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In–vivo measured β-2 Microglobulin Clearance in High-Flux HD & HDF

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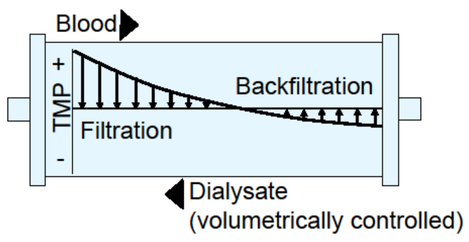
Introduction

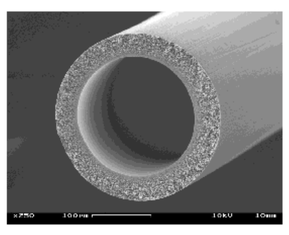
- Highly permeable dialyzers with decreased hollow-fiber diameter are now available for use in HF-HD and HFD, both RRTs with enhanced convective removal of large solutes with putative uremic toxicity,
- Under volumetric control of countercurrent dialysate in HF-HD, fluxes in opposite directions occur in response to self-adjusting TMP along the flow path of the dialyzer. This "Internal-HDF", with simultaneous filtration and substitution by backfiltration, is not readily measurable, but can be deducted from clearance of large, poorly diffusible solutes,

« Internal HDF »



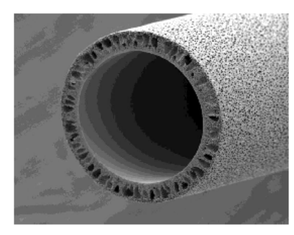
- In the HEMO study of 2002, membrane flux was characterized on the basis of the clearance of the middle molecule β-2 microglobulin (β-2M, MW 11'812),
- For the high-flux arm of the study, this amounted to 33.7 11.4 ml/min with the then available dialyzers [1],
- Aim of this study was to measure patients' in-vivo β-2M clearance and extraction during routine clinical treatments of HF-HD in comparison to those of HDF, performed with the same dialyzers, as specified below.

Methods



(Source: FMC St. Wendel)

Dialyzer studied	Manufacturer	Membrane	Hollow-Fiber Surface	Wall Thickness	Inner-∅	UF-Coefficient
FX CorDiax 80	Fresenius	PS Helixone *plus*	1.8 m²	35 µm	185 µm	64 ml/h*mmHg
Revaclear MAX	Gambro	Polyarylethersulfone	1.8 m²	35 µm	190 µm	60 ml/h*mmHg



(Source: Gambro Hechingen)

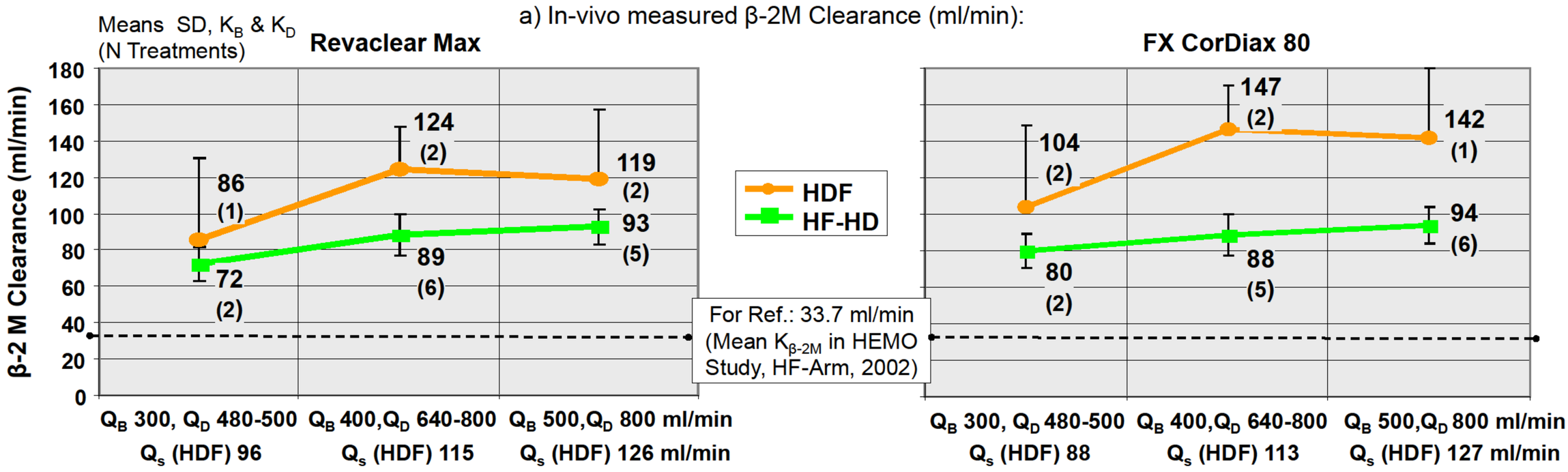
- Twelve consenting patients participated in the study:

Age (yrs.)		Sex	ESRD Vintage (yrs.)		Serum β-2M (mg/l)		(id. HEMO)	
70	12	3 F	8.1	9.3	27.6	4.5	33.5	9.1

- They underwent routine clinical treatments with HF-HD and HDF, the latter performed in the online postdilution auto-substitution mode (Fresenius 5008).
- From measurements for β-2 M (with Abbot-Architect immunoassay) of serum and dialysate samples, obtained at various flow rates during treatment, dialyzer **plasma-clearance for β-2M** was calculated, derived both from mass removal from blood and mass recovery in the dialysate (K_B & K_D),
- β-2M-reduction rate was calculated from pre- to post-treatment changes of patients' serum concentrations, in relation to change of extracellular water volume [2]. Kt/V for β-2M was estimated from measured K & t, with V=1/3 of kinetically derived urea volume, analogous to the HEMO study [1].

Results

a) In-vivo measured β-2M Clearance (ml/min):



b) Characteristics & Quantification of studied Treatments

Means SD	High-Flux HD		HDF		Ref.: HEMO, HF Arm [1]
Dialyzer.	Revaclear Max	FX CorDiax 80	Revaclear Max	FX CorDiax 80	
Treatments (N)	6	7	3	2	
Patient's Weight (kg)	79.1 24.4	77.1 ± 7.1	64.3 ± 12.0	74.6 ± 0.6	
Treatment Time (min)	206 36	208 ± 36	202 ± 10	207 ± 16	
Av. Blood Flow Rate (ml/min)	434 ± 58	455 ± 31	407± 35	414 ± 1	
Total HDF Substitution Vol. (l)			21 1	20 3	
Urea Reduction Rate (%)	77 ± 3	78 ± 3	79 ± 3	78 ± 4	
β-2M Reduction Rate (%)	72 ± 2	76 ± 2	79 ± 3	80 ± 3	
Kt/V of β-2M	1.34 0.19	1.45 0.24	2.28 0.14	2.30 0.36	0.66 0.23

Conclusions

- HDF (with externally forced filtration) remains the most efficient RRT in terms of obtainable clearance of β-2M,
- HF-HD (with self-adjusting "Internal HDF"), performed in the study with more permeable dialyzers and at high flow rates, yielded in-vivo $K_{β-2M}$ of unprecedented magnitudes, effectively approximating those found with HDF,
- As compared to the HEMO study (high-flux arm), the demonstrated in-vivo $K_{β-2M}$ of HF-HD is almost threefold higher,
- Pre- to post-treatment β-2 M reduction rate was found to be >70 % for all treatments of the study,
- Estimated KT/V of β-2 M in the study more than doubled those of the HEMO study and were found to be highest in HDF.

1. *Cheung AK et al: Serum β-2 microglobulin levels predict mortality in dialysis patients: Results of the HEMO study. J Am Soc Nephrol 17:546-555, 2006*

2. *Bergström J, Wehle B: No change in corrected beta 2-microglobulin concentration after cuprophane haemodialysis. Lancet 14;1:628-9, 1987*