LETTER TO THE EDITOR

Evaluation of the efficacy of a very high permeability dialyser and comparison with other high-flux dialyser in online haemodiafiltration

Ana María García-Prieto, Almudena Vega, Soraya Abad, Nicolás Macías, Inés Aragoncillo, Esther Hurtado, Andrés Delgado, Esther Torres, Diego Barbieri and José Luño

Nephrology Department, Gregorio Marañón Hospital, Madrid, Spain

Correspondence and offprint requests to: Ana María García-Prieto; E-mail: anamgarciaprieto@gmail.com

In recent decades, efforts in dialysis have focused on improving the clearance of larger middle molecular weight uraemic toxins, the retention of which has been associated with pathological features of uraemia [1]. Convective flow through haemodialysis membranes using online haemodiafiltration (OL-HDF) techniques has been introduced in recent years to enhance the removal of middle and large molecular weight uraemic toxins [2], resulting in better outcomes in terms of cardiovascular mortality in haemodialysis patients [3]. ‘Super high-flux’ (HF) dialysers are now commercially available, developed for the purpose of removing large amount of larger middle solutes. One of these high performance dialysers, XevontaHI23®Braun, with very high water permeability [in vitro ultrafiltration coefficient ($K_{uf}$) of 124 mL/h/mmHg] has recently been introduced, but there is still a lack of evidence on its use. We designed a transverse study to evaluate the efficacy of this very high permeability (VHP) dialyser and to compare it with another HF dialyser in OL-HDF.

A total of 14 prevalent OL-HDF patients were included. Dialysers were compared in two consecutive mid-week dialysis sessions. Treatments were based on current prescription with no restriction on blood flow. OL-HDF was performed in post-dilution mode with automatic pressure control of convection and no restriction on total convective ultrafiltration volume. The efficacy of each dialyser was analysed by measuring the reduction ratios (RRs) of substances with different molecular weights. We registered total convective volume as well as hourly transmembrane pressure (TMP) with each dialyser. For detailed methodology, see Supplementary Material.

Mean total convective volume per session was significantly higher with the VHP dialyser (33.5 ± 5.4 versus 30.9 ± 4.6 L/sess- sion; $P = 0.013$). There were no differences in in vivo $K_{uf}$, TMP or in the RR of the different molecules between the two dialysers (Table 1).

Despite higher convective volumes achieved with the VHP dialyser, we found no differences in minimum, maximum or mean TMP between the two dialysers. This could be explained by the method of TMP calculation, where only three pressure points are known and the fourth must be assumed, thus introducing great variability [4]. Secondly, it may be explained by differences between in vitro and in vivo $K_{uf}$. It is well described in the literature that in vivo $K_{uf}$ is inferior to in vitro $K_{uf}$, and it progressively decreases during the dialysis session, mainly due to blood protein boundary effects and increased resistance to ultrafiltration [5]. In fact, Braun® sponsored a clinical trial in 2010 that was designed to evaluate the performance and safety profile of Xevonta high-flux dialyser with special focus on determination of in vivo $K_{uf}$ (NCT011111266) but, unfortunately, no results have been posted for this study. Estimated in vivo $K_{uf}$ for the different dialysers was very similar in our study, although it should be noted that estimated in vivo $K_{uf}$ also includes estimated TMP, with its previously described limitations.

Received: 3.12.2018; Editorial decision: 16.7.2019

© The Author(s) 2019. Published by Oxford University Press on behalf of ERA-EDTA.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com
Differences observed in total convective volume between the two dialysers did not result in significantly higher RR of different-sized uraemic toxins either. This could be explained not only by the differences between in vitro and in vivo $K_{uf}$, but also because hydraulic permeability is of utmost importance in HF convective techniques; however, it is not the only factor involved.

In light of the results of our study, we can say that the VHP dialyser achieves higher convective volumes than the HF dialyser with similar removal in middle molecules. We believe that there is an in vivo infra optimization of the VHP dialyser that may explain the similar results obtained in terms of RR of middle molecules despite the higher convective volumes achieved. Future studies should assess whether the optimization on the use of this type of dialysers could improve outcomes.

**SUPPLEMENTARY DATA**

Supplementary data are available at ckj online.

**CONFLICT OF INTEREST STATEMENT**

None declared.

**REFERENCES**

1. Glorieux G, Vanholder R. New uraemic toxins-which solutes should be removed? Contrib Nephrol 2011; 168: 117–128
2. Galach M, Ciechanowska A, Sabalińska S et al. Impact of convective transport on dialyzer clearance. J Artif Organs 2003; 6: 42–48
3. Maduell F, Moreso F, Pons M et al.; ESHOL Study Group. High-efficiency postdilution online hemodiafiltration reduces all-cause mortality in hemodialysis patients. J Am Soc Nephrol 2013; 24: 487–497
4. Pedrini LA. Transmembrane pressure, ultrafiltration coefficient and the optimal infusion rate in haemodiafiltration. Nephrol Dial Transplant 2011; 26: 1445–1446
5. Waniek J. Mathematical modeling of fluid and solute transport in hemodialysis and peritoneal dialysis. J Membr Sci 2006; 274: 24–37

| Dialysis parameters and RRs | VHP dialyser | HF dialyser | P-value |
|-----------------------------|--------------|-------------|---------|
| Mean convective volume per session (L/session) | $33.5 \pm 5.4$ | $30.9 \pm 4.6$ | $0.01$ |
| Minimum TMP (mmHg) | $155.9 \pm 53.7$ | $157.8 \pm 34.6$ | $0.68$ |
| Maximum TMP (mmHg) | $244.85 \pm 41.1$ | $230.7 \pm 38.1$ | $0.09$ |
| Medium TMP (mmHg) | $213.6 \pm 47.2$ | $205.5 \pm 52$ | $0.28$ |
| Mean $K_{u/V}$ per session | $1.8 \pm 0.4$ | $1.9 \pm 0.6$ | $0.31$ |
| Mean ionic dialisance per session (mL/min) | $287 \pm 25$ | $284 \pm 40$ | $0.27$ |
| $In$ vivo $K_{uf}$ (mL/h/mmHg) | $40.9 \pm 10.8$ | $38.2 \pm 6.1$ | $0.3$ |
| Reduction ratios (%) | | | |
| Urea | $85.4 \pm 5$ | $84.4 \pm 44$ | $0.17$ |
| Creatinine | $77.7 \pm 6$ | $77.5 \pm 4$ | $0.34$ |
| Phosphate | $65.9 \pm 11$ | $62.9 \pm 8$ | $0.22$ |
| Myoglobin | $72 \pm 8$ | $73.9 \pm 6$ | $0.33$ |
| Cystatin C | $78.1 \pm 6$ | $79 \pm 4$ | $0.25$ |
| $β$-2-microglobulin | $76.2 \pm 8$ | $81.4 \pm 2$ | $0.11$ |
| Prolactin | $71.1 \pm 9$ | $71 \pm 8$ | $0.73$ |

Values are represented as mean ± SD.