



XXXI Corso Nazionale ANTE - Dialisi e Tecnologia
“Evoluzione tecnologica nei trattamenti dialitici cronici e acuti:
dalla teoria alla pratica”
15-16-17 Aprile 2024 Sala Congressi Hotel CORALLO Viale
Antonio Gramsci, 113, 47838 Riccione RN

Membrane adsorbenti tra vecchie e nuove indicazioni cliniche

dott. P. Fabbrini
ASST NORD MILANO
OSPEDALE BASSINI

Tossine Uremiche e correlazioni cliniche

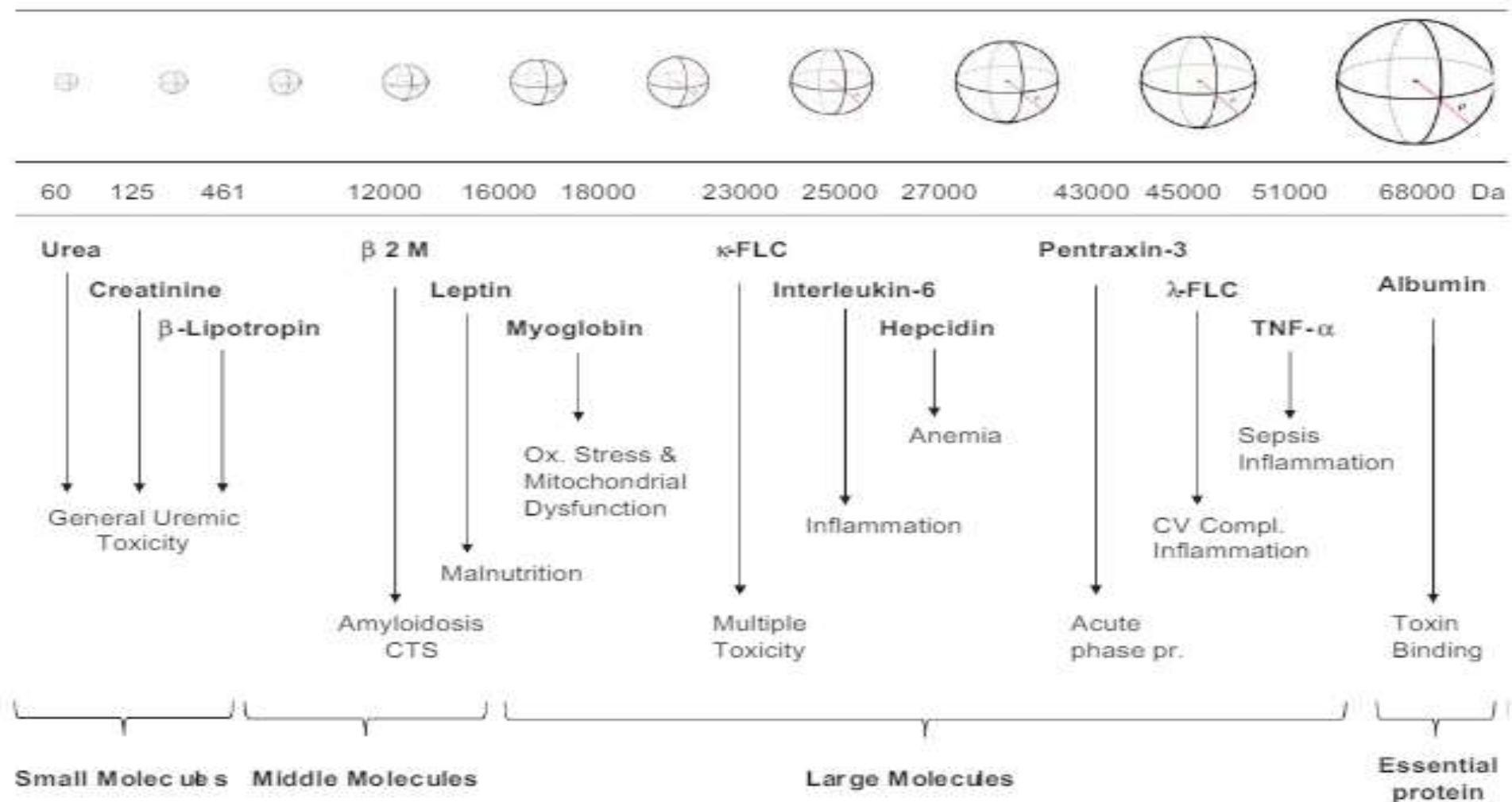
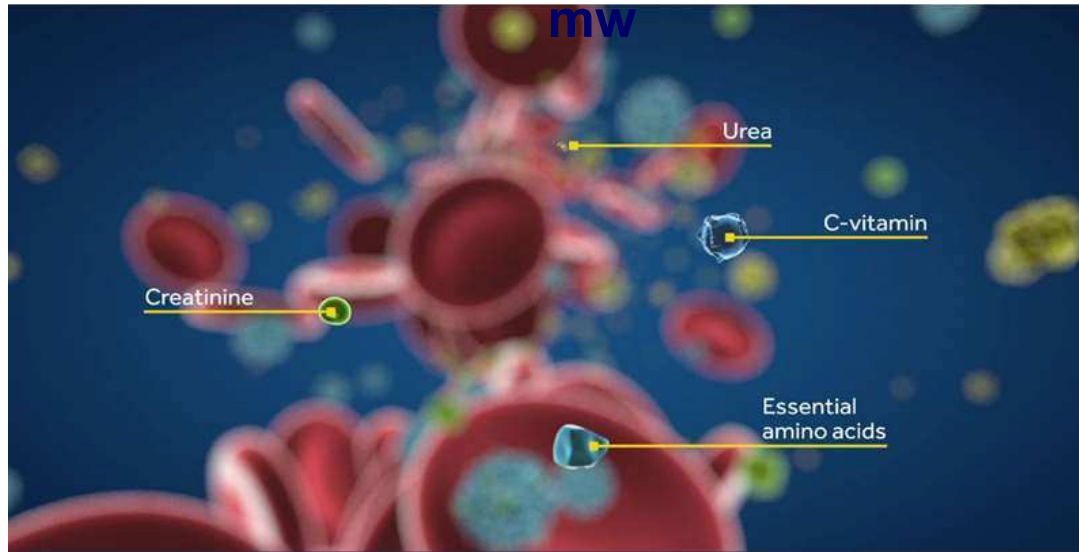
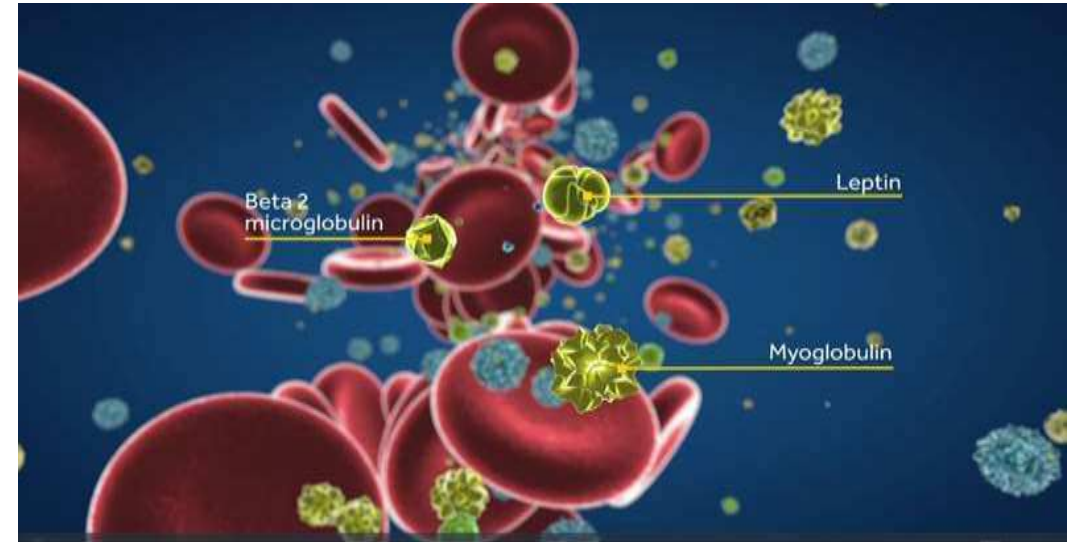


FIGURE 1: Schematic representation of different classes of uraemic toxins with their molecular size and relevant clinical effects.

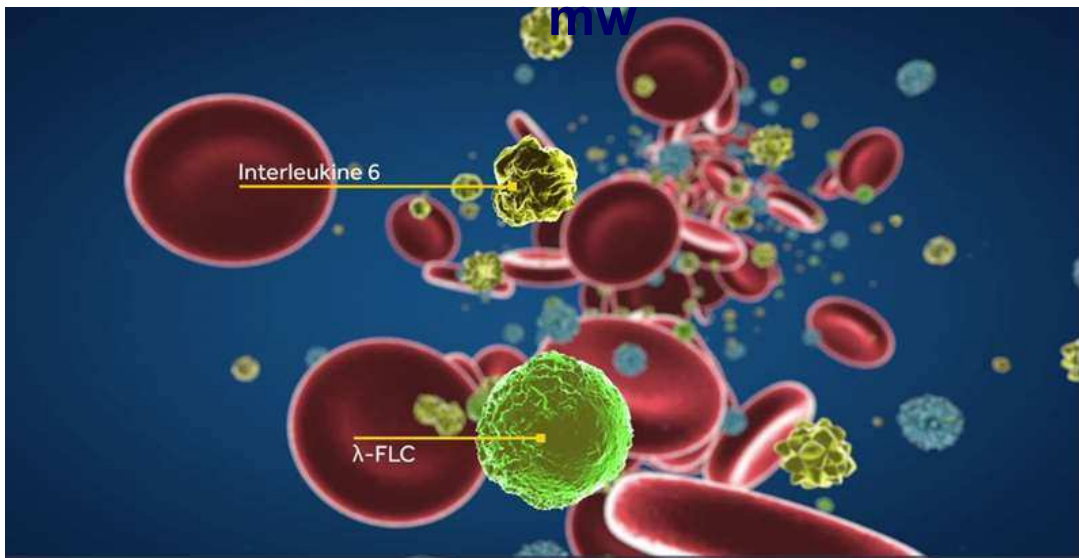
Low mw



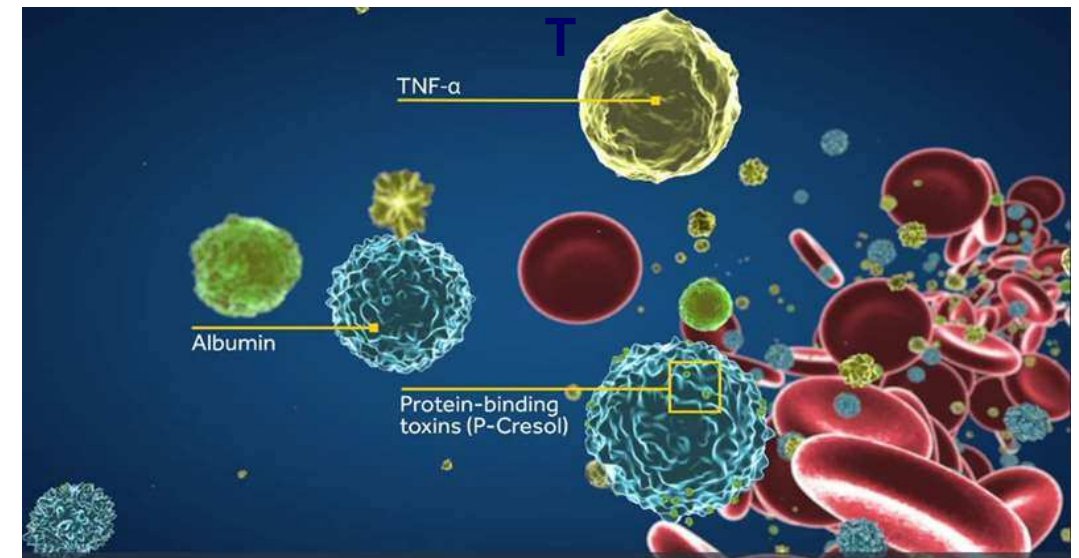
Medium mw



Large mw



PBU T



DIFFUSIONE E CONVEZIONE: CONTRAST STUDY

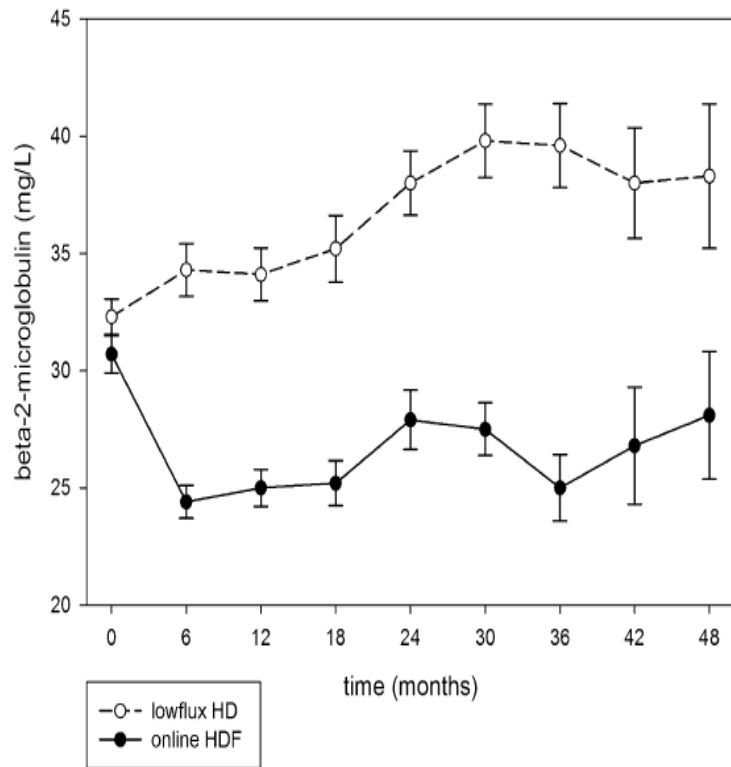
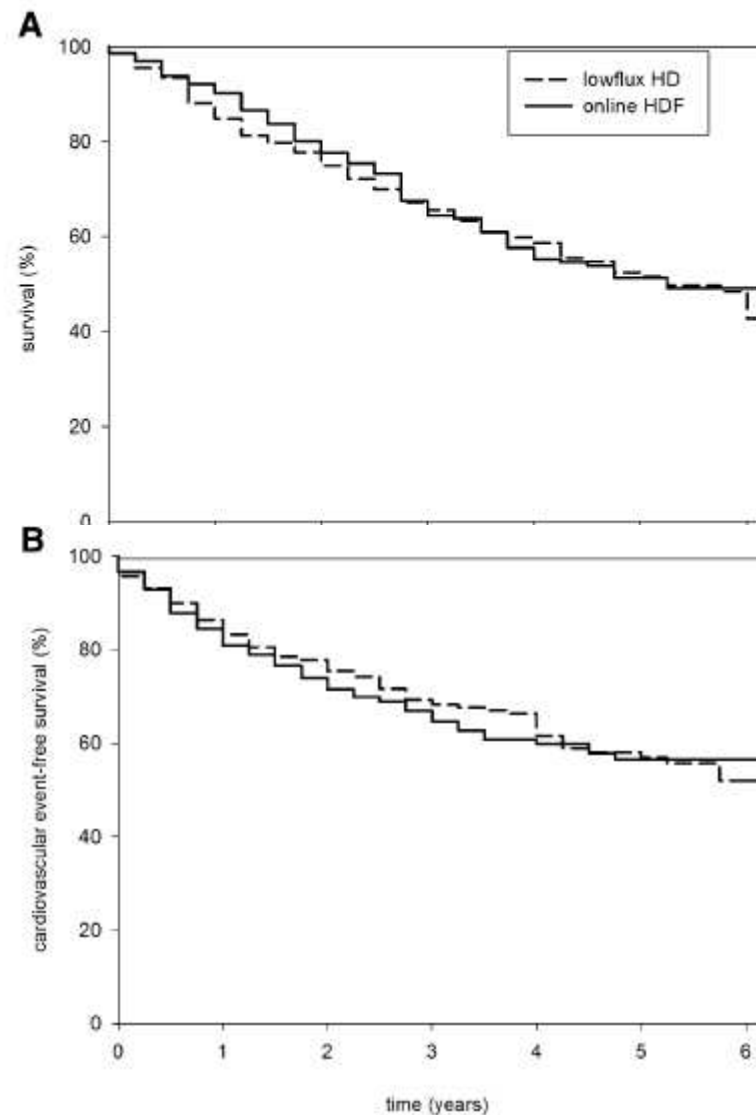


Figure 2. Predialysis β -2-microglobulin levels in patients treated with online hemodiafiltration and low-flux hemodialysis (mean \pm SEM) using measurements of individuals at those time points. The difference between β -2-microglobulin levels for both treatments was significant ($P < 0.001$).



Effect of Online Hemodiafiltration on All-Cause Mortality and Cardiovascular Outcomes

DIFFUSIONE E CONVEZIONE: CONTRAST STUDY

Table 4. Risk of all-cause mortality and fatal and nonfatal cardiovascular events by achieved convection volume in liters per treatment

	Hemodialysis	Online Hemodiafiltration Convection Volume Tertiles			P for Trend
		<18.17 L	18.18–21.95 L	>21.95 L	
Total mortality					
crude	1.0	0.95 (0.66–1.38)	0.83 (0.57–1.22)	0.62 (0.41–0.93)	0.010
adjusted ^a	1.0	0.79 (0.53–1.14)	0.77 (0.51–1.14)	0.65 (0.42–0.99)	0.012
adjusted ^b	1.0	0.80 (0.52–1.24)	0.84 (0.54–1.29)	0.61 (0.38–0.98)	0.015
Fatal and nonfatal cardiovascular events					
crude	1.0	1.37 (0.94–1.98)	1.06 (0.72–1.56)	0.76 (0.50–1.16)	0.473
adjusted ^a	1.0	1.41 (0.92–2.11)	0.93 (0.62–1.40)	0.77 (0.48–1.21)	0.369
adjusted ^b	1.0	1.35 (0.86–2.11)	1.04 (0.66–1.62)	0.72 (0.44–1.19)	0.475

THE MORE THE BETTER?

RESEARCH SUMMARY

Effect of Hemodiafiltration or Hemodialysis on Mortality in Kidney Failure

Blankestijn PJ et al. DOI: 10.1056/NEJMoa2304820

CLINICAL PROBLEM

Hemodiafiltration and hemodialysis are two methods of treating kidney failure. Data comparing survival outcomes with these approaches have been largely inconclusive; results of one randomized, controlled trial indicating a lower risk of death with hemodiafiltration may have reflected confounding bias.

CLINICAL TRIAL

Design: A multinational, pragmatic, open-label, randomized, controlled trial assessed the benefits and harms of high-dose hemodiafiltration as compared with conventional high-flux hemodialysis in patients with kidney failure.

Intervention: 1360 adults with stage V kidney failure who had received hemodialysis for ≥ 3 months were assigned to receive high-dose hemodiafiltration (a convection volume of ≥ 23 liters in postdilution mode per session) or continuation of high-flux hemodialysis. The primary outcome was death from any cause.

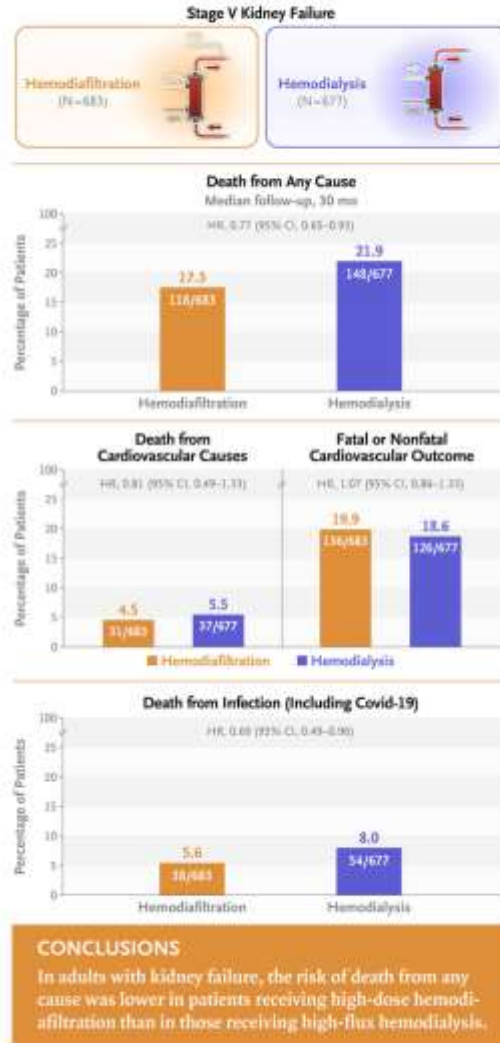
RESULTS

Outcomes: During a median follow-up of 30 months, the risk of death from any cause was lower in patients receiving high-dose hemodiafiltration than in those receiving hemodialysis. The survival effect of hemodiafiltration appeared to be limited to those without a history of cardiovascular disease or diabetes.

LIMITATIONS AND REMAINING QUESTIONS

- The achieved sample size was lower than originally planned because of difficulty recruiting patients during the Covid-19 pandemic.
- Inclusion criteria may have resulted in a trial population that was healthier than the general population of patients who receive hemodialysis in Europe and the United States.
- Findings may not be generalizable beyond White European populations.

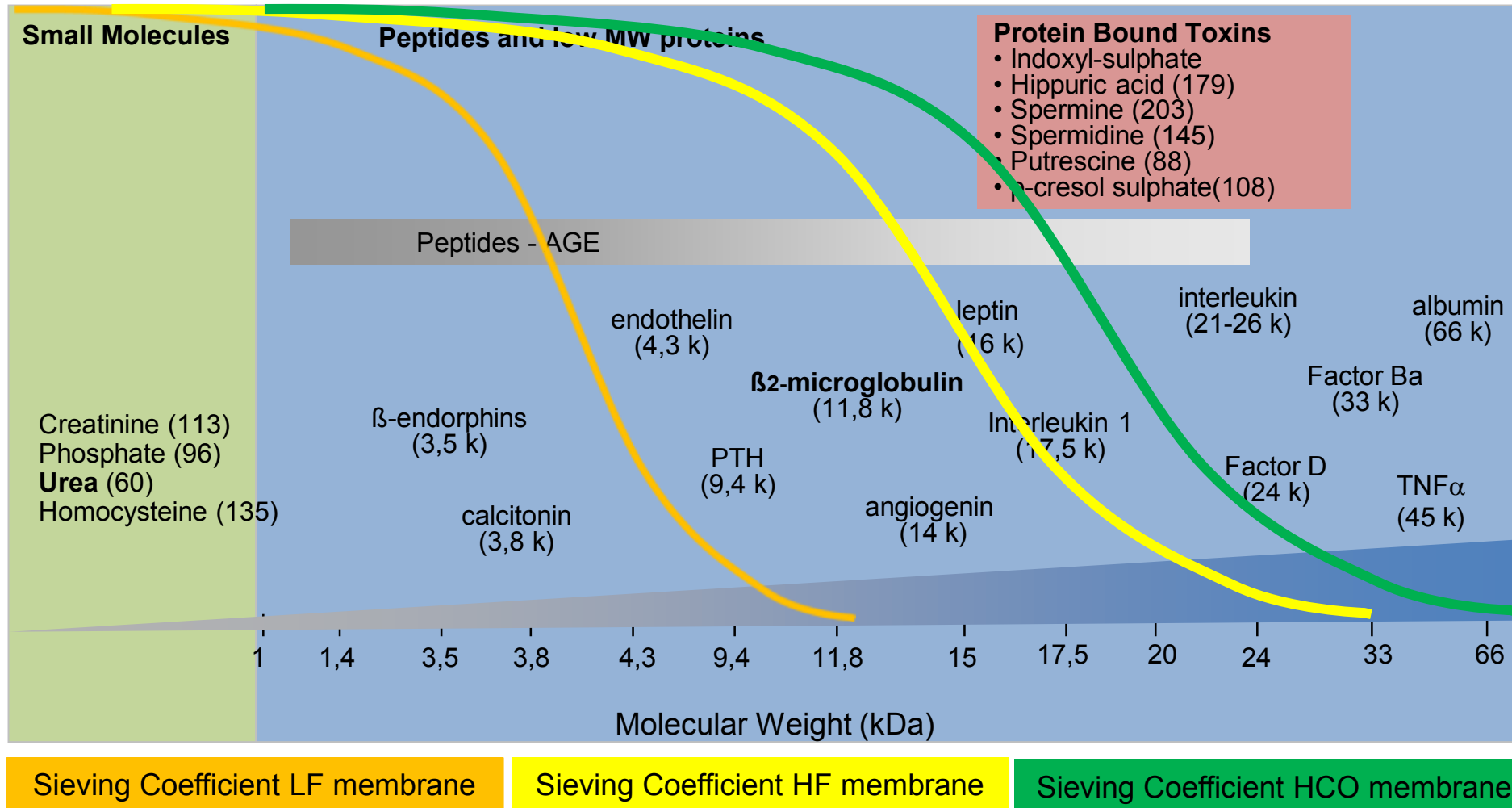
Links: [Full Article](#) | [NEJM Quick Take](#) | [Editorial](#)



ALLORA HA SENSO ESTENDERE ANCHE LO SPETTRO DELLE MOLECOLE RIMOSSE? COME INTRODURRE L'ADSORBIMENTO?

Tossine Uremiche

overcome Membranes limitations



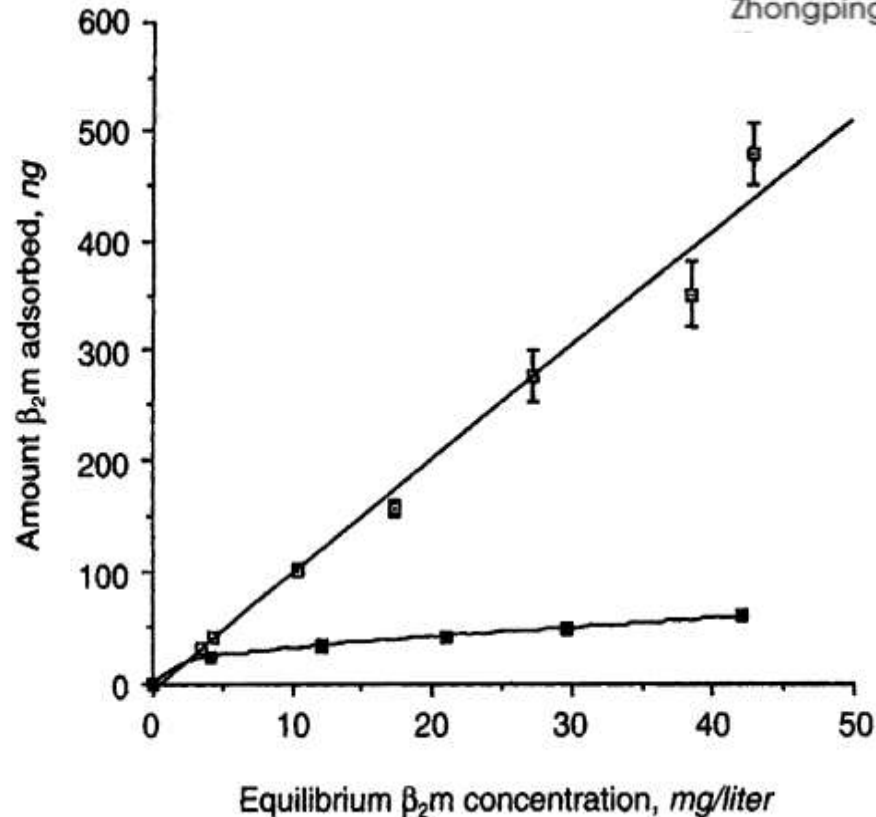
DIALISI CON ADSORBIMENTO



ADSORBIMENTO

Blood-Membrane Interactions During Dialysis

Zhongping Huang,* Dayong Gao,† Jeffrey J. Letteri,† and William R. Clark†§

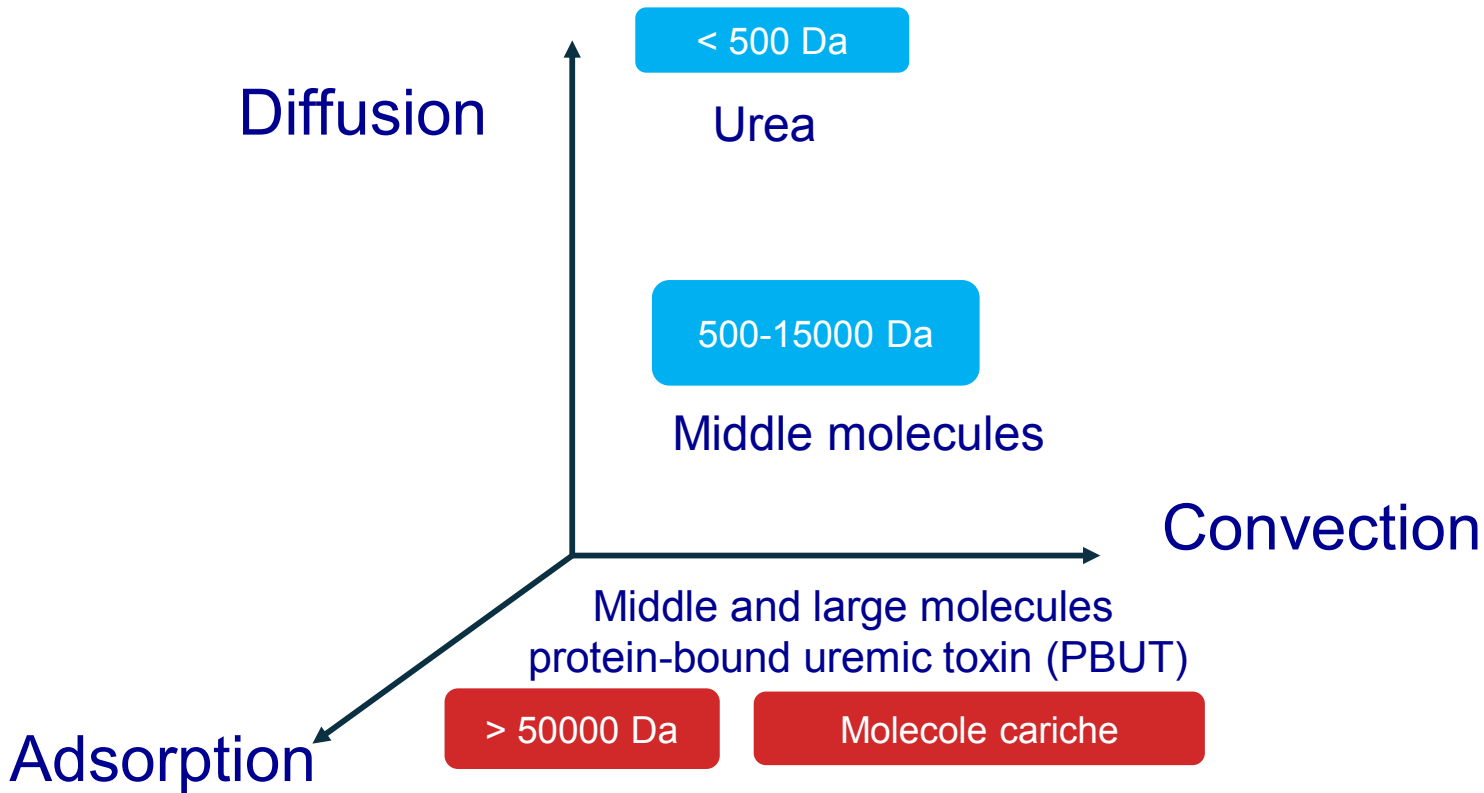


FORZE COINVOLTE

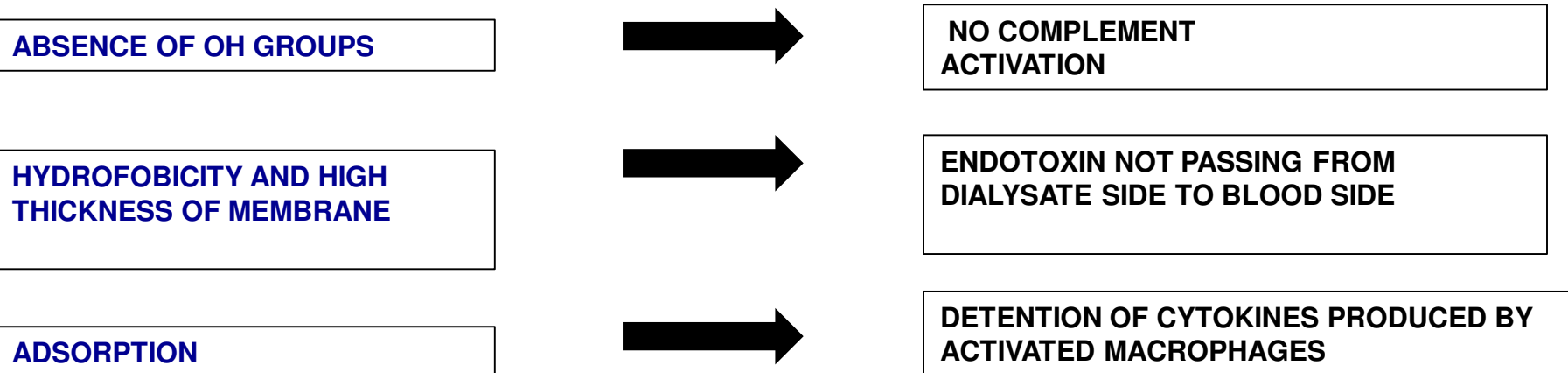
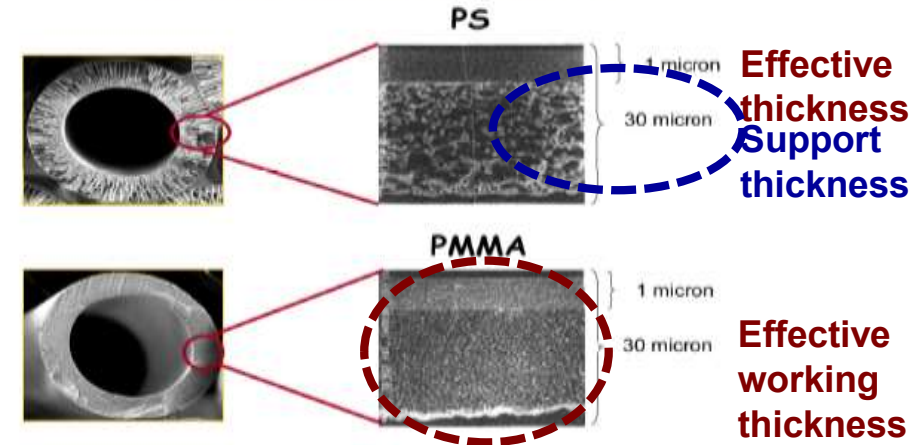
- INTERAZIONI IDROFOBICHE
- FORZE IONICHE-ELETTROSTATICHE
- FORZA DI VAN DER WAALS

A **Langmuir isotherm** is characterized by a linear relationship between the solid and solution phases at low values of the latter. As solution phase increases, the solid phase concentration reaches a plateau, corresponding to monolayer protein deposition. The slope of the initial linear portion is proportional to adsorption affinity while the plateau surface concentration represents the surface's capacity

Membrane adsorbenti: *PMMA*, *PEPA*, *AN69*.....



CARATTERISTICHE DEI FILTRI IN POLIMETILMETACRILATO (PMMA)

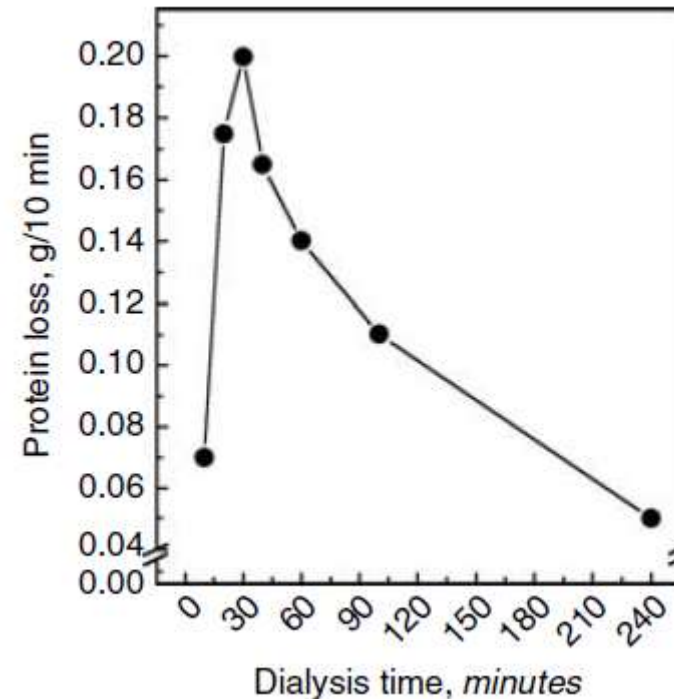
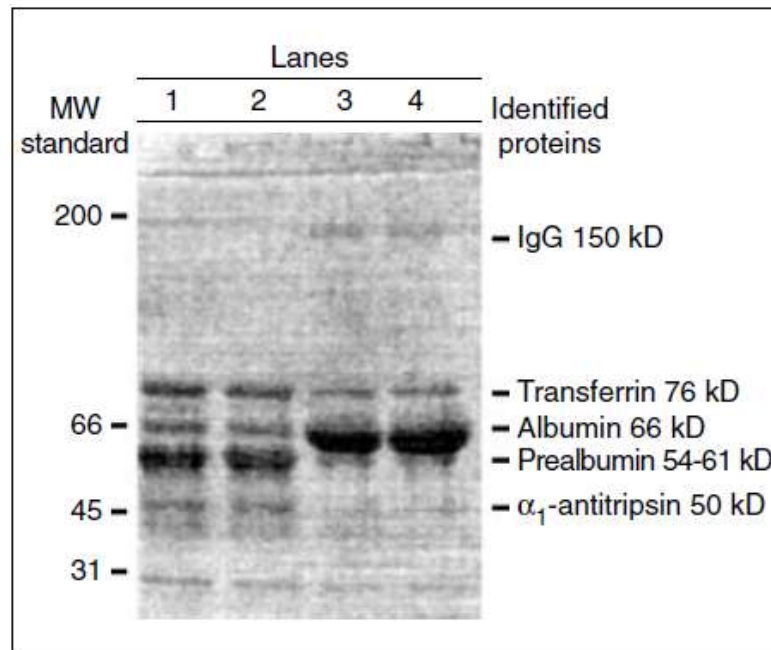


PMMA ADSORPTION DIALYSIS

Galli F. et al KI 2005

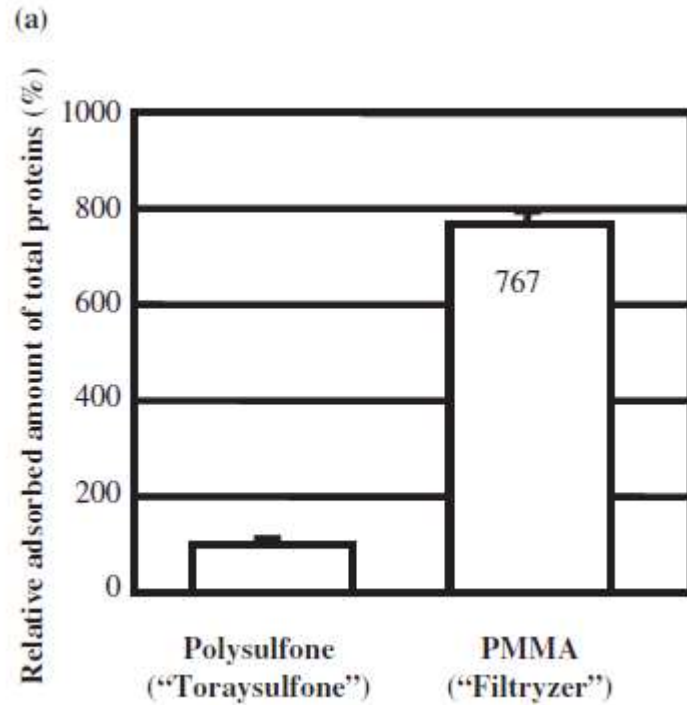
	NPLD	PLD
Total proteins <i>g/dialysis session</i>	0.26 (0.20–0.32)	2.86 (1.28–4.13)
Proteins subfractions <i>MW</i>	Densitometry (% of total O.D.)	
α_1 -antitripsin (50)	15.5	1.0
Prealbumin (54–61)	31.0	7.8
Albumin (66)	20.7	75.6
Transferrin (76)	17.4	10.9
IgG (150)	N.D.	2.8

PROCESSO EFFICIENTE
PROCESSO SATURABILE

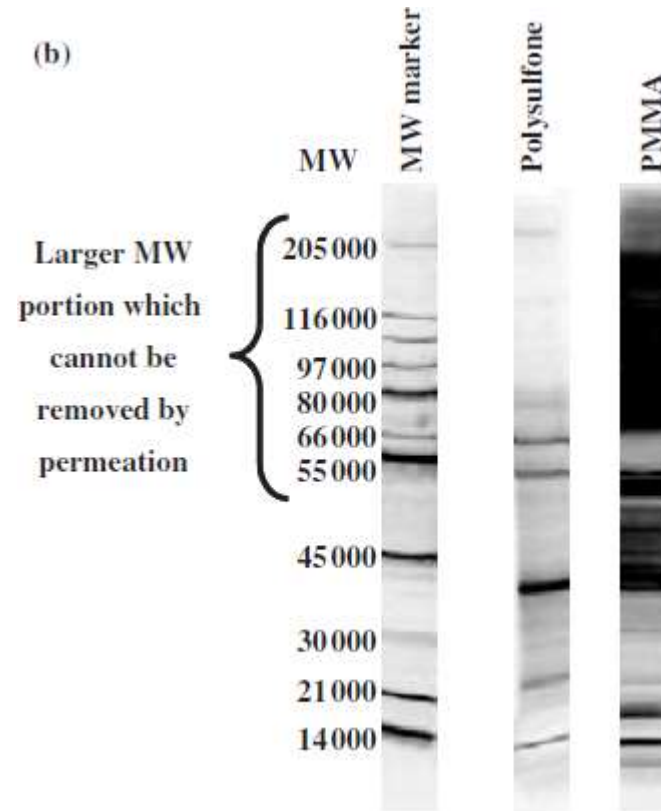


PMMA ADSORPTION DIALYSIS

a) QUANTITA' TOTALE DI PROTEINE ADSORBITE



b) PATTERN ELETTROFORETICO DELLE PROTEINE ASSORBITE



PMMA ADSORPTION DIALYSIS

Table 2. Pre-HD levels of proteins, protein glycation and oxidation indices, cytokines and CRP, adhesion molecules, and MCP-1 in the plasma of patients at baseline and after 6 months (end of the study) of treatment with PLD (study group) and NPLD (control group)

	Healthy subjects	Control group on NPLD		Study group on PLD	
		Baseline	6 months	Baseline	6 months
Plasma proteins and glycooxidation markers					
Plasma proteins <i>g/dL</i>	7.6 ± 1.3	6.7 ± 0.4	6.7 ± 0.9	6.9 ± 0.5	6.8 ± 0.6
Albumin <i>g/dL</i>	4.5 ± 0.9	4.1 ± 0.3	3.9 ± 0.8	4.0 ± 0.4	3.8 ± 0.4
Transferrin <i>mg/dL</i>	272.4 ± 98.2	260.0 ± 81.9	252.9 ± 67.7	256.4 ± 57.1	264.3 ± 68.5
f-pentosidine <i>pmol/mL plasma</i>	N.D.	110.4 ± 30.2	112.5 ± 27.6	106.1 ± 24.0	60.2 ± 18.9 ^b
Total pentosidine <i>pmol/mg protein</i>	1.4 ± 0.3 ^d	26.5 ± 8.7	25.0 ± 11.1	23.5 ± 9.3	15.4 ± 5.2 ^b
Albumin-pentosidine <i>pmol/mg albumin</i>	5.4 ± 4.6 ^d	38.1 ± 16.6	37.9 ± 18.0	36.3 ± 14.2	23.8 ± 8.9 ^b
Protein carbonyls <i>arbitrary units</i>	39.1 ± 30.2 ^d	260.5 ± 165.6	245.2 ± 177.0	229.8 ± 156.8	132.2 ± 117.5 ^b
AOPP <i>arbitrary units</i>	12.7 ± 14.0 ^d	100.3 ± 68.6	114.1 ± 78.3	104.7 ± 60.2	64.6 ± 56.6 ^b
Cytokines and CRP					
IL-1β <i>pg/mL</i>	2.7 ± 1.1 ^d	4.4 ± 3.0	4.8 ± 2.2	4.1 ± 3.3	2.1 ± 1.9 ^{a,e}
TNF-α <i>pg/mL</i>	9.1 ± 3.2 ^d	19.0 ± 4.0	21.0 ± 5.5	18.7 ± 4.3	15.1 ± 3.1 ^b
IL-6 <i>pg/mL</i>	2.4 ± 0.9 ^d	5.3 ± 2.1	5.8 ± 2.3	5.0 ± 1.9	3.1 ± 0.6 ^{b,f}
IL-10 <i>pg/mL</i>	6.0 ± 2.5 ^d	3.3 ± 0.4	3.0 ± 0.5	3.0 ± 0.6	5.0 ± 4.4 ^{b,e}
INF-γ <i>pg/mL</i>	12.7 ± 3.2 ^c	9.9 ± 1.5	10.9 ± 1.9	9.2 ± 1.6	12.6 ± 1.7 ^b
CRP <i>mg/L</i>	7.9 ± 3.6 ^d	25.8 ± 28.6	27.4 ± 24.0	22.7 ± 33.9	12.1 ± 9.1
Adhesion molecules and MCP-1					
ICAM-1 <i>ng/mL</i>	232.5 ± 89.6	283.4 ± 65.3	282.9 ± 96.5	270.7 ± 77.8	240.8 ± 67.6
VCAM-1 <i>ng/mL</i>	589.0 ± 171.4 ^d	973.6 ± 435.9	938.5 ± 259.9	941.0 ± 458.2	772.3 ± 285.4
Selectin-E <i>ng/mL</i>	48.4 ± 16.5	63.5 ± 30.5	68.2 ± 26.9 ^e	58.2 ± 27.3	63.2 ± 36.7
MCP-1 <i>pg/mL</i>	207.3 ± 91.5 ^d	420.1 ± 154.9	468.9 ± 182.5	408.8 ± 170.2	381.5 ± 141.5

N.D., not detectable. Data are mean ± 1 SD.

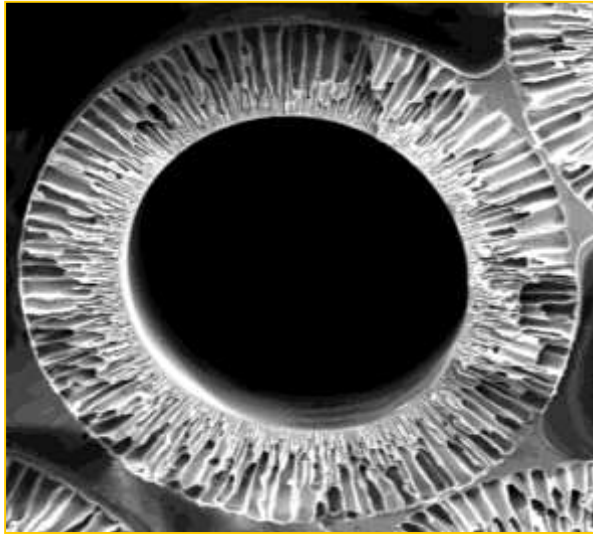
^a*P* < 0.05 and ^b*P* < 0.01 vs. baseline values.

^c*P* < 0.05 and ^d*P* < 0.01 vs. patients' data (when not otherwise specified).

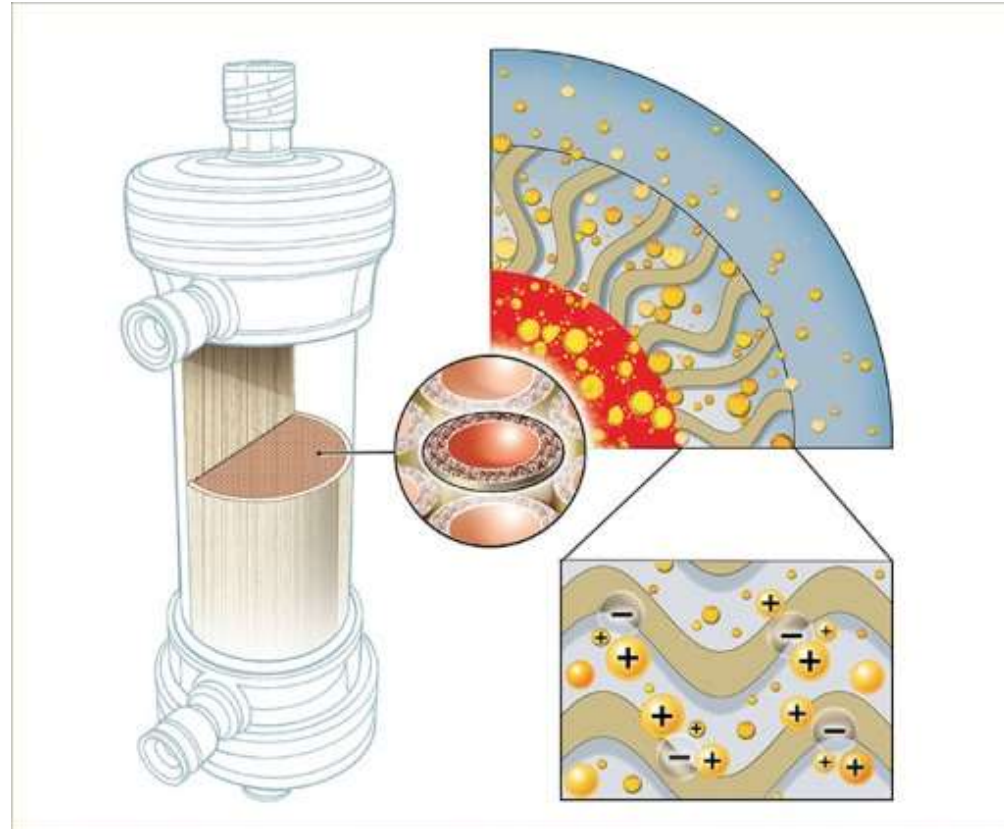
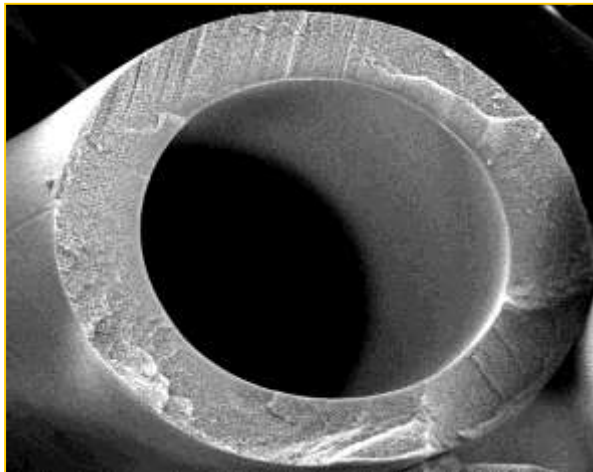
^e*P* < 0.05 and ^fnot significant vs. healthy control subject data.

POLIMETILMETACRILATO (PMMA)

POLISULFONE



PMMA



Membrane e sopravvivenza

RESEARCH ARTICLE

Effect of dialyzer membrane materials on survival in chronic hemodialysis patients: Results from the annual survey of the Japanese Nationwide Dialysis Registry

Masanori Abe¹*, Takayuki Hamano², Atsushi Wada³, Shigeru Nakai⁴, Ikuto Masakane⁵, on behalf of the Renal Data Registry Committee, Japanese Society for Dialysis Therapy⁶

142,412 patients on maintenance hemodialysis considered (from 2008 to 2009). Patients treated with:

cellulose triacetate (**CTA**), ethylene vinyl alcohol (**EVAL**), polyacrylonitrile (**PAN**), polyester polymer alloy (**PEPA**), polyethersulfone (**PES**), polymethylmethacrylate (**PMMA**), and polysulfone (**PS**).

>>> 1 YEAR All Cause Mortality analysis (Cox regression) to estimate the possible association with baseline membrane dialyzers use.

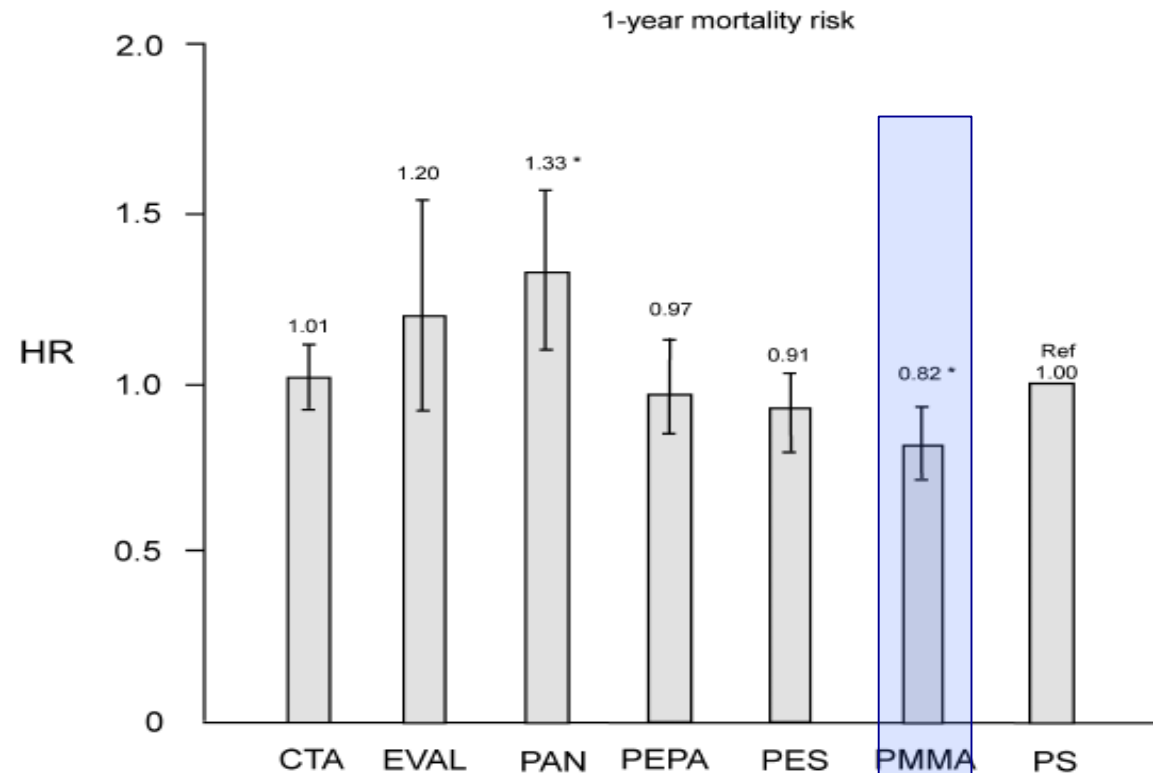


Fig 3. HRs of all-cause mortality after propensity score matching for six types of dialyzer groups compared to the PS group using Cox proportional hazards regression. *P < 0.01 vs. PS. CTA, cellulose triacetate; EVAL, ethylene vinyl alcohol; HR, hazard ratio; PAN, polyacrylonitrile; PEPA, polyester polymer alloy; PES, polyethersulfone; PMMA, polymethylmethacrylate; PS, polysulfone.

Inflammation in uremia and CVD

Review Article

Biomarkers of Chronic Inflammatory State in Uremia and Cardiovascular Disease

International Journal of Inflammation

Home Editorial Board Author Guidelines Aims and Scope Submit a Manuscript

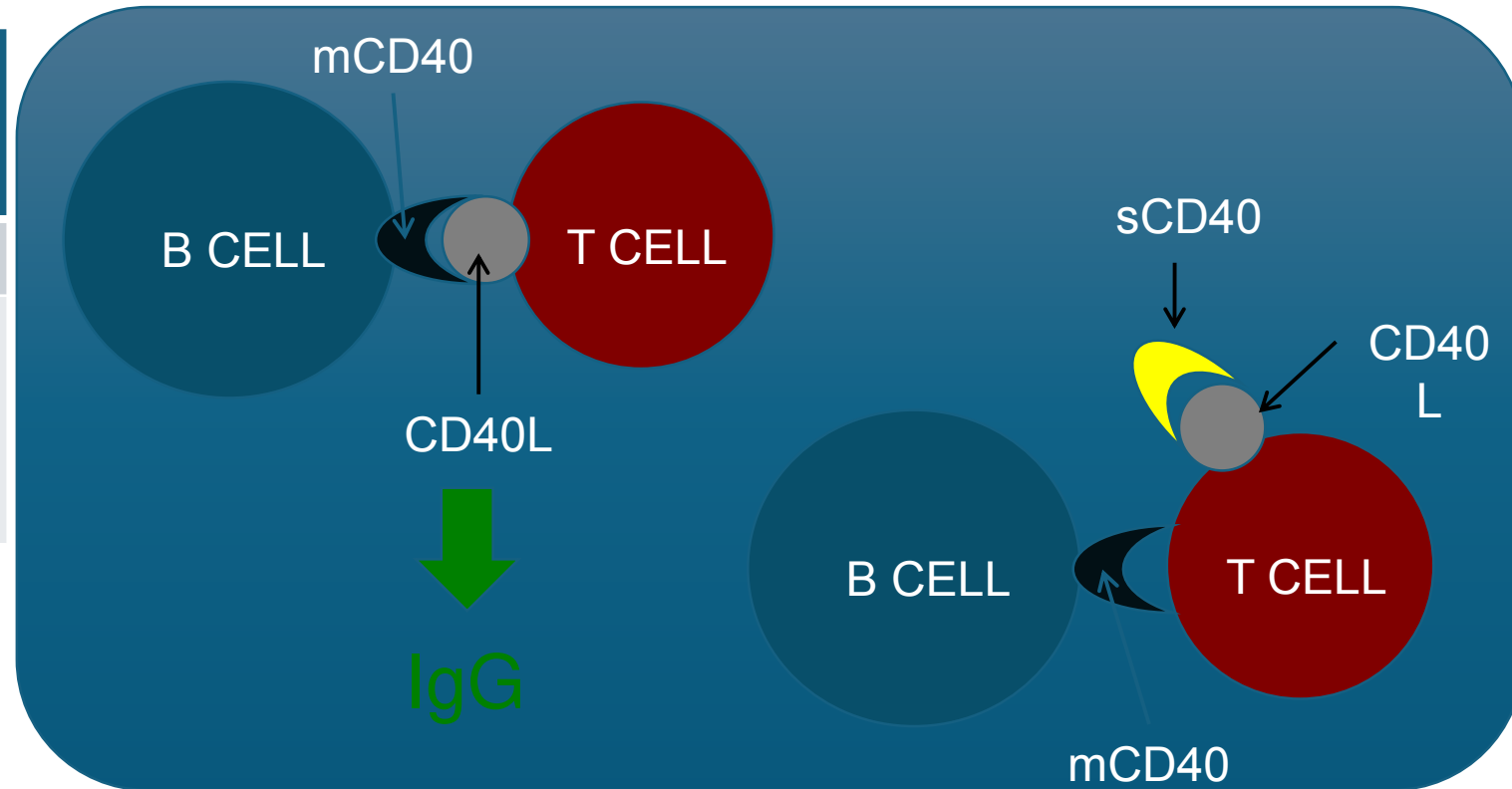
Vincenzo Panichi, Alessia Scatena, Massimiliano Migliori,
Valentina Marchetti, Sabrina Paoletti, and Sara Beati

Nephrology and Dialysis Unit, Versilia Hospital, Via Aurelia 335, 55034 Lido di Camaiore, Italy

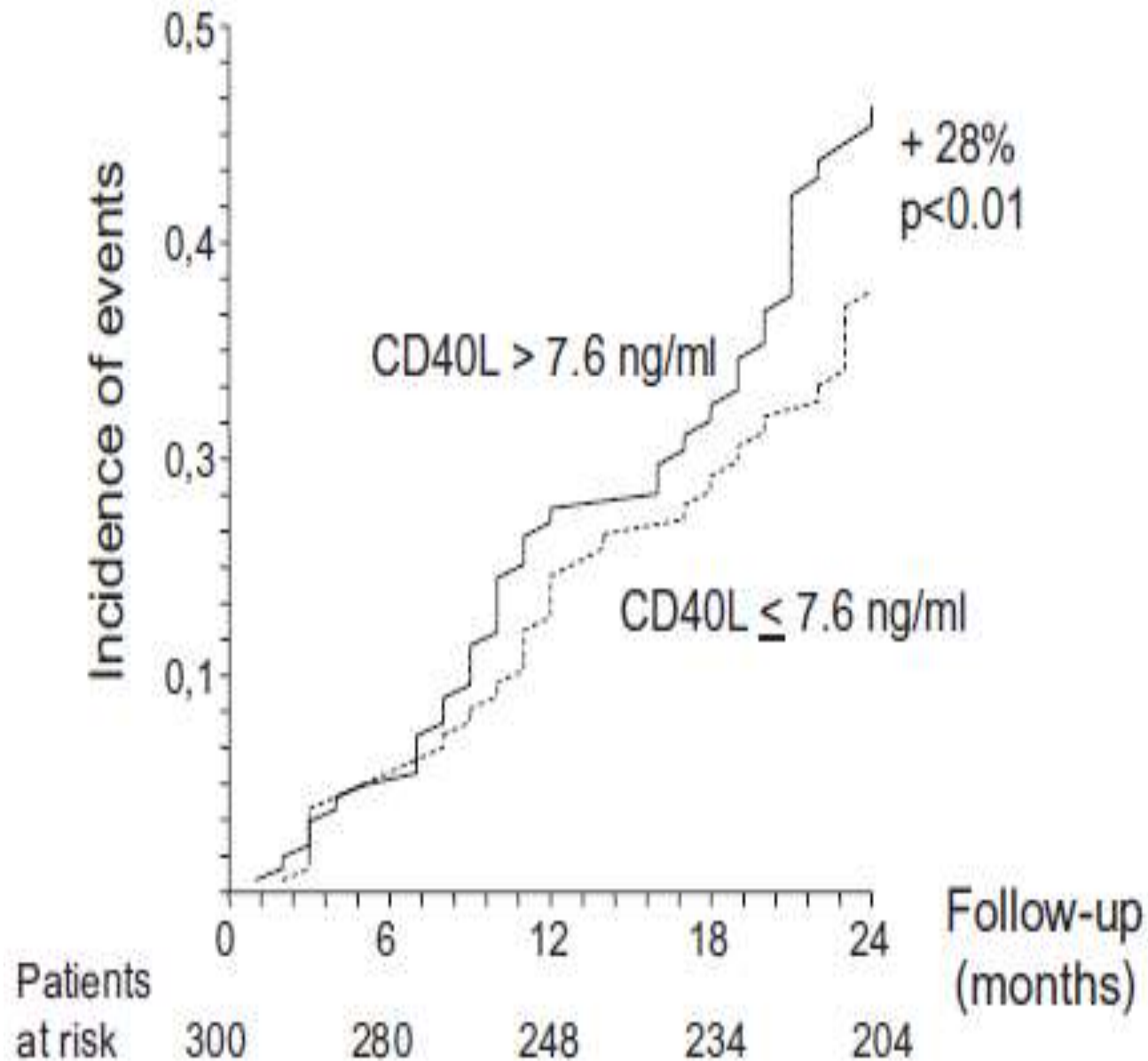
Correspondence should be addressed to Vincenzo Panichi, vpanichi@usl12.toscana.it

Received 6 March 2012; Revised 5 April 2012; Accepted 17 April 2012

TRADITIONAL MARKERS	IL-6	CRP
NON TRADITIONAL MARKERS	CD40/CD40 L complex	PTX-3

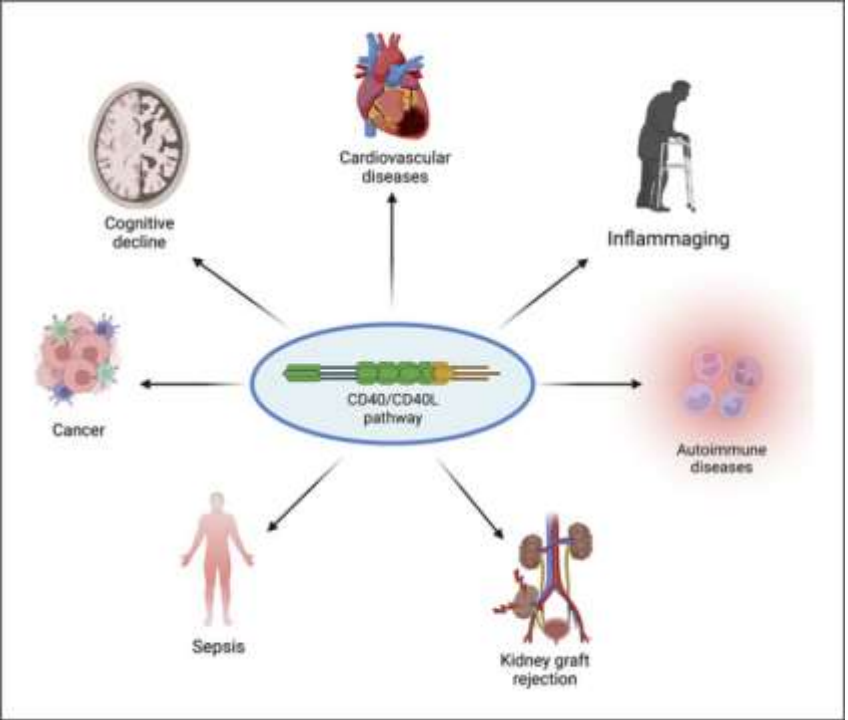
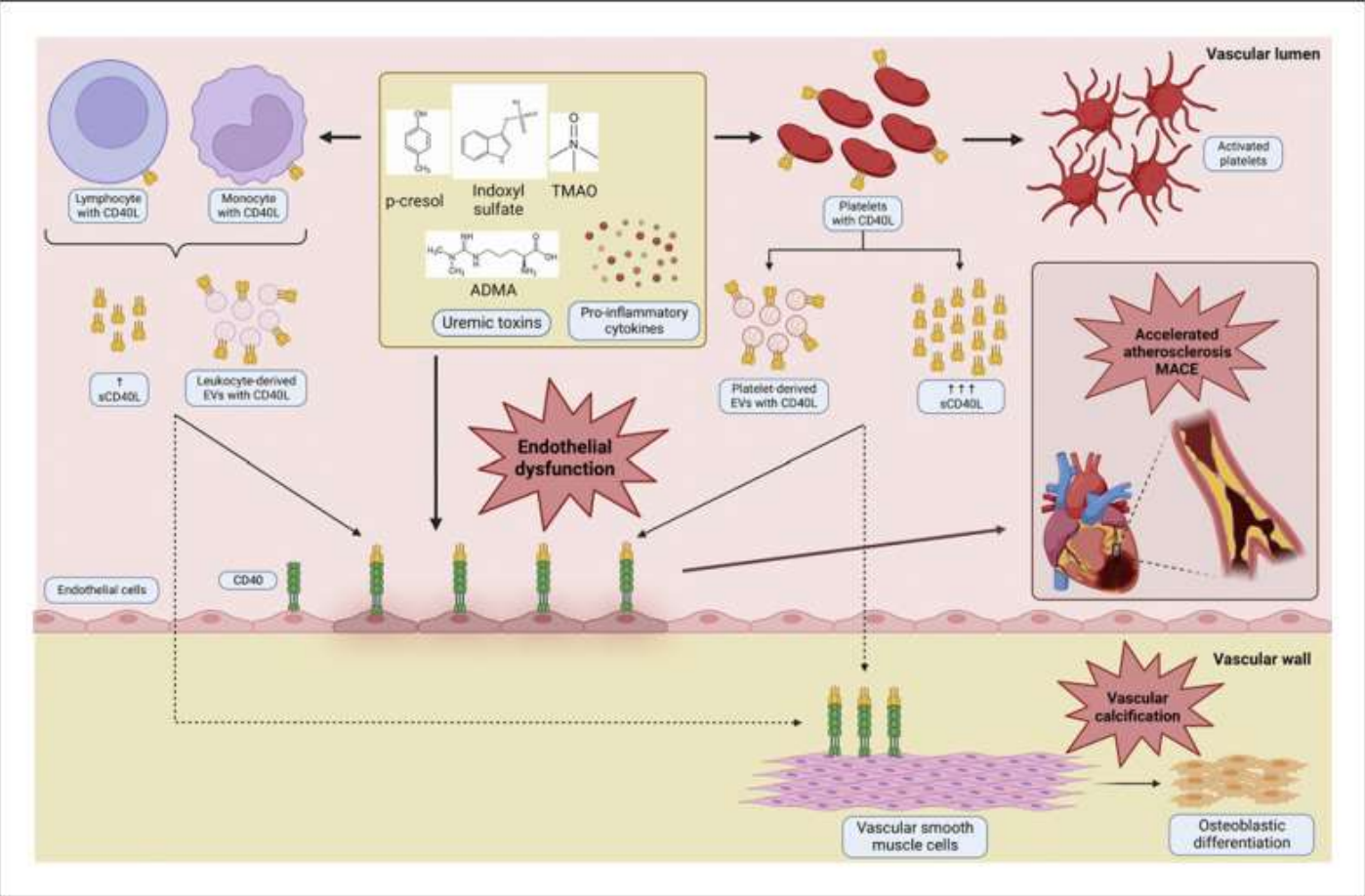


Il fattore Solubile CD40 Ligando predittivo di mortalità e morbidità cardio vascolare



the prognostic value of sCD40L as factor of cardiovascular Morbidity and Mortality is evident also in over 200 chronic HD patients from the RISCAVID population at 24-month follow-up

Role of the CD40-CD40 Ligand Pathway in Cardiovascular Events, Neurological Alterations, and Other Clinical Complications of Chronic Hemodialysis Patients: Protective Role of Adsorptive Membranes



HBV and sCD40

Potential role of soluble CD40 in the humoral immune response impairment of uraemic patients

CÉCILE CONTIN,* VINCENT PITARD,* YAHSOU DELMAS,† NADÈGE PELLETIER,‡ THIERRY DEFRANCE,‡
 JEAN-FRANÇOIS MOREAU,* PIERRE MERVILLE*† & JULIE DÉCHANET-MERVILLE* *UMR-CNRS 5540,
 Université Bordeaux 2, Bordeaux, France, †Department of Nephrology and Hemodialysis, CHU Bordeaux,
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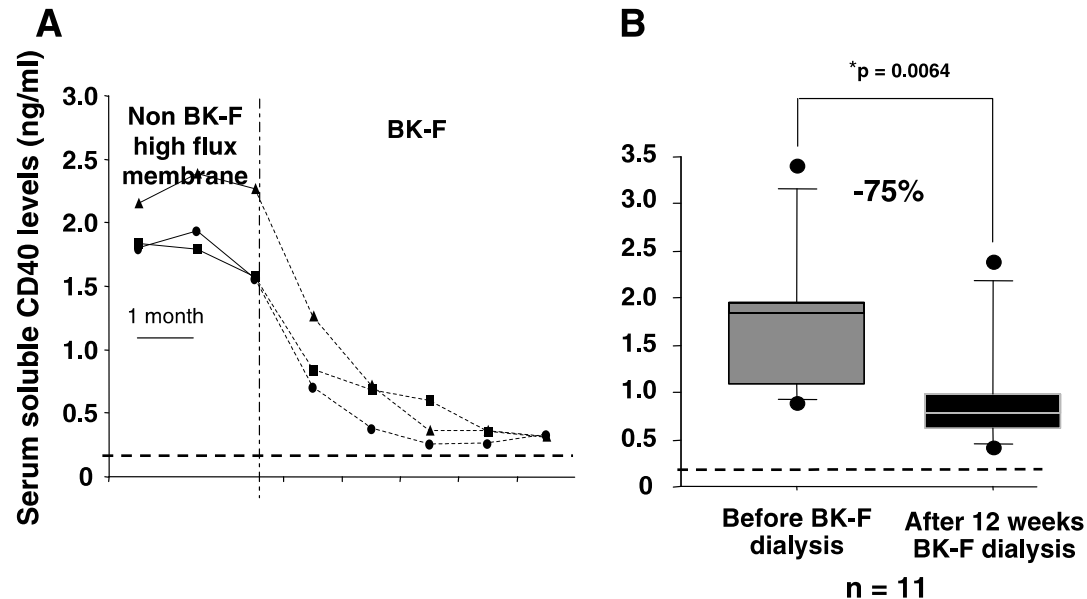


Fig. 3. Longitudinal follow-up of sCD40 levels in patients dialysed on non-PMMA high-flux membranes or BK-2.1F membranes. **(A)** Soluble CD40 concentrations were measured monthly by ELISA in the serum of three patients dialysed on non-PMMA high-flux membrane and who were then switched to BK-2.1F membrane. Blood samples were taken after the dialysis session. Dotted line represents mean level of sCD40 in healthy subjects. **(B)** Levels of sCD40 in the serum of 11 patients before and after 12 weeks of dialysis on BK-2.1F membrane. *Non-parametric Wilcoxon *U*-test.

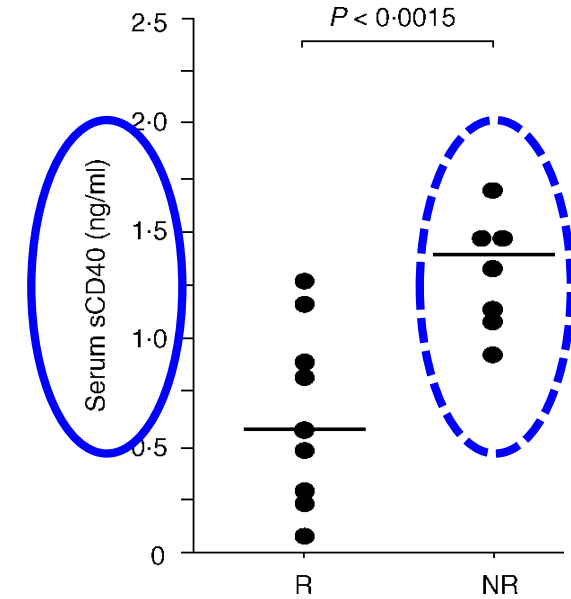


Figure 6. Serum sCD40 levels in chronic haemodialysed patients in the course of Hepatitis B vaccination and correlation to their vaccinal response status. Two groups of haemodialysed patients were set up according to their response to hepatitis B vaccination. Responsive patients (R, $n = 9$) presented >10 IU/l of anti-HBs IgG one month after last vaccine injection whereas Non-responsive patients (NR, $n = 8$) presented <10 IU/l. sCD40 values of each patients correspond to the mean of the four sCD40 values obtained during the vaccination. Lines represent the median values of sCD40 for all the patients of each group. * $P < 0.0015$ determined using a Mann-Whitney test.

PMMA e vaccinazione HBV

Ralli Chiara¹, Imperiali Patrizio¹, Gabbriellini Claudio², Conti Paolo², Lombardi Marco³, Sidoti Antonino⁴, Capitanini Alessandro⁵, Piluso Adriano⁶, Tekle Kiros Seble⁶, Duranti Diletta⁷ and Duranti Ennio^{1*}

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Keywords: Hemodialysis; Immune dysfunctions;

Research Article

Hemodialysis with Polymethylmethacrylate Restores the Response to Hepatitis B Vaccination in Chronic Dialysis Patients: Hypothesized Mechanism of Action

Abstract

Patients undergoing hemodialysis often present with a reduced response to anti-hepatitis B virus (anti-HBV) vaccination. The soluble form of CD40 (sCD40) is elevated in hemodialysis patients and this has been shown to correlate with lack of response to anti-HBV vaccination. Due to its high molecular weight, conventional dialyzers cannot clear sCD40. Previous studies have demonstrated, that dialysis membranes in polymethylmethacrylate (PMMA) can reduce the levels of sCD40. We have studied the effect of dialysis with PMMA membranes in patients who were non-responders to anti-HBV vaccination after a complete cycle of vaccinations. Interestingly, we found that significantly more patients in the PMMA group were able to mount a response to vaccination, compared to the control group (P = 0.04).

1 2 3 4 5

NDT Plus (2016) 3 [Suppl 1]: i20–i27
 doi: 10.1093/ndtplus/sfq033

Potential role of the soluble form of CD40 in deficient immunological function of dialysis patients: new findings of its amelioration using polymethylmethacrylate (PMMA) membrane

Cécile Contin-Bordes^{1,2}, Adeline Lacraz³ and Valérie de Précigout³

	Total	Controls	PMMA
Patients	32	15	17
Average age	73 ± 12	78 ± 9	67 ± 15
Gender (M/F)	18/14	8/7	10/7
Dry weight (kg)	74 ± 21	75 ± 17	73 ± 26
Dialysis vintage (months)	75 ± 58	97 ± 67	54 ± 48
Type of dialysis	Bicarbonate	Bicarbonate	Bicarbonate
Membrane	Polysulfone-polyamide	Polysulfone-polyamide	PMMA series BK-F
HBsAb (UI/L)	< 10	< 10	< 10

	Controls	PMMA	X ² test
Patients	15	17	
Patients with HBsAb > 10	2	8	
Percentage of responders	13 %	47 %	0.04



Short Notes

Adsorptive Hemodialysis by Polymethylmethacrylate (PMMA): an update on Hepatitis B Vaccination Immunoresponce

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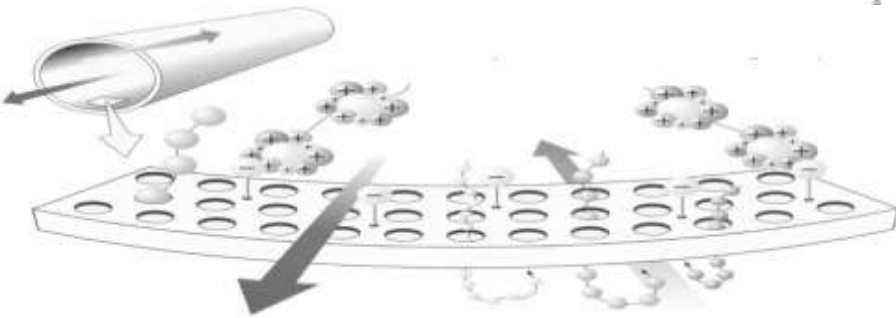
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OPEN ACCESS

Uraemic itching: do polymethylmethacrylate dialysis membranes play a role?

Filippo Aucella^{1,2}, Mimmo Vigilante¹, Antonio Gesuete², Gianfranco Maruccio¹, Angelo Specchio¹ and Loreto Gesualdo²



F. Aucella *et al.*

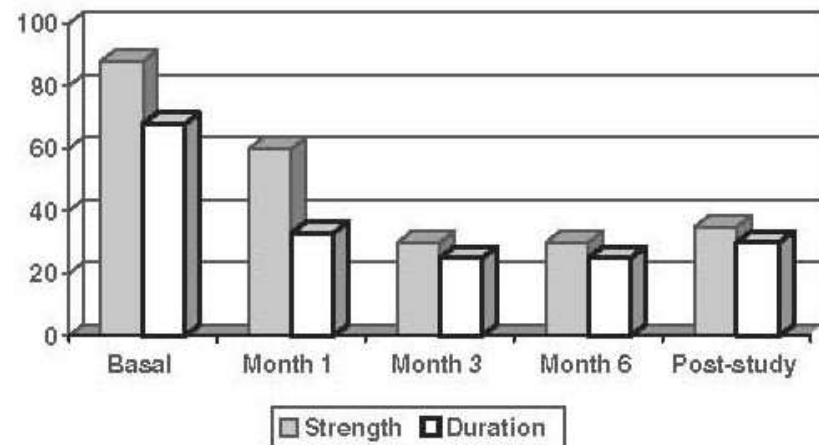


Fig. 3. Effect of BG-U (PMMA membrane) on the subjective assessment of uraemic itch: average values of eight patients who had previously been dialysed using low-flux membranes.



IL PRURITO UREMICO: UNA SFIDA NON RISOLTA

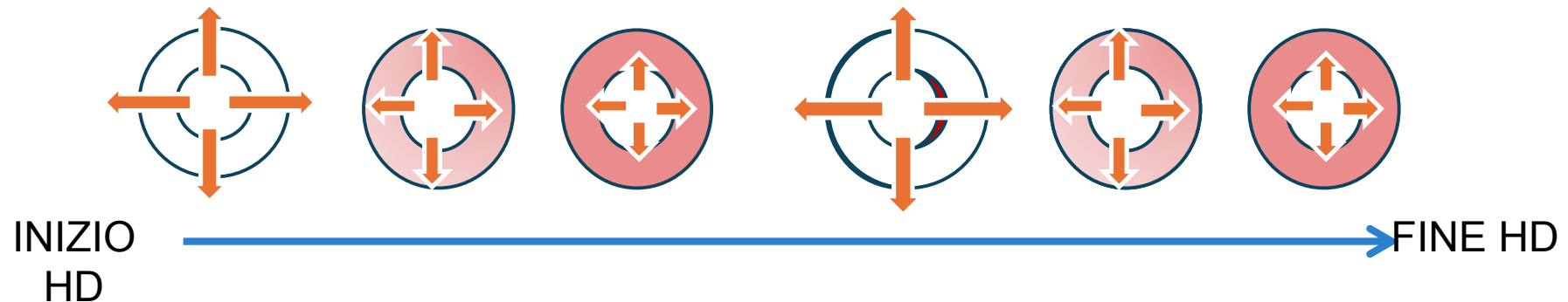
F. Aucella, A. Gesuete

Struttura Complessa di Nefrologia e Dialisi, Ospedale "Casa Sollievo della Sofferenza, Istituto di Ricovero e Cura a Carattere Scientifico, San Giovanni Rotondo (FG)

TABELLA III - ALGORITMO DI TRATTAMENTO DI UP

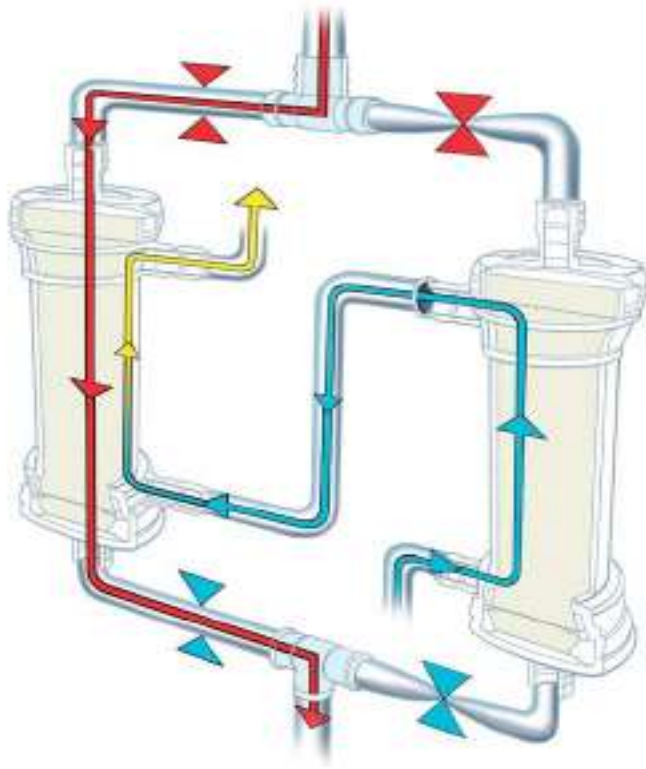
Toppe	Possibili opzioni terapeutiche	Livello di evidenza	Nomi commerciali e dose
STEP 1	<ul style="list-style-type: none"> Ottimizzare la dialisi: efficienza, biocompatibilità, uso di membrane in PMMA Controllo del metabolismo calcio-fosforo Controllo iperparatiroidismo secondario 	3	filtri serie BG-U, Estor
STEP 2	<ul style="list-style-type: none"> Emollienti ad alto contenuto di acqua 	3	Lenoxiol fluido, Leviax lozione, Cetafil crema; 2 applicazioni al di.
STEP 3	<ul style="list-style-type: none"> Creme alla Capsaicina allo 0,025% (<i>off-label</i>) Capsule o creme a base di acido γ-linolenico 	1	Cerotto Bertelli, Dolpyc, Capsolin; 2 volte al di. Primrose oil, 2 cps/die o Eucerin crema, 2 volte al di
STEP 4	<ul style="list-style-type: none"> Ciclo di terapia fisica con UVB (a banda ristretta) 	1	3 sedute a di alterni, indi 1 a settimana, sino a n. 9 sedute totali
STEP 5	<ul style="list-style-type: none"> Gabapentin post-dialisi (<i>off-label</i>) 	1	Neurontin, Gabapentin Teva, Gabapentin Sigma Tau; 100 mg post dialisi e successiva titolazione
STEP 6	<ul style="list-style-type: none"> Carbone attivo per os 	1	6 gr/die per os
STEP 7	<ul style="list-style-type: none"> Nalfurafina ev o Butorfanolo intranasale 	2	non ancora in commercio in Italia

ENHANCED ADSORPTION DIALYSIS

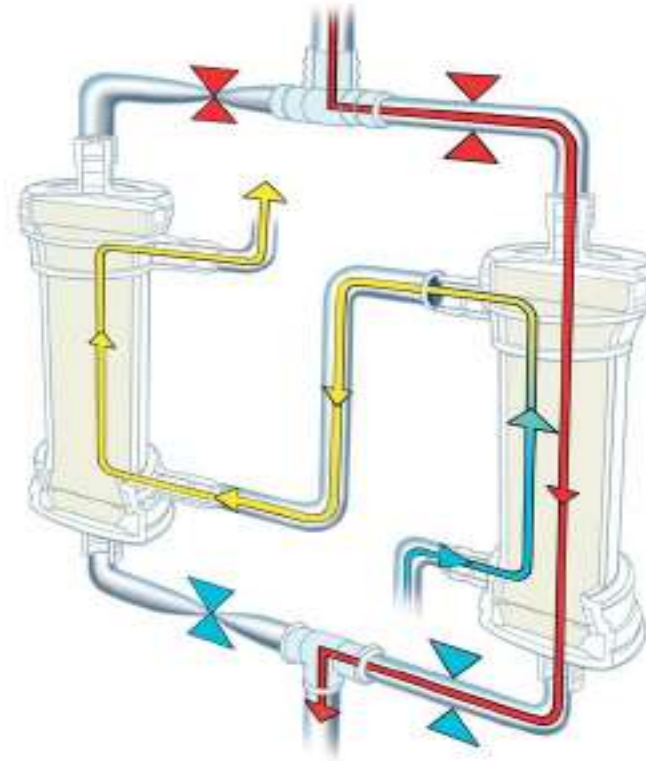


ENHANCED ADSORPTION DIALYSIS

PRIME DUE ORE



ULTME DUE ORE



Role of light chain clearance in the recovery of renal function in multiple myeloma: another point of view

Acute kidney injury (AKI) in patients with multiple myeloma (MM) requiring renal replacement treatment (RRT) is associated with high morbidity and mortality. Early reduction of serum free light chains (FLC) with adjuvant intensive hemodialysis (IHD) may improve renal outcomes. We aim to evaluate the impact on kidney function of IHD (PMMA dialysis membranes or HFR) vs. standard dialysis.

Methods



Multicentric retrospective study



25 patients (2011–2018)

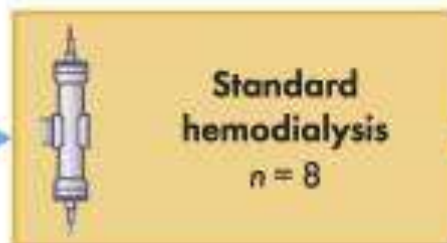
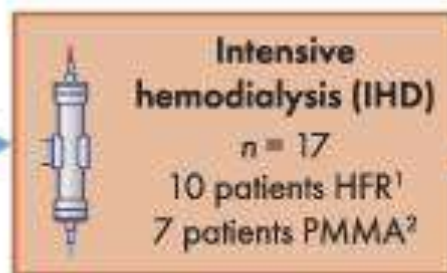


AKI related to de novo or first relapsed MM
 Need of RRT

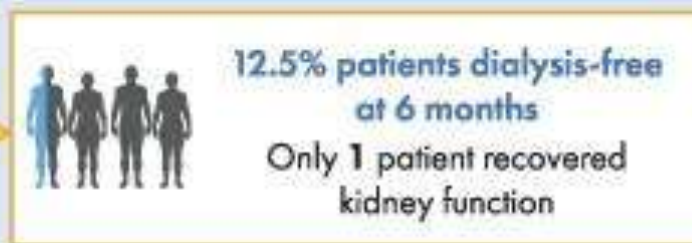
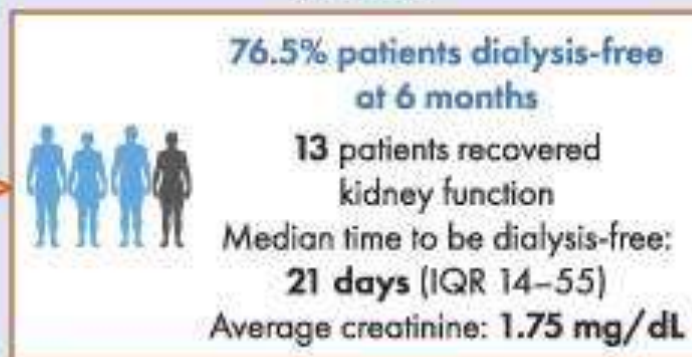


Same targeted MM therapy (84% bortezomib-based therapy)

¹HFR: hemodiafiltration with endogenous reinfusion
²PMMA: polymethylmethacrylate membranes



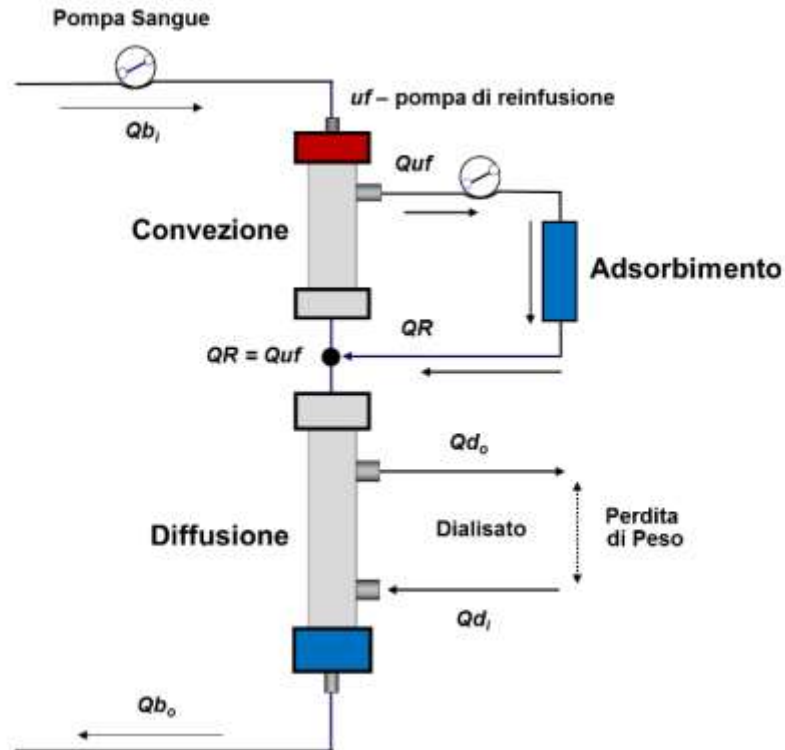
Results



Conclusion: Early reduction of FLC with IHD as an adjuvant treatment along with MM targeted therapy may exert a positive impact on renal recovery.

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 Clinical Kidney Journal (2023)
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HFR – HFR SUPRA



Evidence That p-Cresol and IL-6 Are Adsorbed by the HFR Cartridge: Towards a New Strategy to Decrease Systemic Inflammation in Dialyzed Patients?

Eleonora Riccio¹, Mauro Cataldi², Lucia Grumetto³, Loredana Postiglione⁴, Bruna Guida⁵, Bruno Maristella Minco¹, Gennaro Argentino¹, Roberta Russo¹, Stefania Brancaccio¹, Andrea Memoli¹ Memoli^{1*}

PLOS ONE. April 2014 | Volume 9 | Issue 4

	Before HFR	After HFR	Reduction Ratio (%)	Before HD	After HD	Reduction Ratio (%)
Albumin (g/dl)	3.6±0.2	4.2±0.3	-	3.8±0.3	4.2±0.2	-
Total Cresol (mg/l)	11.6±6.3	5.8±2.7*	53.6±12.5	8.6±5.3	5.4±3.0	37.1±20.2 [°]
IL-6 (pg/ml)	57.6±58.3	48.4±53.1	4.3±34.5	48.7±33.6	53.9±48.3	-

La mortalità della popolazione uremica in trattamento sostitutivo permane inaccettabilmente alta principalmente per cause cardiovascolari. È noto infatti che oltre i fattori di rischio tradizionali il paziente uremico presenta fattori non tradizionali come l'accumulo di tossine uremiche e una condizione di aumentata infiammazione



Criteri di inclusione

- Età > 18 anni
- Età dialitica > 6 mesi
- Portatore di FAV con Q_B di almeno 300-350 ml/min
- Consenso informato

Cross over

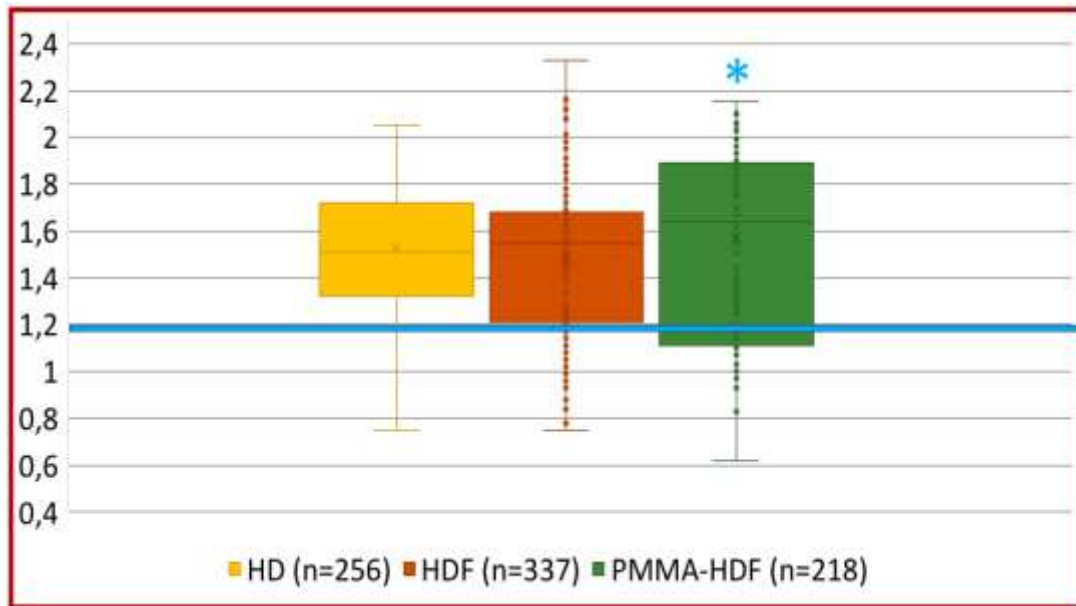
Gr. A	HD → HDF → PMMA-HDF
Gr. B	HDF → PMMA-HDF → HD
Gr. C	PMMA-HDF → HD → HDF

Prelievi

A seduta	Kt/V; Totale quota convettiva; durata metodica
Mensili	Hb; Ferritina; PCR; TnT; P; Urea; ALB
Trimestrali	Tossine: sFLC; β 2m; p-Cresol; p-Indoxyl Marker di flogosi: Epcidina; IL-6; TNF α ; CD40L; NGAL

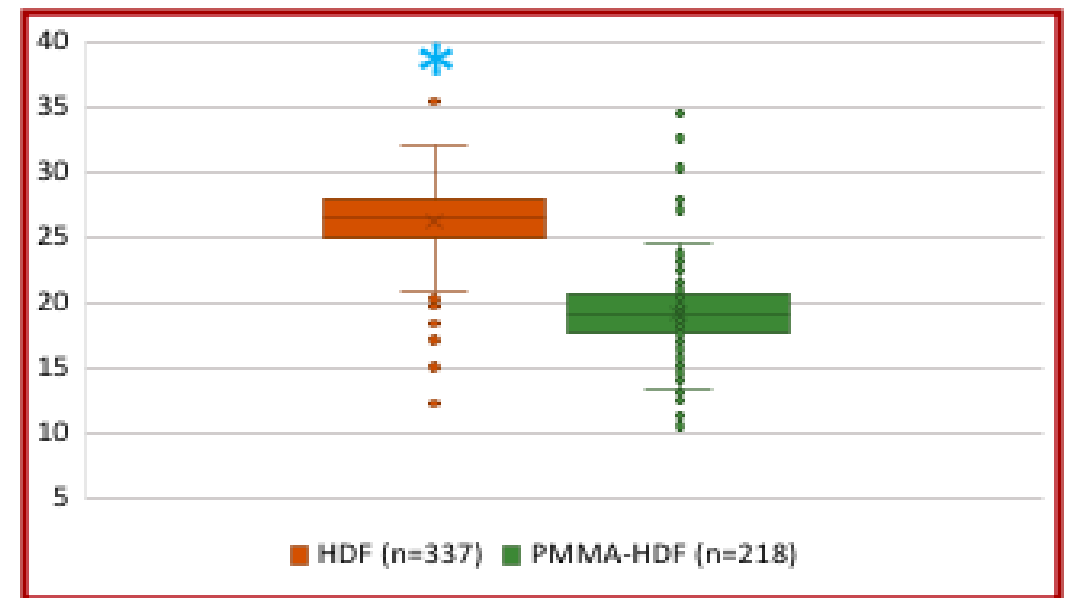
	HD (n=256)	HDF (n=337)	PMMA-HDF (n=218)
Durata seduta (min)	224	234	222

Kt/V

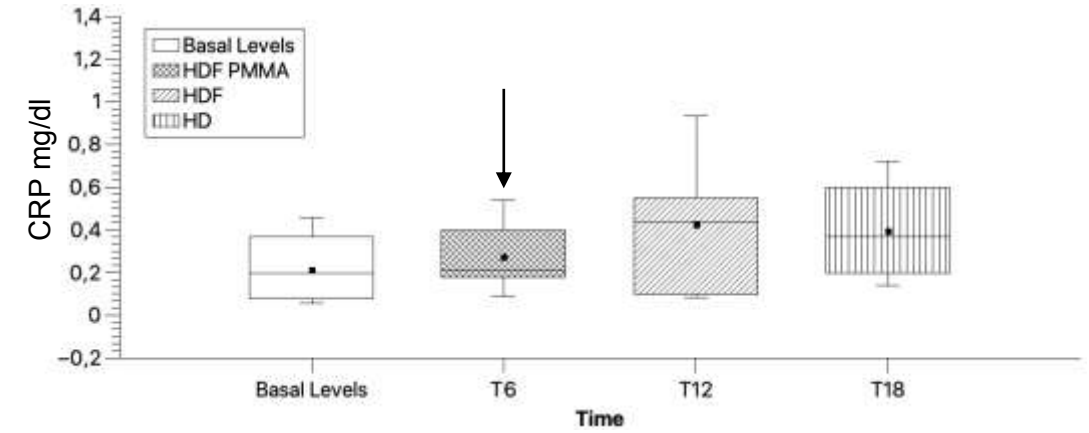
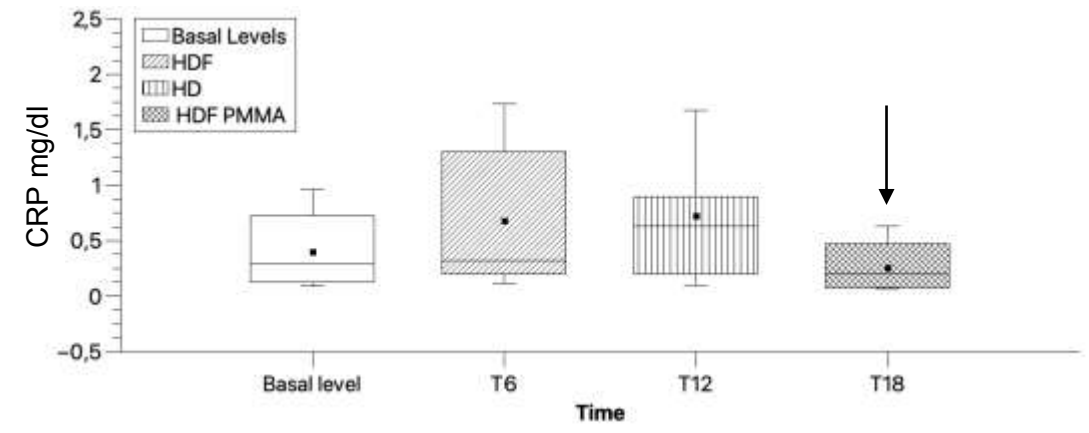
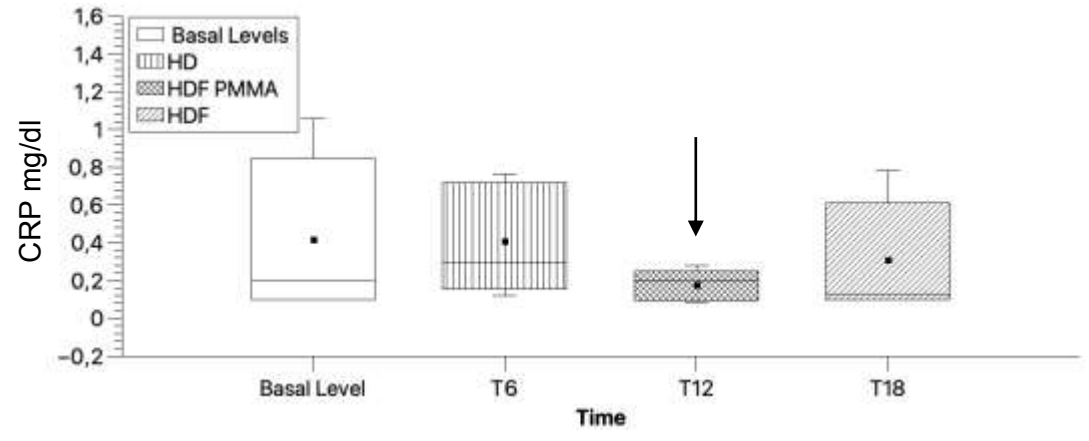
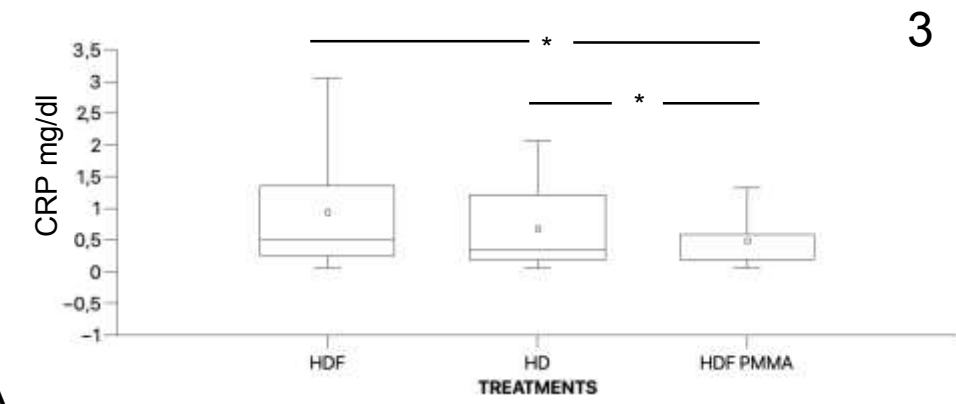
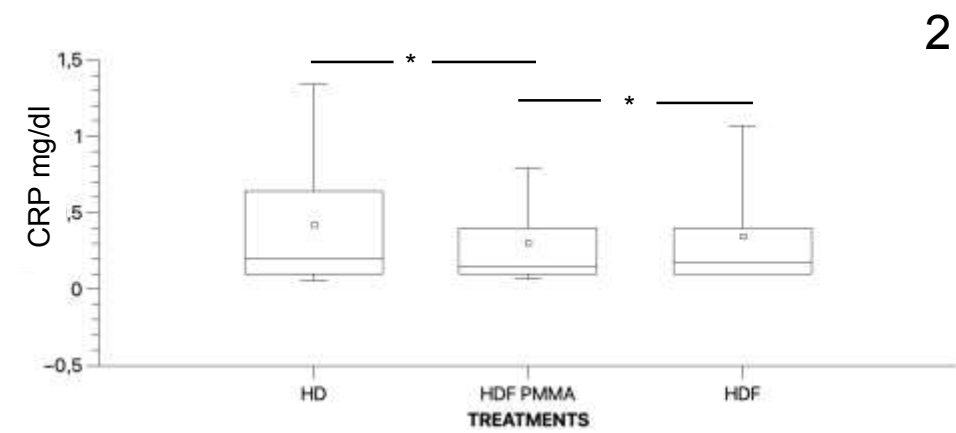
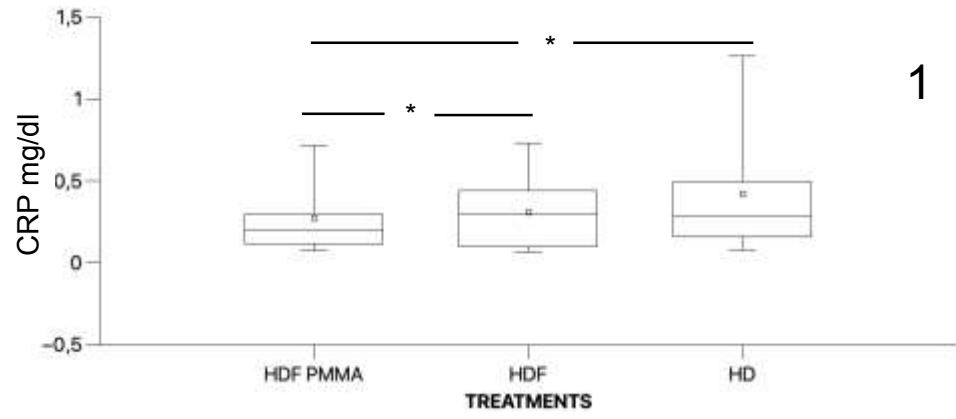


* p < 0.001 vs HDF

Volume convettivo (L / seduta)



* p < 0.05 vs PMMA-HDF

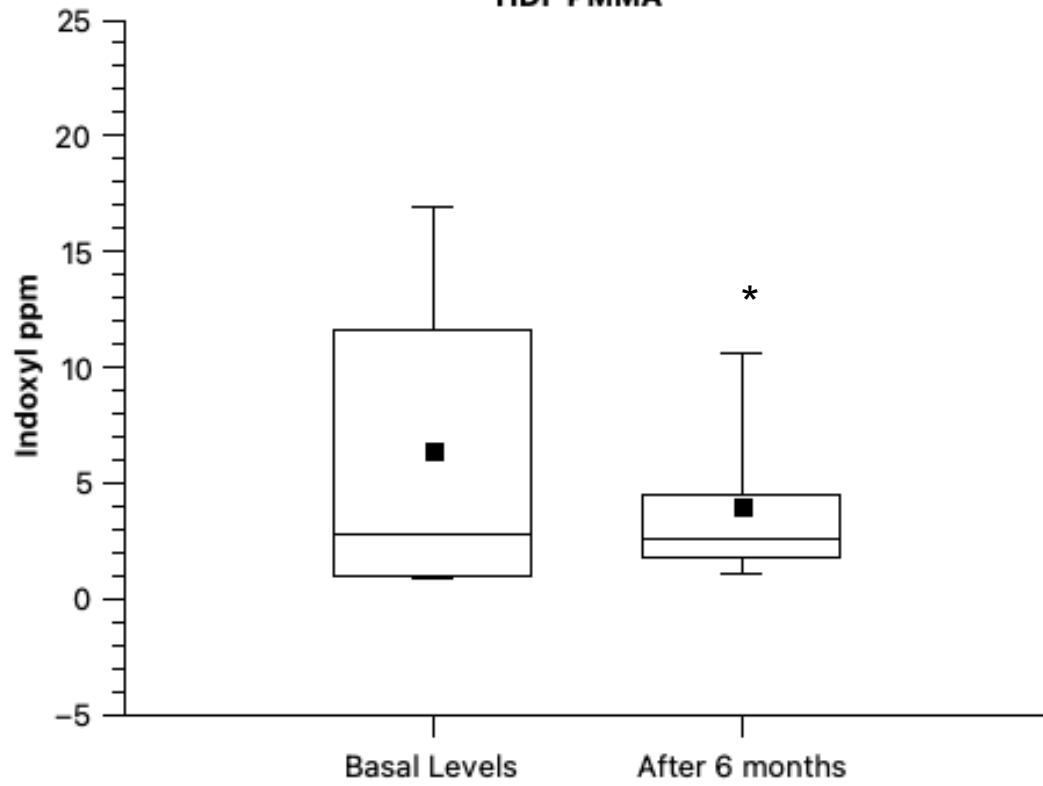


A

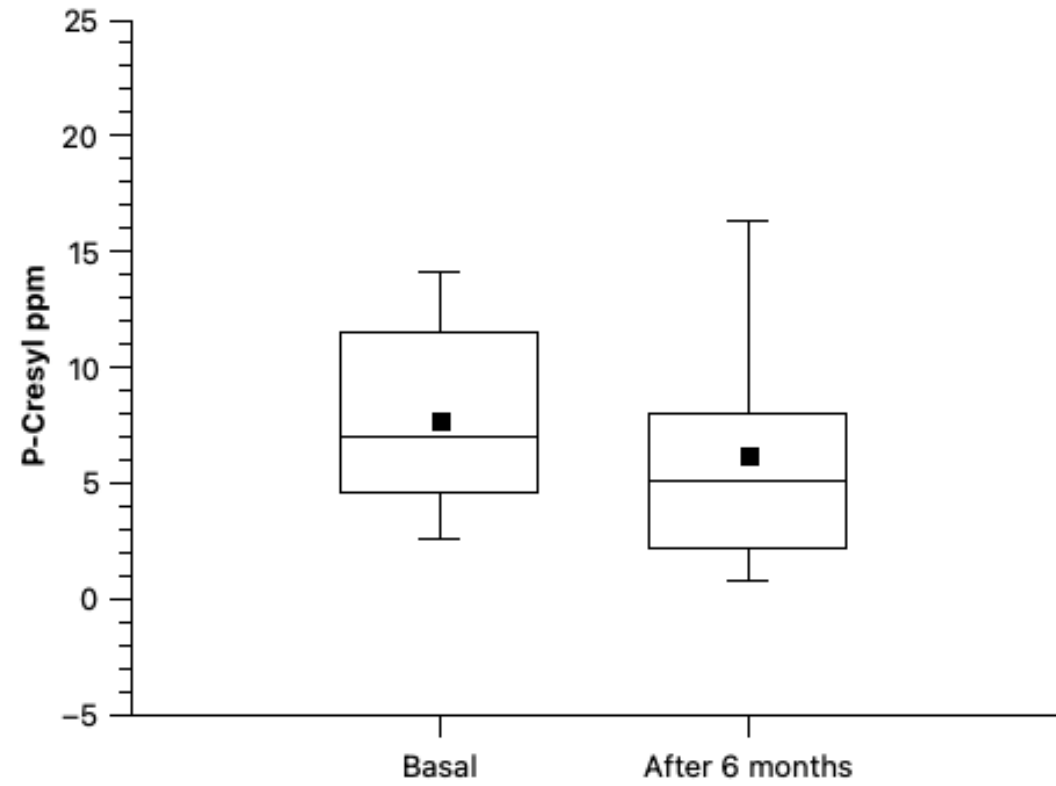
B

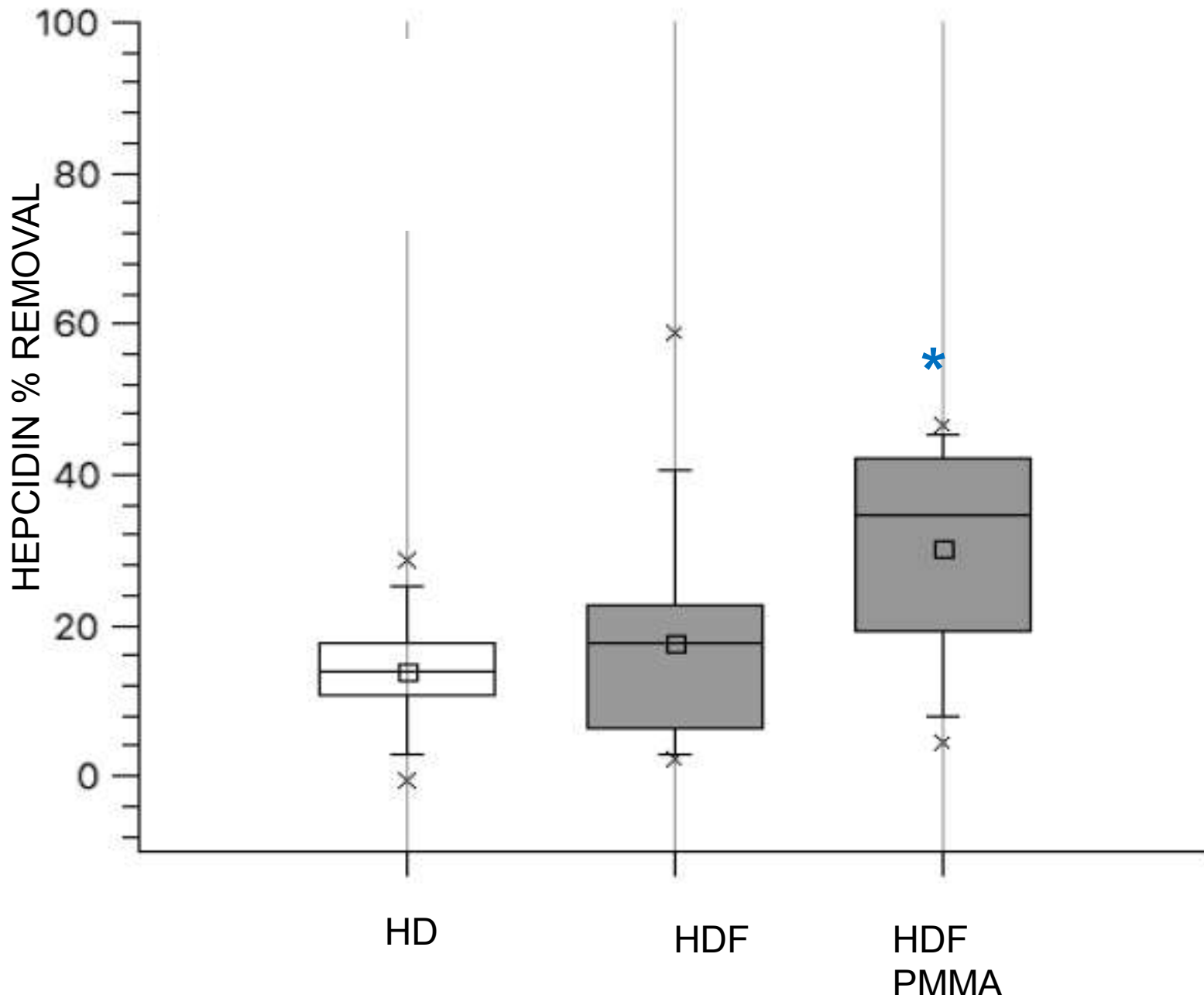
EFFETTO SULLE PBUT

HDF PMMA



HDF PMMA





LA HDF PMMA
ERA LA
METODICA PIÙ
EFFICENTE NEL
RIMUOVERE
HEPCIDINA NELLA
SINGOLA SEDUTA

NUOVE TIPOLOGIE DI PMMA: RIDOTTA L'ATTIVAZIONE PIASTRINICA

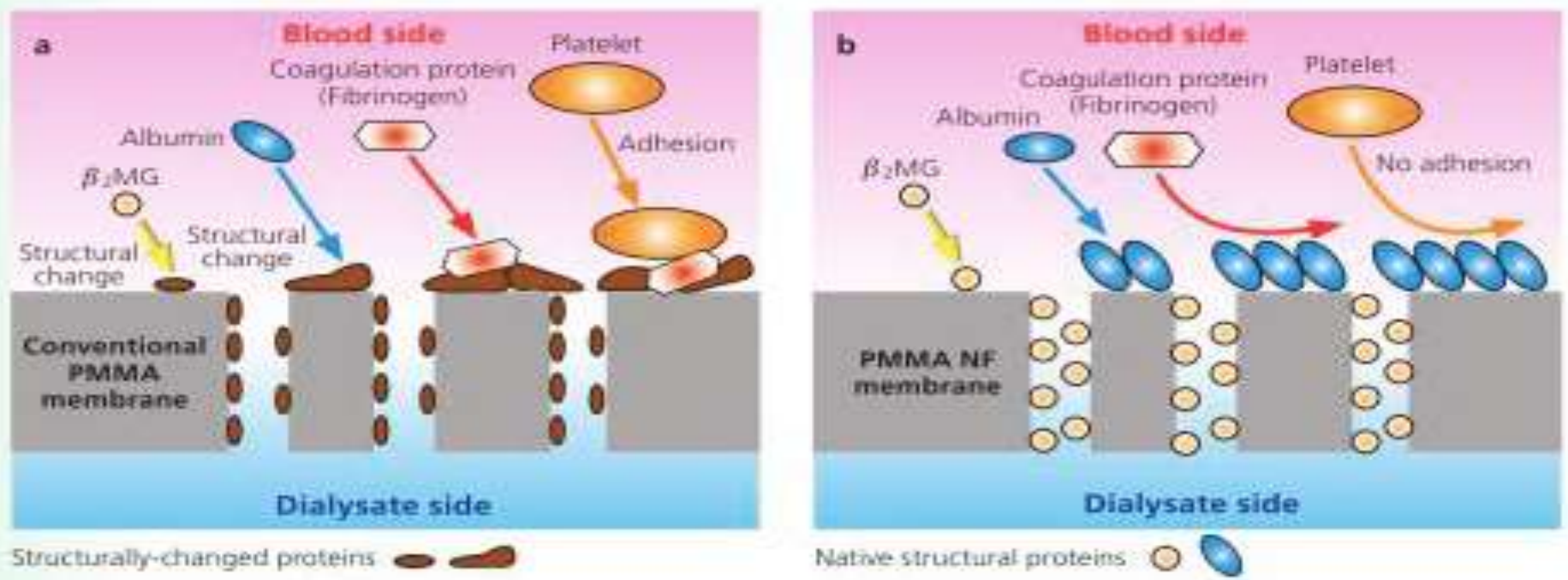


Fig.1 Schema of the protein adsorption mechanism on the PMMA membrane¹⁾

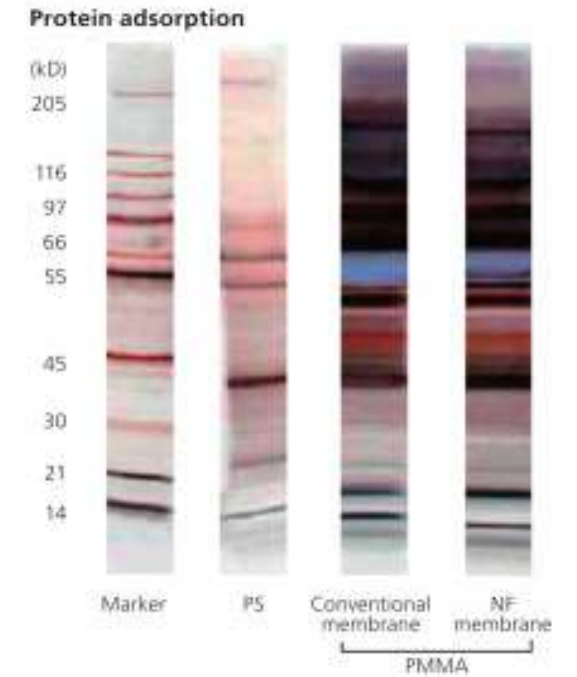


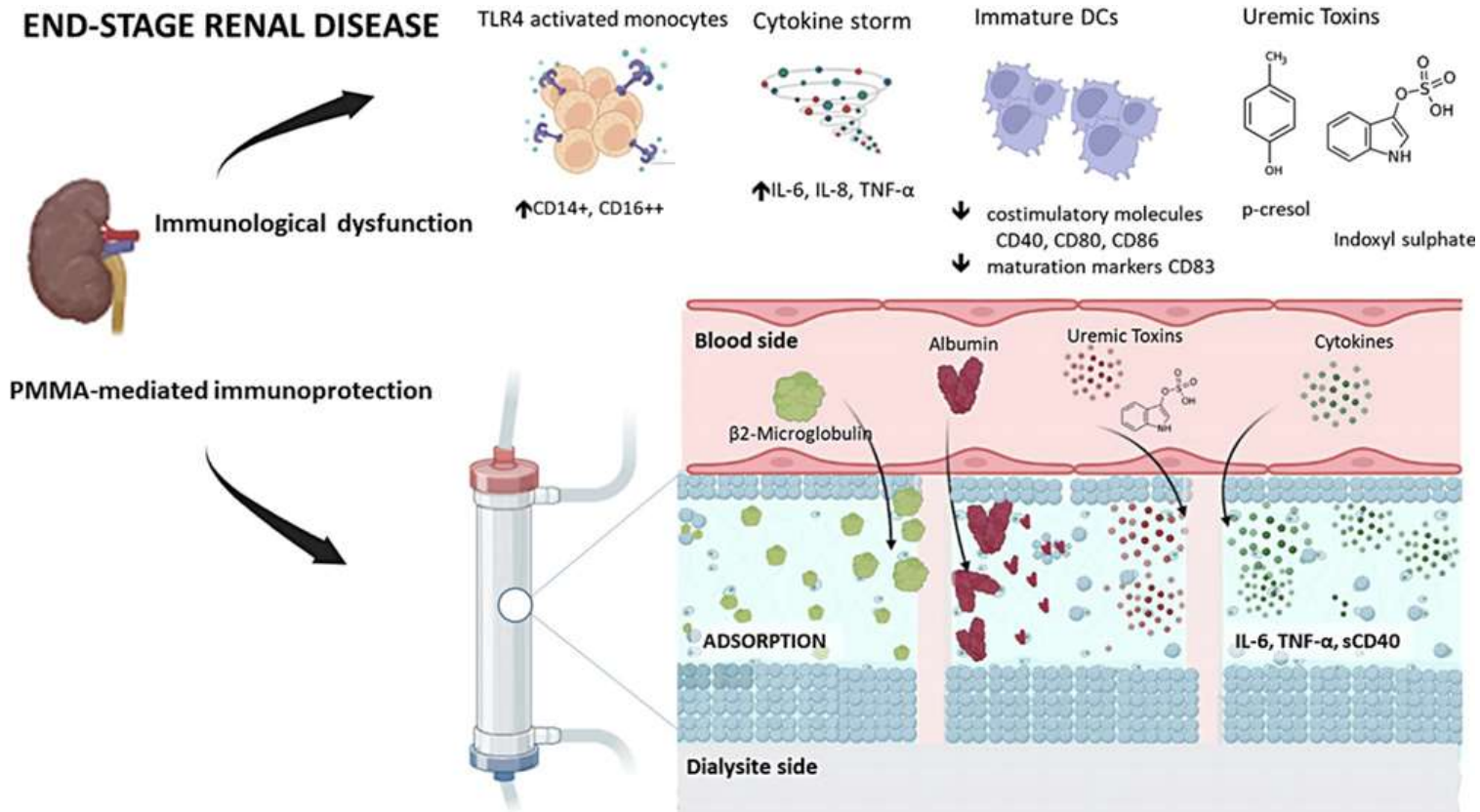
Fig.7 Electrophoretic patterns of proteins adsorbed by membrane^{2) 4)}

Specifications		NF-U Series			
Type		NF-1.3U	NF-1.6U	NF-1.8U	NF-2.1U
Fibers	Effective surface area (m ²)	1.3	1.6	1.8	2.1
	Effective length (mm)	195			
	Inside diameter (μm)	200			
	Membrane thickness (μm)	30			
Blood volume (mL)		83	103	118	135
Clearance (mL/min)*	Urea	233	246	254	260
	Creatinine	200	217	225	231
	Phosphate	182	198	208	217
	Vitamin B ₁₂	110	128	140	149
	Inulin	62	72	77	85
UFR in vitro (mL/hr/mmHg) **		32	38	45	48

* Clearance are typical data with aqueous solution. (Q_B: 300 mL, Q_D: 500±10 mL/min, Q_F: 10±2 mL/min, Temp.: 37±1 °C)

Enhancing Immune Protection in Hemodialysis Patients: Role of the Polymethyl Methacrylate Membrane

Rossana Franzina, Alessandra Stasi, Gianvito Caggiano, Elena Squicciarro, Vincenzo Losappio, Marco Fiorentino, Carlo Alfieri, Giovanni Stallone, Loreto Gesualdo, Giuseppe Castellano

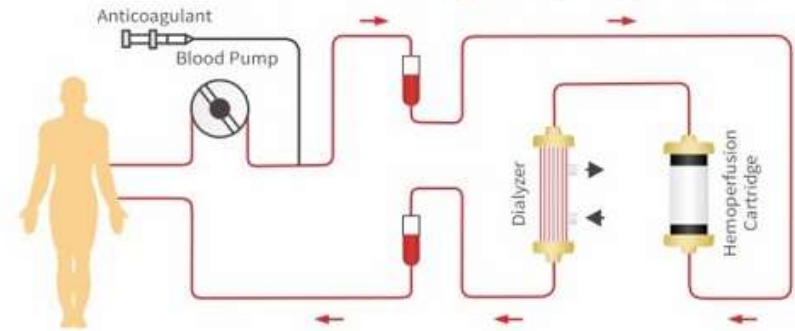


Minor attivazione del complemento ,
maggiore biocompatibilità
→
minor attivazione immunologica

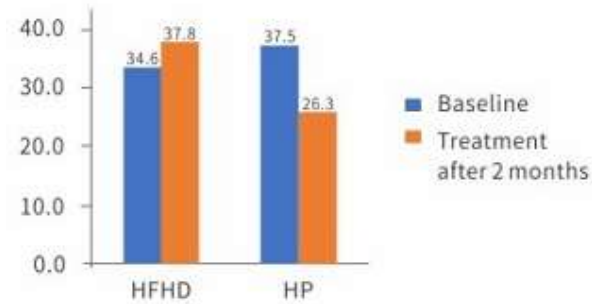
HEMOPERFUSION

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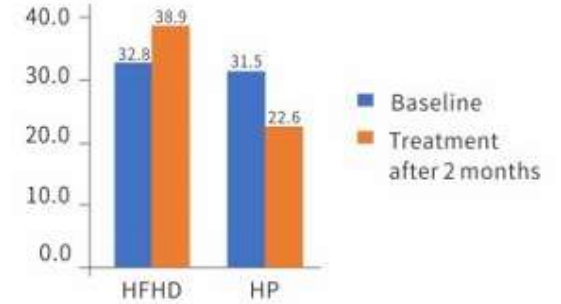
Advanced Technology · Simple Operation



Indoxyl Sulphate*

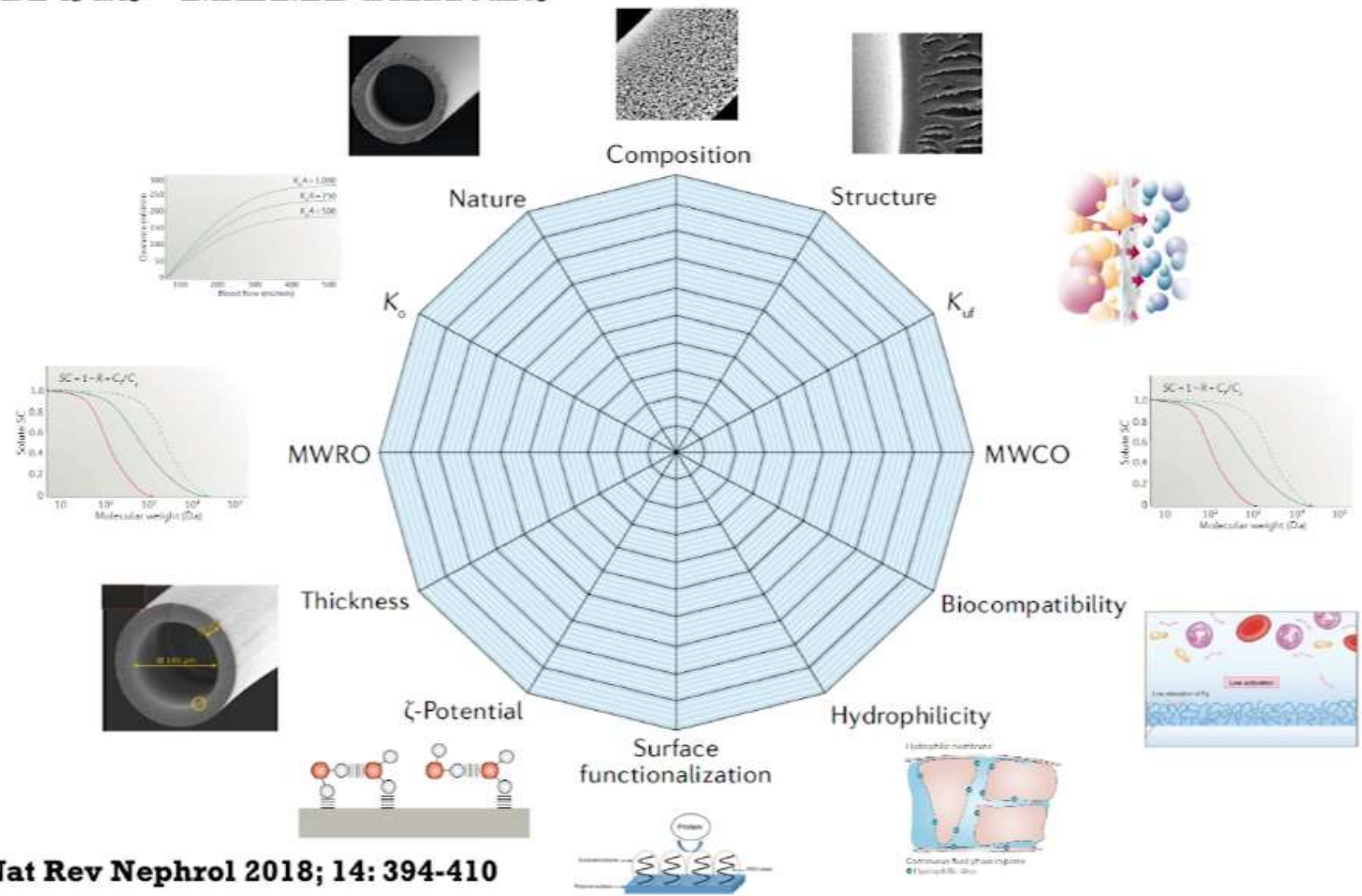


P-cresyl Sulphate*



*Unpublished data

MULTIDIMENSIONAL CLASSIFICATION OF DIALYSIS MEMBRANES



Ronco C, Clark WR. Nat Rev Nephrol 2018; 14: 394-410