Surface, a parameter to consider in high convection volume HDF

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INTRODUCTION:

Convection volume seems to be crucial to the survival benefits proposed for HDF. However, high convection requires increasing transmembrane pressure (TMP) which in turn may change the membrane's behavior and dialyser's performances.

AIM:

We wanted to characterize the influence of membrane surface area on the physics and on the removal performances of high convection volume on-line post-dilutional HDF.

METHODS:

12 stable dialysis patients were successively treated with Amembris® **1.8 m²** and **2.3 m²** dialysers, and two **high convection flows** were used for 1 week each :

- **Q_{UF}-optimal**: the dialysis setting is maintained at the maximum in vivo global ultrafiltration coefficient (**$_G K_{D-UF}$ max**) [1]
- **Q_{UF}-max**: the convection flow is set to the maximum, limited only by the European Best Practice Guidelines (EBPG: <30% blood flow / 300 mmHg of TMP).

Continuous sampling of spent dialysate was performed in all dialysis sessions and total mass of urea, creatinine, and total proteins were measured.

SDS-PAGE scanning of the removed proteins and **ELISA** quantification of removal of β2-microglobulin (B2M), retinol binding protein, lambda light chains of immunoglobulins, α1-antitrypsin and albumin were performed.

RESULTS

Dialysis performances

With the Q_{UF}-optimal and 1.8 m² dialyser, mean session time was 235 ± 3 min, mean blood flow was 368 ± 10 mL/min, mean dialysate flow was 602 ± 1 mL/min and weight loss was 2.9 ± 0.2 kg. For these parameters no significant differences were observed between the 2 dialyser surfaces and Q_{UF} conditions.

The total **convection volumes** depended on Q_{UF} condition and on surface, while the **spKt/V** was similar across the four conditions (table).

Table. Dialysis performances by dialyser surface and Q_{UF} condition

	Dialyser surface	Q_{UF} condition		P-value
		Q_{UF}-optimal	Q_{UF}-max	
Convection volume (L)	**1.8 m²**	20.6 ± 0.4	24.5 ± 0.6	<0.001[a]
	2.3 m²	21.7 ± 0.4	24.3 ± 0.6	
Removed urea (mmol /session)	**1.8 m²**	545 ± 43	473 ± 32	0.03[b]
	2.3 m²	491 ± 44	471 ± 38	
spKt/V	**1.8 m²**	1.77 ± 0.05	1.78 ± 0.05	0.5
	2.3 m²	1.75 ± 0.04	1.75 ± 0.05	

[a] significant effect of Q_{UF} condition at both surfaces, and significant surface effect at the Q_{UF}-optimal condition

[b] no Q_{UF} condition effect at either surface; no surface effect at either Q_{UF} condition

TMP alarms and achievement of convection volume prescription

Increasing from **Q_{UF}-optimal to Q_{UF}-max** using the 1.8 m² dialyser resulted in frequent TMP alarms and only 33% of the sessions reached the prescribed convection volume.

Increasing the **dialyser's surface to 2.3 m²** significantly decreased the number of alarms and increased the number of sessions reaching the aimed convection volume (100% at Q_{UF}-optimal and 79% at Q_{UF}-max).

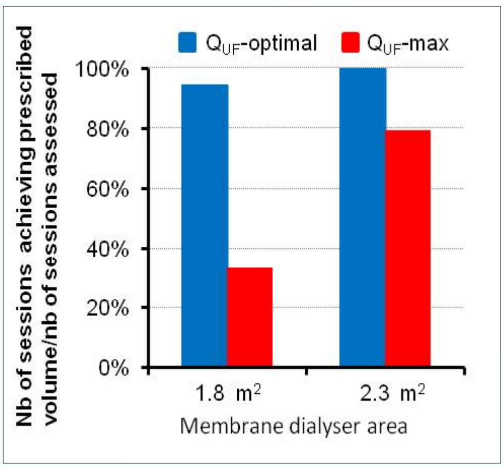

Figure 1. Proportion of sessions achieving the prescribed volume by dialysis surface and Q_{UF} condition

Protein removal

Removal of **low mol wt proteins** observed on SDS-PAGE pattern analysis and quantified **B2M removal** did not change across the 4 different conditions (figure 2).

Removal of **high molecular weight proteins** increased with convection, similarly to quantified **albumin removal** (figure 2, p<0.001). The highest albumin loss was observed with the larger dialyser at Q_{UF}-max.

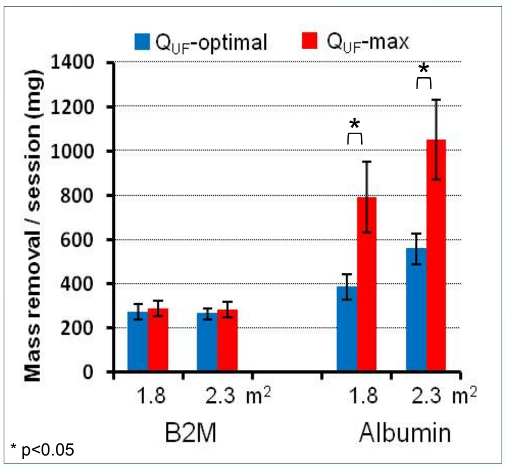

Figure 2. Mass of β2-microglobuline (B2M) and albumin removed by session, depending on dialysis surface and Q_{UF} condition

CONCLUSIONS:

Increasing membrane surface area reduced the number of alarms allowing a more frequent accomplishment of the prescribed convection volumes. However, the use of larger dialysers in a Q_{UF}-max situation, results in an increased albumin loss suggesting that when large dialysers are used a Q_{UF}-optimal setting seems more appropriate.

REFERENCE: [1]Ficheux A, Ronco C, Brunet P, Argilés A. The ultrafiltration coefficient: this old 'grand inconnu' in dialysis. Nephrol Dial Transplant. 2013 Dec 19. [Epub ahead of print].