Water permeability of high-flux dialyzer membranes after Renalin reprocessing

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To the Editor: I found the description of changes in membrane hydraulic permeability associated with multiple-use with Renalin® Cold Sterilant[1] by Dr Labib *et al.* quite thought provoking.

Over the years, many aspects of dialyzer performance and reprocessing have been investigated, but few have focused on water permeability. The methods used by Dr Labib to determine permeability, however, must be seriously questioned. Dr Labib describes a 'dead-end filtration method' for determining water permeability that involved pressurizing the dialysate compartment of the dialyzer and measuring filtrate from an open blood port. Dr Labib states that measuring filtration from dialysate to blood or blood to dialysate will give the same filtration rate. Although this hypothesis may sound reasonable in theory, the testing results may not be equal when it is applied to hollow fiber dialyzers. Pressurizing the dialysate compartment can lead to fiber collapse from the external pressure, resulting in an artificially low filtration rate. This phenomenon puts the results of Dr Labib's study in question. As the normal dialysis process is accomplished from the blood to the dialysate side of the dialyzer, confirmation of the data generated by measuring hydraulic permeability under actual use conditions would have been more prudent.

Dr Labib also attempts to relate changes in hydraulic permeability to changes in beta-2 microglobulin removal. Dr Labib states that 'extensive evidence' exists that correlates loss of beta-2 microglobulin clearance to Renalin reprocessing and then uses the hemodyalysis (HEMO) study as an example. To support what we believe to be a somewhat commercially biased premise, Dr Labib has only selected data associated with a cellulose triacetate membrane, now being utilized in a fraction of all procedures, and has chosen to ignore the vast majority of the HEMO study data that demonstrated that the beta-2 microglobulin removal rate of F80 polysulfone dialyzers remained quite stable, with only an 11% decrease in removal rate over 10 uses[2]. The HEMO study correlates well with the work of Lain *et al.*[3] that cites instances of an 18% decrease in beta-2 microglobulin clearance over a single treatment.

1. Labib ME, Murawski J, Tabani Y *et al.* Water permeability of high-flux dialyzer membranes after Renalin reprocessing. *Kidney Int advance online publication* 2007, 27 March; doi:10.1038/sj.ki.5002212.
2. Cheung AK, Agodoa LY, Daugirdas JT *et al.* Effects of hemodialyzer reuse on clearances of urea and beta-2 microglobulin. *J Am Soc Nephrol* 1999; **10**: 117–127.
3. Lain JD, Cheng CH, Chang YL, Hsiong, CH Lee CJ. Clinical experience and model analysis on beta-2 microglobulin kinetics in high-flux hemodialysis. *Artif Organs* 1119; **17**: 758–763.

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Response to 'Comments on water permeability of high-flux dialyzer membranes'

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We very much appreciate Mr Carlson's interest in our study of *Water Permeability of High-Flux Dialyzer Membranes after Renalin Reprocessing.*[1] In terms of the hydraulic permeability measurements, the pressures we used in obtaining these data were similar to the pressures used during the reverse ultrafiltration cycle employed with current Renalin reprocessing – there is no evidence in any of the extensive reprocessing literature that such reverse pressures cause fiber collapse. In addition, we used the same procedure to evaluate the permeability of new and used dialyzers; thus, any potential 'artifacts' in these measurements would have no effect on the significant reduction in the water permeability after Renalin reprocessing seen in our study. Furthermore, actual water permeability values obtained in both flow directions (from lumen to dialysate and from dialysate to lumen) are identical – see table below. A complete theory for the dead-end filtration method for hemodialyzers has been developed and tested by Wupper *et al.*[2] (Table 1).

Mr Carlson is correct in pointing out that there is considerable discrepancy (and controversy) in the literature regarding the impact of different reprocessing methods on dialyzer properties and clinical performance. It was not our intention to provide a comprehensive evaluation of that literature – there are several excellent reviews of this subject in the literature, including two recent publications by Twardowski.[3,4] The studies that we cited in our manuscript included data on multiple dialyzers (and not just the cellulose triacetate membranes, as stated by Mr Carlson). For example, the study by Leypoldt *et al.*[5] reported a significant reduction in β_2-microglobulin clearance for polysulfone dialyzers reprocessed with peracetic acid, with very similar results reported by Ouseph *et al.*[6] and Castro *et al.*[7] have also given additional confirmation of the clinical effects of Renalin reprocessing of high-flux dialyzers on β_2-microglobulin serum levels.

The permeability data reported in our study are also consistent with the results of Wolff and Zydney[8] from prior *in vitro* studies using peracetic acid reprocessing. In addition, the magnitude of the change in water permeability for these dialyzers was completely consistent with

Table 1 | Water permeability measured from lumen to dialysate and from dialysate to lumen for Fresenius F80B and Gambro 17R dialyzers

Water permeability (ml/h/mm Hg)	Fresenius F80B	Gambro 17R
Lumen to dialysate	152±4	418±13
Dialysate to lumen	155±3	415±11

the measured reduction in dextran clearance of patient reuse dialyzers (Table 1), which was evaluated using standard methods with solute transport from the blood to the dialysate. Both water permeability and dextran clearance results provide a measure of the potential changes in the convective clearance of important middle molecules in hemodialysis.

We hope that our new data showing the large effect of Renalin reprocessing on the hydraulic permeability of high-flux polysulfone dialyzers and on middle solute clearance will provide additional insights and perspectives on this important subject.

1. Carlson W. Water permeability of high-flux dialyzer membranes after Renalin reprocessing. *Kidney Int* 2007 (in press).
2. Wupper A, Dellanna F, Baldamus CA, Woermann D. Local transport processes in high-flux hollow fiber dialyzers. *J Membr Sci* 1997; **131**: 181–193.
3. Twardowski ZJ. Dialyzer reuse – part I: historical perspective. *Semin Dial* 2006a; **19**: 41–53.
4. Twardowski ZJ. Dialyzer reuse – Part II: Advantages and disadvantages. *Semin Dial* 2006b; **19**: 217–226.
5. Leypoldt JK, Cheung AK, Deeter RB. Effect of hemodialyzer reuse: dissociation between clearances of small and large solutes. *Am J Kidney Dis* 1998; **32**: 295–301.
6. Ouseph R, Smith BP, Ward RA. Maintaining blood compartment volume in dialyzers reprocessed with peracetic acid maintains Kt/V but not beta(2)-microglobulin removal. *Am J Kidney Dis* 1997; **30**: 501–506.
7. Castro R, Morgado T. β_2-microglobulin clearance decreases with Renalin reuse. *Nephron* 2002; **90**: 347–348.
8. Wolff SH, Zydney AL. Effects of peracetic acid reprocessing on the transport characteristics of polysulfone hemodialyzers. *Artif Organs* 2005; **29**: 166–173.

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