60 ± 11.5		60.1 ± 14.3		28 ± 17.2		58.6 ± 8.8		44.4 ± 15.7		48.7 ± 14.1	
	Pearson	p (sig.)	Pearson	p (sig.)	Pearson	p (sig.)	Pearson	p (sig.)	Pearson	p (sig.)	Pearson	p (sig.)	Pearson	p (sig.)
Convective volume	0.607	<0.001	0.431	0.006	0.395	0.013	0.113	0.613	0.492	0.005	0.630	0.001	0.461	0.027
Convective volume/1.73 m <sup>2</sup>	<b>0.747</b>	<b>&lt;0.001</b>	<b>0.522</b>	<b>0.001</b>	<b>0.509</b>	<b>0.001</b>	0.860	0.780	0.433	<b>0.009</b>	<b>0.653</b>	<b>0.001</b>	<b>0.510</b>	<b>0.013</b>
Convective volume/weight	<b>0.698</b>	<b>&lt;0.001</b>	<b>0.545</b>	<b>&lt;0.001</b>	<b>0.561</b>	<b>&lt;0.001</b>	0.800	0.724	0.356	0.036	<b>0.651</b>	<b>&lt;0.001</b>	<b>0.464</b>	<b>0.026</b>
Convective volume/TBW	<b>0.708</b>	<b>&lt;0.001</b>	<b>0.528</b>	<b>0.001</b>	<b>0.481</b>	<b>0.002</b>	0.129	0.567	0.327	0.056	<b>0.677</b>	<b>&lt;0.001</b>	<b>0.523</b>	<b>0.010</b>
Convective volume/ECW	<b>0.755</b>	<b>&lt;0.001</b>	<b>0.537</b>	<b>0.001</b>	<b>0.492</b>	<b>0.001</b>	0.116	0.697	0.374	0.027	<b>0.677</b>	<b>&lt;0.001</b>	<b>0.533</b>	<b>0.009</b>
Convective volume/ICW	<b>0.663</b>	<b>&lt;0.001</b>	<b>0.496</b>	<b>&lt;0.001</b>	<b>0.465</b>	<b>0.003</b>	0.138	0.541	0.287	0.095	<b>0.667</b>	<b>0.001</b>	<b>0.506</b>	<b>0.014</b>

ECW: extracellular water; ICW: intracellular water; sig.: significance; TBW: total body water.  
In bold: correlations that exceed that obtained with the unadjusted convective volume. In italics: insignificant correlations.



**Fig. 1 – Correlation between the elimination of indoxyl sulphate (left) and p-cresyl sulphate (right) and the total convective volume unadjusted (CV) (y1 axis – left–) and adjusted to extracellular water (EV/ECW) (y2 axis – right–).**

area can be helpful when bioimpedance spectroscopy is not available.<sup>6</sup> In this new analysis, it is confirmed that the elimination of protein-bound molecules in OL-HDF, in addition to being conditioned by the amount of convective transport and the proportion of plasma protein binding, also depends on body composition. The influence of body composition and fluid distribution probably reflects the distribution volume of these molecules or their availability to be purified. In this regard, the ECW used to standardise convective transport is also the index that best predicts the elimination of protein-bound toxins such as indoxyl or p-cresyl sulphate (Fig. 1).

In conclusion, body composition influences the elimination of uraemic toxins of different sizes, in addition to protein-bound molecules. Convective volume adjusted to ECW or TBW is a useful marker to evaluate the efficacy of OL-HDF in the elimination of protein-bound molecules and toxins.

#### REFERENCES

1. Maduell F, Moreso F, Pons M, Ramos R, Mora-Macià J, Carreras J, et al. High-efficiency postdilution online hemodiafiltration reduces all-cause mortality in hemodialysis patients. *J Am Soc Nephrol.* 2013;24:487–97.
2. Pedrini LA, de Cristofaro V, Comelli M, Casino FG, Prencipe M, Baroni A, et al. Long-term effects of high-efficiency on-line haemodiafiltration on uraemic toxicity. A multicentre prospective randomized study. *Nephrol Dial Transplant.* 2011;26:2617–24.

3. Canaud B, Bowry SK. Emerging clinical evidence on online hemodiafiltration: Does volume of ultrafiltration matter? *Blood Purif.* 2013;35:55–62.
4. Daugirdas JT. Kt/V (and especially its modifications) remains a useful measure of hemodialysis dose. *Kidney Int.* 2015;88:466–73.
5. Davenport A, Peters SA, Bots ML, Canaud B, Grooteman MP, Ascì G, et al. Higher convective volume exchange with online hemodiafiltration is associated with survival advantage for dialysis patients: the effect of adjustment for body size. *Kidney Int.* 2016;89:193–9.
6. Macías N, Santos García A, Vega Martínez A, Abad Estébanez S, Goicoechea Diezhandino M, López Gómez JM. Importance of body water in the efficacy of convective solute transport in online hemodiafiltration. *Ther Apher Dial.* 2017;21:88–95.

Nicolás Macías\*, Soraya Abad, Inés Aragoncillo, Andrés Hernández, Esther Torres, Alba Santos, Juan Manuel López Gómez, José Luño, Almudena Vega

Servicio de Nefrología, Hospital Gregorio Marañón, Madrid, Spain

\* Corresponding author.

E-mail address: [nicomc13@gmail.com](mailto:nicomc13@gmail.com) (N. Macías).

2013-2514/© 2018 Sociedad Española de Nefrología. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.nefro.2018.09.005>