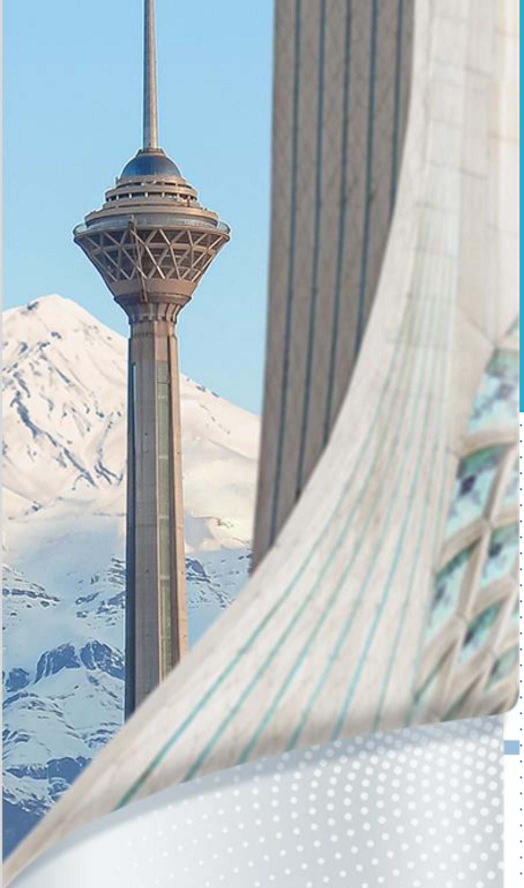


The 19th International Congress of Nephrology, Dialysis and Transplantation (ICNDT)

12-15 December 2023
Homa Hotel, Tehran

Nephrology and Transplantation Department
Labbafinejad Medical Center

Shahid Beheshti University of Medical Sciences

Social Security Organization of Islamic Republic of Iran

HDF Online

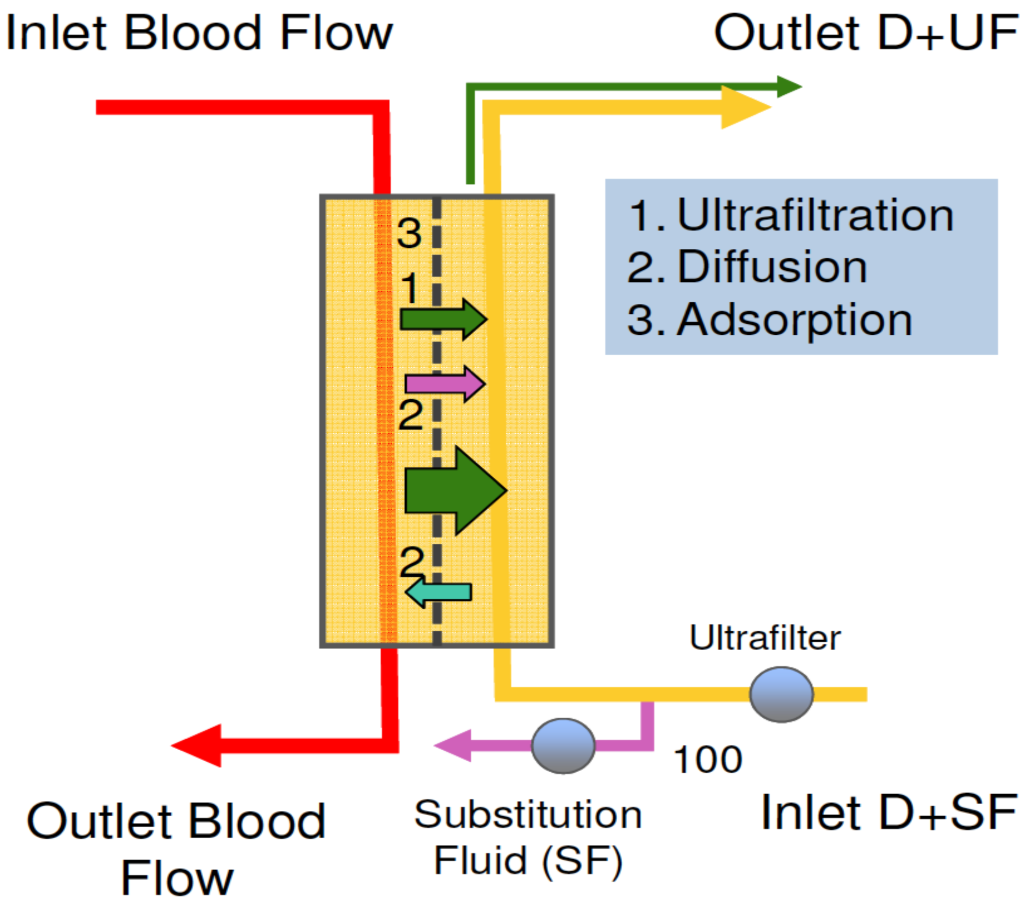
Nooshin Dalili, MD

Associate Professor of Nephrology

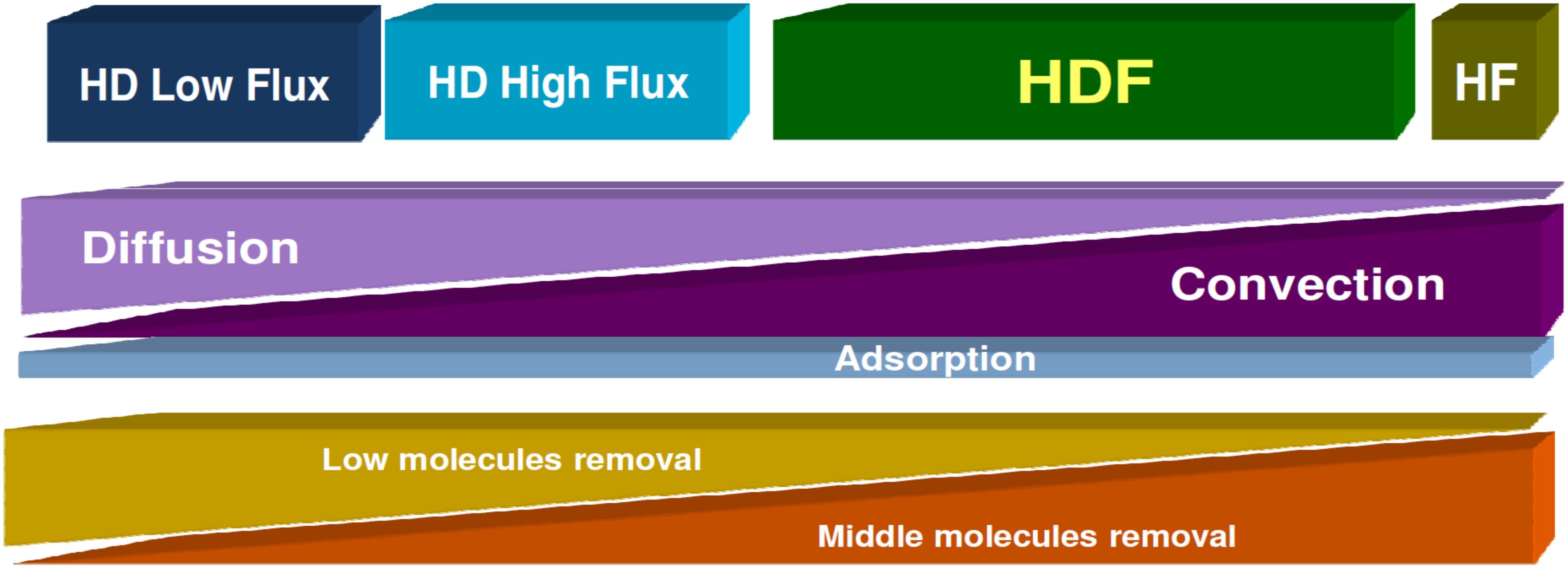
Labbafinejad Medical Center,SBMU

December, 2023

HDF combines diffusive, convective and adsorptive clearances in the same module



Hemodiafiltration enhances clearances of middle and large molecular weight solutes



Review

Blood Purification

Blood Purif 2015;40(suppl 1):2–11
DOI: 10.1159/000437403

Published online: September 8, 2015

Hemodiafiltration: Technical and Clinical Issues

Claudio Ronco

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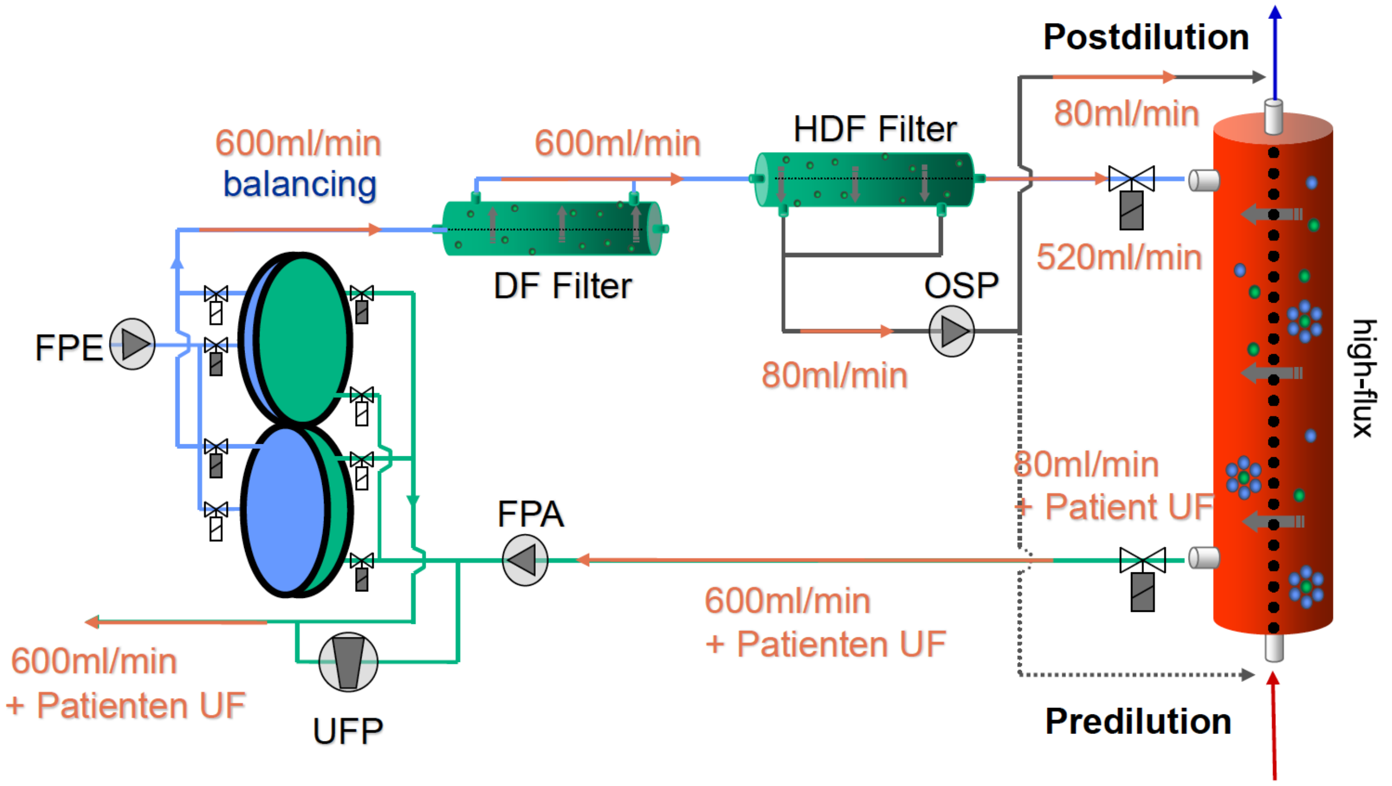
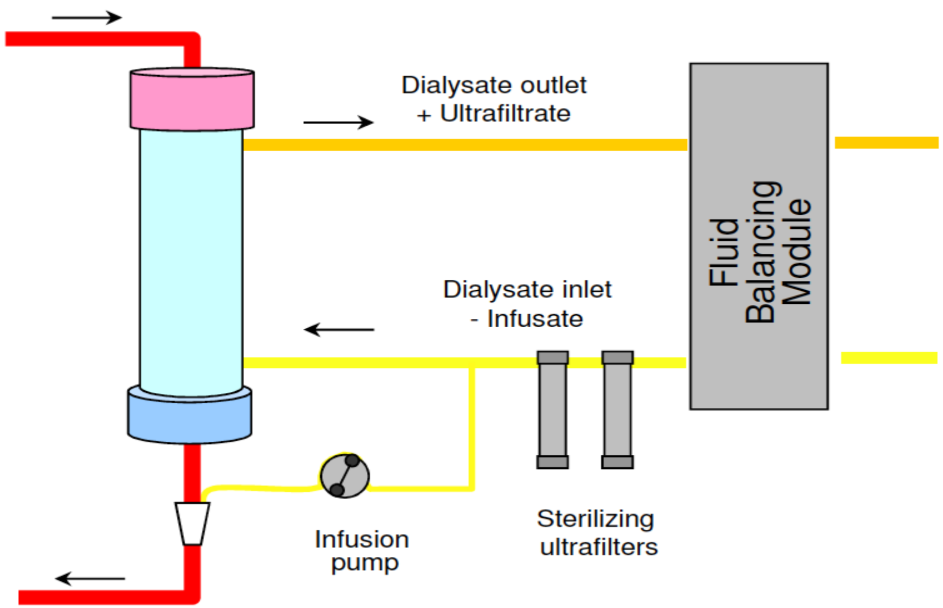
HDF On-line



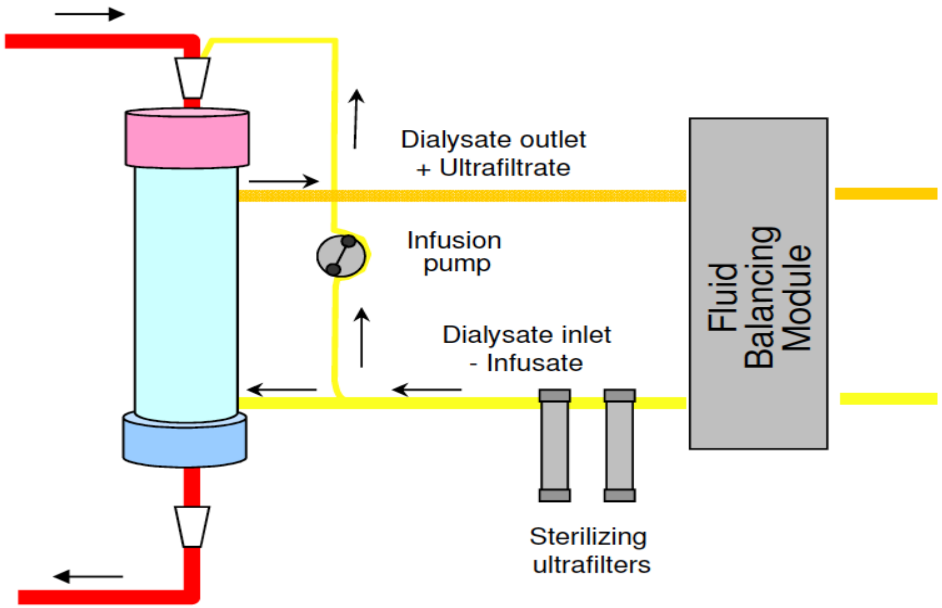
Blood Purif 2015;40(suppl 1):2–11
DOI: 10.1159/000437403

Online HDF, Modalities of substitution



Post-dilution on-line HDF

Volume of substitution ≈ 25l/ses

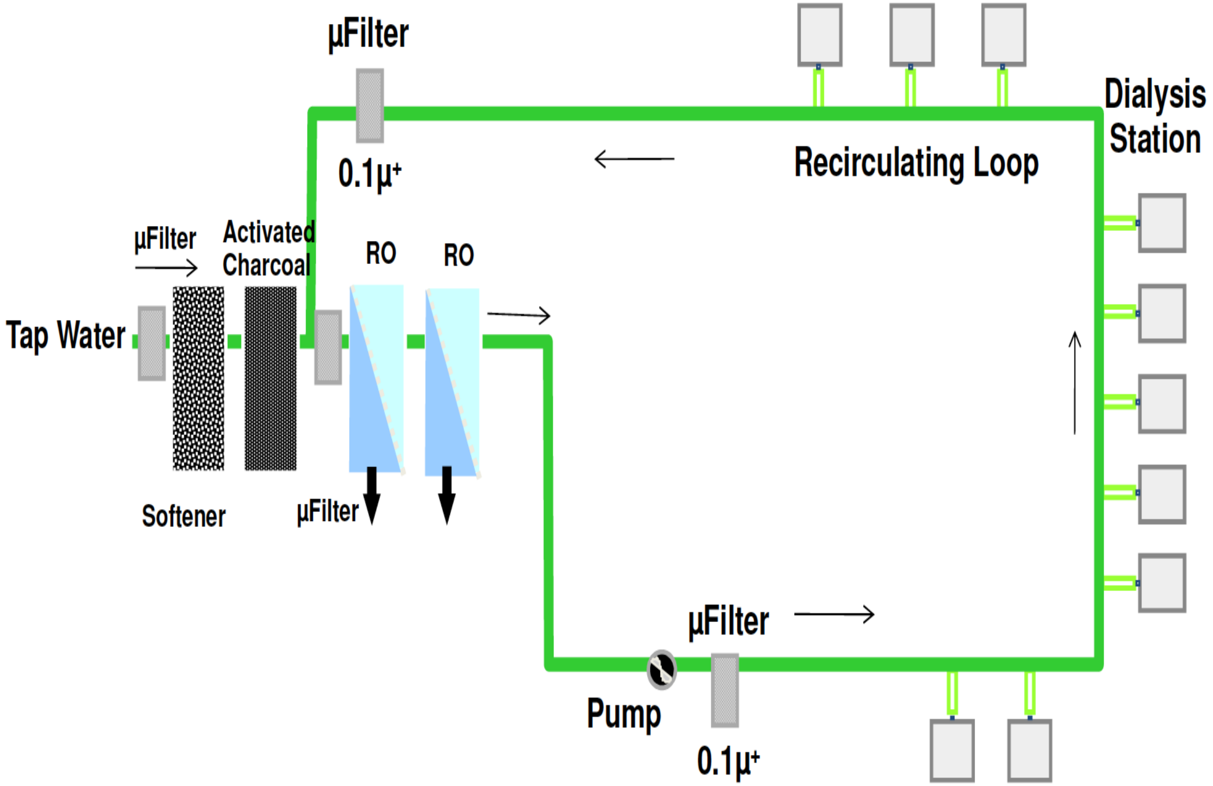


Pre-dilution on-line HDF

Volume of substitution ≈ 50l/ses

Blood Purif 2015;40(suppl 1):2–11
DOI: 10.1159/000437403

Water treatment system to produce ultrapure water



Water and dialysis fluid tend to the same degree of microbiological purity

International standards of water and dialysis fluid			
Maximum levels	Regular Water	Ultrapure Water	Ultrapure Dialysis Fluid
Microbial contamination (CFU/ml) *Sensitized methods*	<100	<0.1	<0.1
Bacterial endotoxins (IU/ml) *LAL*	<0.25	<0.03	<0.03

Nephrol Dial Transplant (2002) 17 [Suppl 7]: 45–62

		Hi 18				Hi 20				Hi 23			
Dialysate flow (Q_D) mL/min		500	500	500	800	500	500	500	800	500	500	500	800
Blood flow (Q_B) mL/min		200	300	400	500	200	300	400	500	200	300	400	500
Clearance Ultrafiltration flow (Q_F)=0mL/min	Urea	198	281	341	414	199	287	349	427	199	290	354	439
	Creatinine	194	263	304	372	196	271	316	390	197	276	324	403
	Phosphate	194	263	297		196	271	309		198	277	320	
	Vitamin B_{12}	155	184	210	239	161	195	220	259	166	204	227	272
SC, (Sieving Coefficient) Q_B = 300 mL/min Q_F = 60mL/min	β_2-Microglobulin	> 0.8											
	Albumin	< 0.001											
Ultrafiltration coefficient mL/h/mmHg Q_B = 300mL/min		99				111				124			
KoA Urea (Q_B = 300mL/min, Q_D = 500mL/min)		1450				1714				1900			
Volume of blood compartment (mL)		110				125				141			
Membrane material		amembris polysulfone											
Surface area (M^2)		1.8				2.0				2.3			
Sterilization		Oxygen-free gamma											
Wall thickness/inner diameter (µm)		35/195											
Units per box		20											

Table 1. Summary of middle molecules (*n*=59)

Removed by High Flux (<15 kD)	Molecular Mass, kD	Removed by HDF (15–24.9 kD)	Molecular Mass, kD	Not Currently Removed (>25 kD)	Molecular Mass, kD
Methionine-enkephalin	0.5	Clara cell protein	15.8	Hyaluronic acid	25
Glutathione	0.6	Leptin	16	β-Trace protein	26
Angiotensin A	0.8	Myoglobin	17	Soluble TNF receptor-1	27
δ–Sleep-inducing peptide	0.8	TNF-α	17	Adiponectin	30
Dinucleoside polyphosphates	1	Soluble TNF receptor-2	17	FGF-23	32
Substance P	1.3	IL-1β	17.5	α1-Microglobulin	33
Motilin	2.7	FGF-2	18	VEGF	34.2
Orexin B	2.9	IL-10	18	YKL-40	40
Atrial natriuretic peptide	3	Retinol binding protein	21.2	Pentraxin-3	40.2
Desacylgherlin	3.2	Prolactin	22	α1-Acid glycoprotein	43
Vasoactive interstinal peptide	3.3	κ-Ig light chain	22.5	AGEs	45
Calcitonin	3.4	Complement factor D	23.75	λ-Ig light chain	45
Gherlin	3.4	IL-18	24	Visfatin	55
β-Endorphin	3.4	IL-6	24.5	AOPPs	>60
Orexin A	3.5				
Calcitonin gene–related peptide	3.7				
Cholecystokinin	3.8				
Endothelin	4.2				
Neuropeptide Y	4.2				
SIAM-1	4.2				
Adrenomedullin	5.7				
Osteocalcin	5.8				
IGF-1	7.6				
IL-8	8				
Parathyroid hormone	9.5				
Guanylin	10.3				
β2-Microglobulin	11.8				
Uroguanylin	12				
Resistin	12.5				
Cystatin C	13.3				
Degranulation inhibiting protein[a]	14.1				

Thirty-one molecules had molecular mass under 15 kD, and therefore, they can be removed by high-flux dialysis. Fourteen molecules had molecular mass between 15 and 25 kD, and therefore, they can be removed by HDF. Fourteen molecules had molecular mass >25 kD. HDF, hemodiafiltration; FGF, fibroblast growth factor; VEGF, vascular endothelial growth factor; AGE, advanced glycosylation end product; AOPP, advanced oxidative protein products.

[a]Degranulation inhibiting protein corresponds to angiogenin.

Clin J Am Soc Nephrol 13: 805–814, 2018.

Table 3. Involvement of large middle molecules with cardiovascular disease

Middle Molecule	Association	Possible Mechanisms
IL-18	Cardiovascular mortality; aortic pulse wave velocity; unstable coronary plaque; coronary and thoracic aortic calcification	Promotion of atherosclerotic plaque instability, induction of IFN-γ, promotion of collagen and lipid deposition
IL-6	Left ventricular hypertrophy, systolic dysfunction; cardiovascular mortality	Coordination of local inflammatory cell influx and lymphocyte proliferation; promotion of coagulation
IL-1β	Left ventricular hypertrophy	Promotion of local inflammatory response within plaque
TNF-α	Left ventricular hypertrophy	Promotion of cardiac inflammatory response to stress
Pentraxin-3	Unstable coronary plaque	Infiltration of neutrophils into atherosclerotic plaque, prothrombotic effects, impairment of NO production
β-Trace protein	Atherosclerotic plaque; cardiovascular mortality	Possible functions acting against platelet aggregation *via* catalyzation of PGD2 production
Prolactin	Cardiovascular mortality	Proliferation of vascular smooth muscle cells, promotion of vasoconstriction
AGEs	Cardiovascular mortality	Deposition within vessel wall; induction of oxidative stress, inflammation, and endothelial dysfunction
Visfatin	Unstable atherosclerotic plaque	Induction of inflammatory macrophages within atherosclerotic plaque
Adiponectin	Atherosclerotic plaque	Expression of adhesion molecules; foam cell formation
Leptin	Atherosclerotic plaque	Expression of adhesion molecules; production of MCP-1, IL-6, and TNF-α
FGF-2	Cardiac hypertrophy	Induction of cardiomyocyte hypertrophic response
FGF-23	Cardiac hypertrophy	Induction of cardiomyocyte hypertrophic response

NO, nitric oxide; AGE, advanced glycosylation end products FGF, fibroblast growth factor.

Clin J Am Soc Nephrol 13: 805–814, 2018.

Original Paper

Blood Purification

Blood Purif 2015;40:53–58
DOI: 10.1159/000430903

Received: October 14, 2014
Accepted: April 23, 2015
Published online: June 24, 2015

Treatment Time or Convection Volume in HDF: What Drives the Reduced Mortality Risk?

Table 2. Results

	HD patients; convection volume 0 l (n = 356)	HDF patients; convection volume <18.18 l (n = 115)	HDF patients; convection volume 18.18–21.95 l (n = 114)	HDF patients; convection volume ≥21.95 l (n = 115)
Crude	1.0	0.95 (0.66–1.38)	0.83 (0.57–1.21)	0.61 (0.41–0.93)[c]
Adjusted[a]	1.0	0.78 (0.52–1.16)	0.83 (0.56–1.23)	0.62 (0.41–0.95)[c]
Adjusted including treatment time[b]	1.0	0.74 (0.49–1.12)	0.83 (0.56–1.23)	0.64 (0.42–0.98)[c]

HRs for death of participants treated with HDF divided in tertiles of achieved convection volume as compared to participants treated with HD (reference group, HR 1.0); HRs with 95% confidence intervals.

[a] Adjusted for: center differences, age, sex, previous vascular disease, diabetes, previous transplantation, baseline residual kidney function, baseline albumin, baseline creatinine, baseline hematocrit, vascular access and use of α- and β-blockers, RAS inhibitors and calcium antagonists at baseline (208 events, 75 missing). [b] Adjusted for all confounders mentioned above plus treatment time (208 events, 75 missing). [c] Indicates a significant difference in all-cause mortality risk at the level of $p \leq 0.05$.

Survival benefit of high-volume HDF over HD is independent of treatment time.

Blood Purif 2015;40:53–58
DOI: 10.1159/000430903

Dialysis

Short-term Effects of Online Hemodiafiltration on Phosphate Control: A Result From the Randomized Controlled Convective Transport Study (CONTRAST)

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Marinus A. van den Dorpel, MD, PhD,[3] Muriel P.C. Grooteman, MD, PhD,[2,4]
Renée Lévesque, MD,[5] Menso J. Nubé, MD, PhD,[2,4] Michiel L. Bots, MD, PhD,[6]
Peter J. Blankestijn, MD, PhD,[1] and Piet M. ter Wee, MD, PhD,[2,4] on behalf of the CONTRAST Investigators

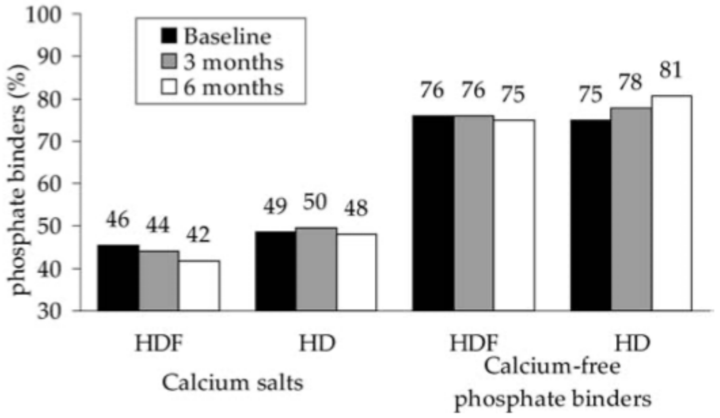


Figure 2. Proportion of patients using calcium salts and calcium-free phosphate binders at baseline and after 3 or 6 months of follow-up. Numbers above bars represent percentages. Abbreviations: HD, hemodialysis; HDF, hemodiafiltration.

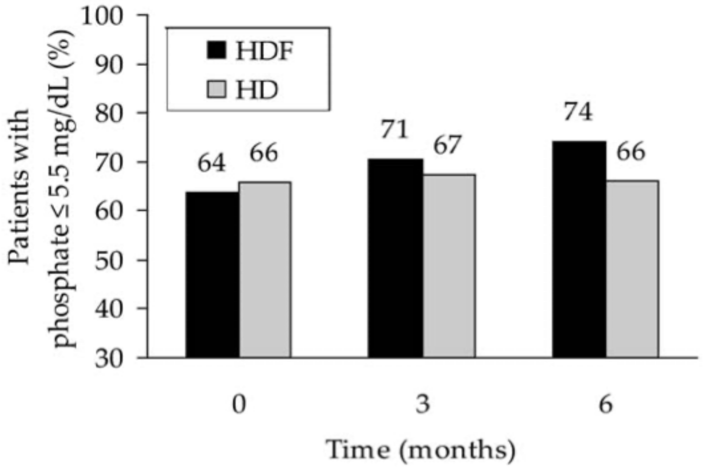
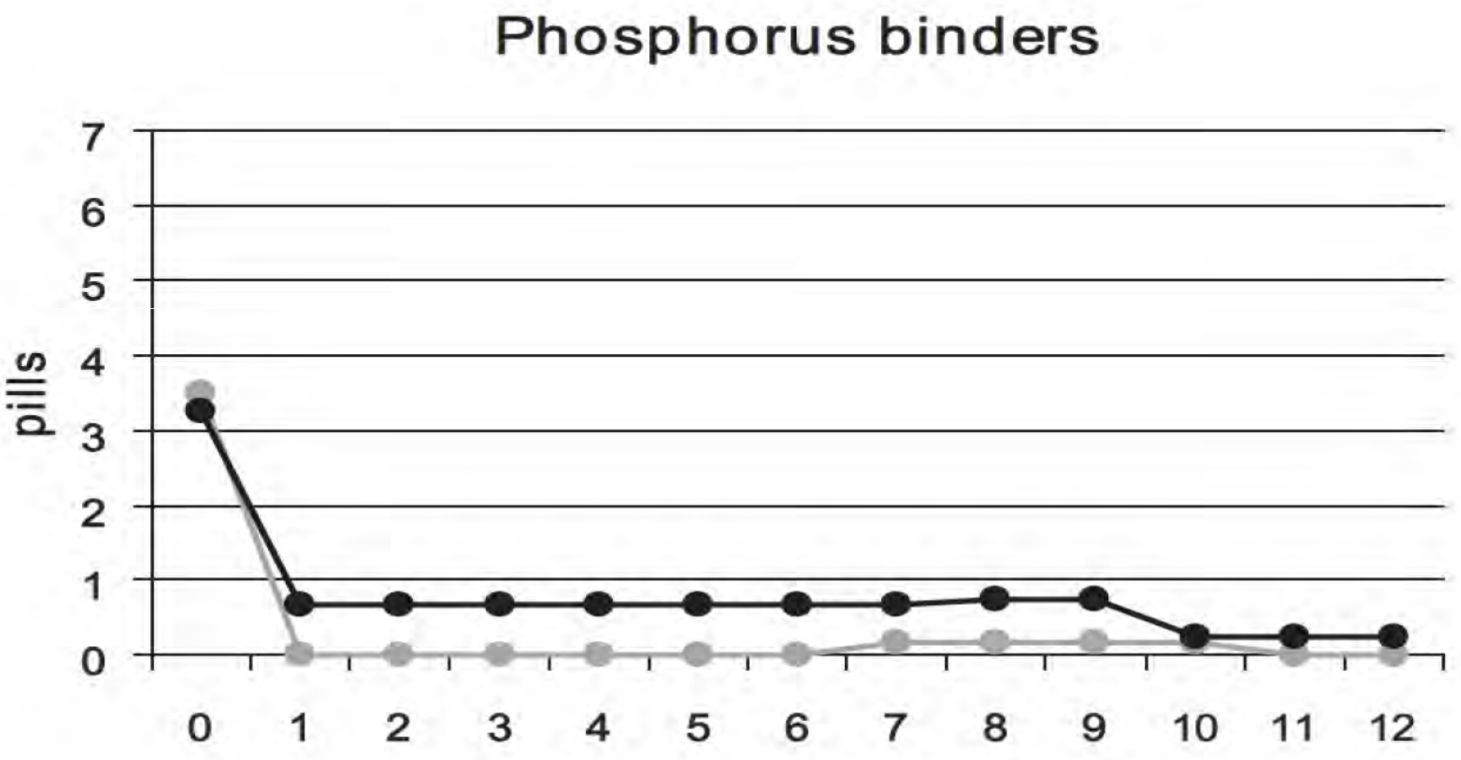
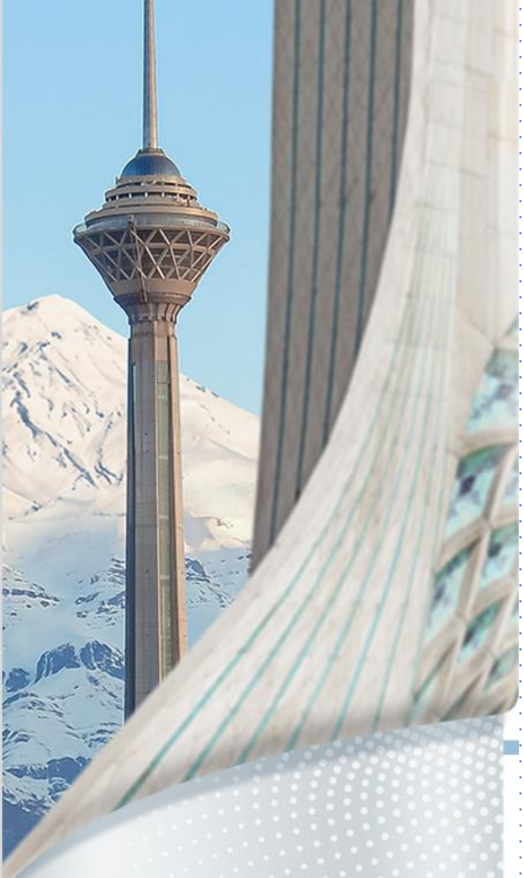


Figure 3. Proportion of patients achieving phosphate treatment targets at baseline and after 3 or 6 months of follow-up. Numbers above bars represent percentages. [a]$P < 0.05$ (vs baseline); [b]$P < 0.05$ (difference in change between groups). Abbreviations: HD, hemodialysis; HDF, hemodiafiltration.

Considerable reduction of phosphate binders consumption



Maduell F et al, *Nephro Dial Transplant*. 2011; 0:1-13 ePub 13Sep2011



The 19th International Congress of Nephrology, Dialysis and Transplantation (ICNDT)

12-15 December 2023
Homa Hotel, Tehran

β_2 microglobulin

Hakim Vs Labbafinejad

	Baseline	6 months	12 months	Period 1	Period 2
				P: baseline vs 6 months	P: 6 months vs 12 months
Study group: n=30 OL-HDF					
eKt/V	1.20±0.08	1.21±0.08	1.34±0.11	NS	<0.0001
β_2 microglobulin (mg/dL)	35.0±9.6	34.9±9.2	24.5±9.0	NS	<0.0001
Controls: n=35 Low Flux HD					
eKt/V	1.22±0.06	1.23±0.07	1.22±0.06	NS	NS
β_2 microglobulin (mg/dL)	36±12	37±13	37±11	NS	NS

Original Report: Patient-Oriented, Translational Research

American Journal of Nephrology

Am J Nephrol 2008;28:949–957
DOI: 10.1159/000142724

Received: March 2, 2008
Accepted: May 15, 2008
Published online: July 2, 2008

Inflammation and Oxidative Stress in Patients on Hemodiafiltration

Vasilis Filiopoulos[a] Dimitrios Hadjiyannakos[a] Polixeni Metaxaki[a]
Vasilis Sideris[b] Lambrini Takouli[a] Angeliki Anogiati[b]
Dimosthenis Vlassopoulos[a]

[a]Nephrology Department, A. Fleming Hospital and [b]Hematology Department, Pendeli Pediatric Hospital, Athens, Greece

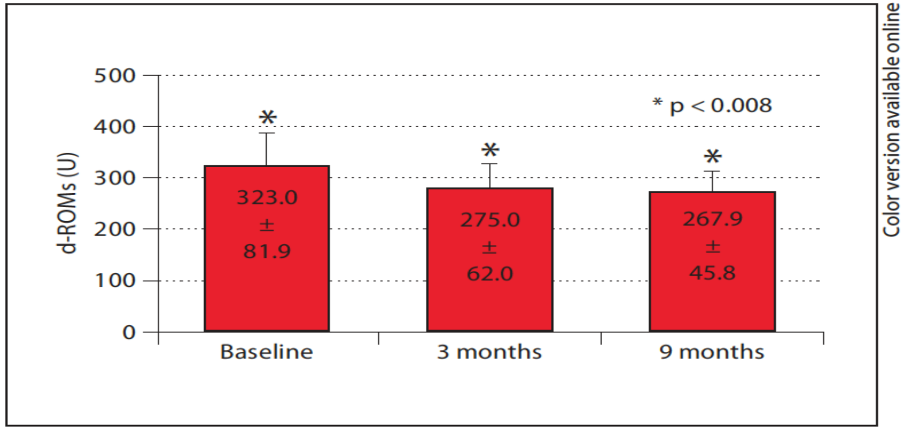


Fig. 1. Variations in plasma d-ROM levels during the study.

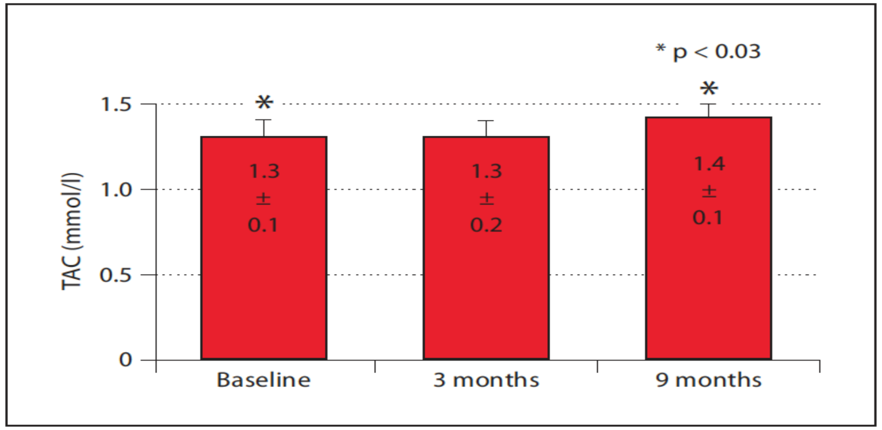


Fig. 2. Variations in plasma TAC levels during the study.

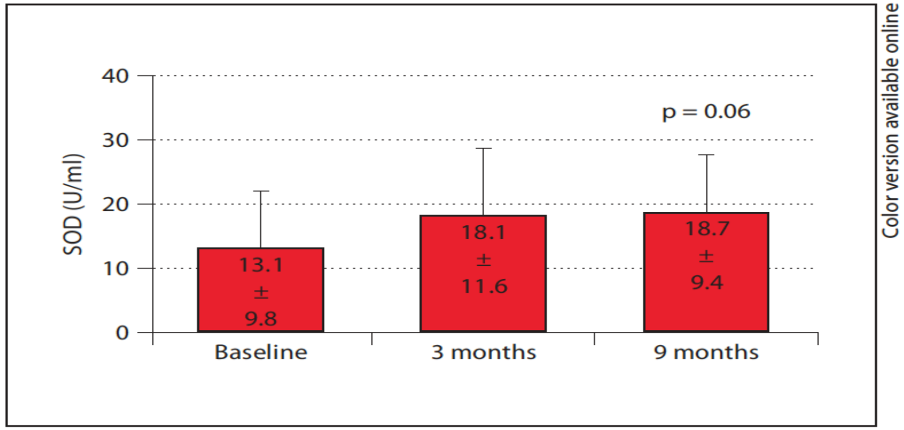


Fig. 3. Variations in plasma SOD levels during the study.

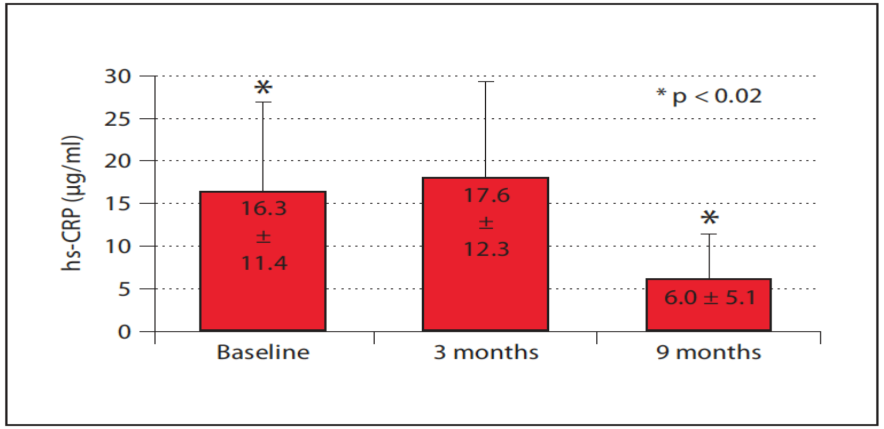


Fig. 4. Variations in plasma hs-CRP levels during the study.

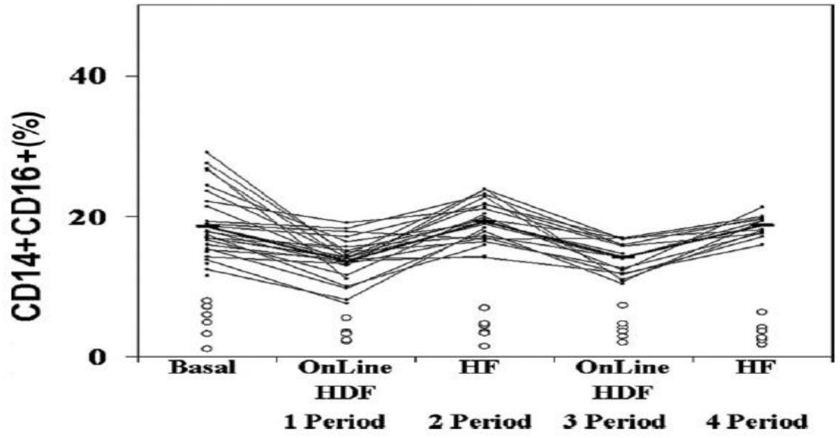
Am J Nephrol 2008;28:949–957

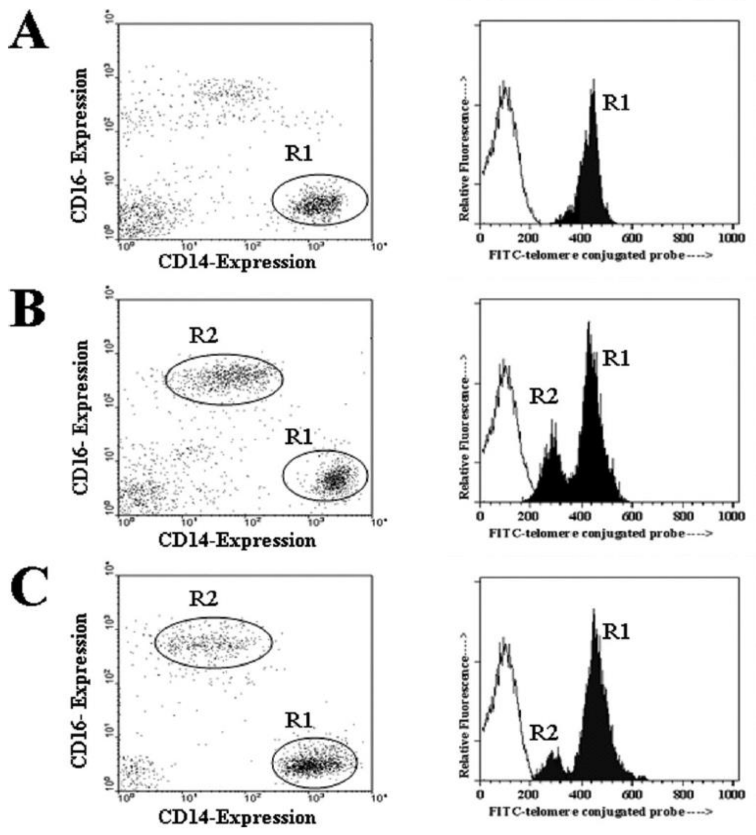
Beneficial effects in reducing the activation of circulating cells, protein systems and preventing the induction of inflammation

On-Line Hemodiafiltration Reduces the Proinflammatory $CD14^{+}CD16^{+}$ Monocyte-Derived Dendritic Cells: A Prospective, Crossover Study

Julia Carracedo,* Ana Merino,* Sonia Nogueras,* Diana Carretero,* Isabel Berdud,* Rafael Ramírez,* Ciro Tetta,† Mariano Rodríguez,* Alejandro Martín-Malo,* and Pedro Aljama*

*Unidad de Investigación, Servicio de Nefrología, Hospital Universitario Reina Sofía, Córdoba, Spain; and †Fresenius Medical Care, Research Extracorporeal Therapies, Bad Homburg, Germany





J Am Soc Nephrol 17: 2315–2321, 2006. doi: 10.1681/ASN.2006020105

In-Depth Review

Blood Purification

Blood Purif 2011;32:210–219
DOI: 10.1159/000329573

Published online: July 29, 2011

Impact of Hemodialysis Therapy on Anemia of Chronic Kidney Disease: The Potential Mechanisms

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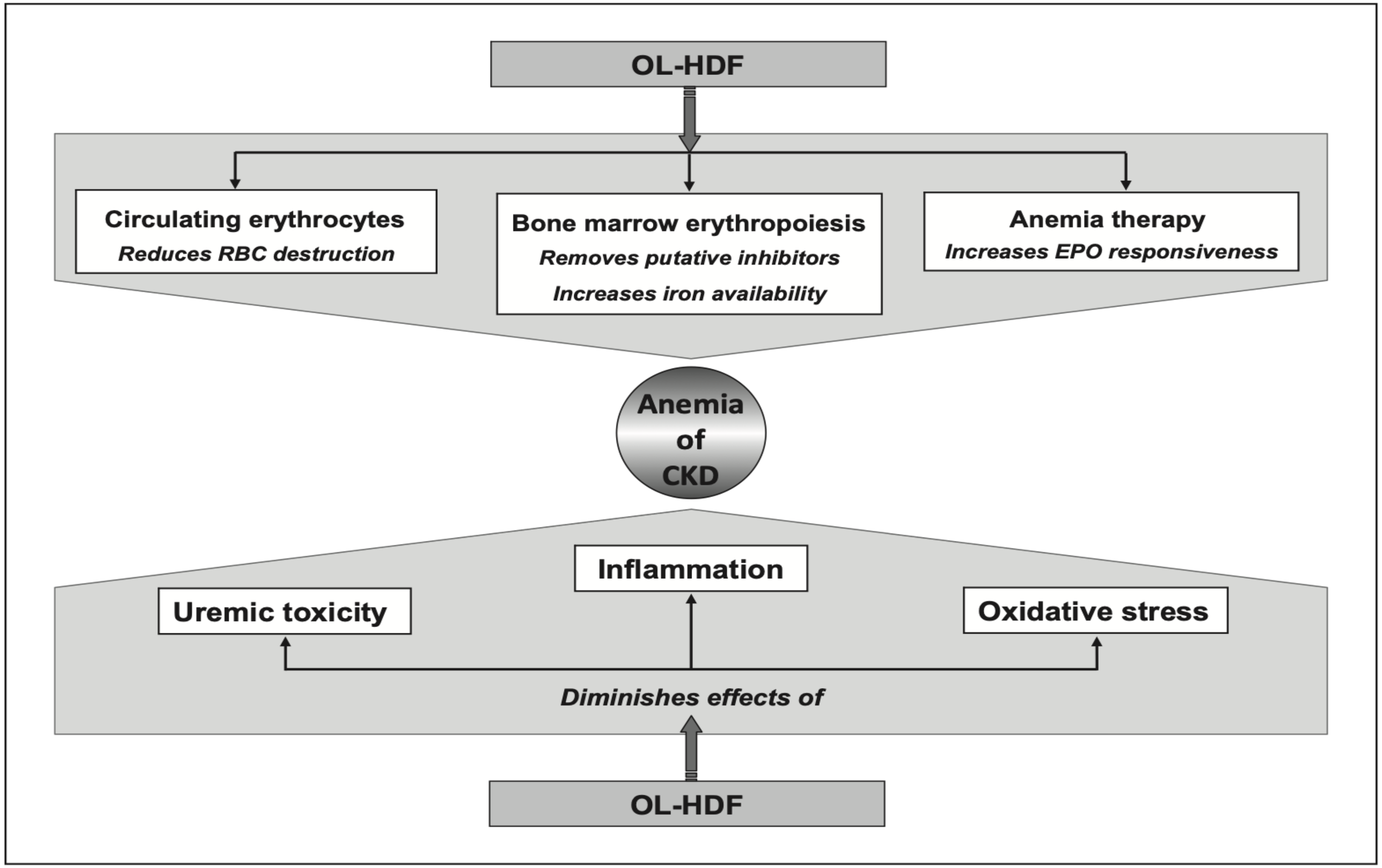

Fig. 2. Mechanisms by which OL-HDF could provide benefits in terms of anemia control. Published data show that OL-HDF favorably impacts anemia of CKD by not only removing putative inhibitors that suppress erythropoiesis, reducing red cell destruction and increasing iron availability, but also by restricting underlying conditions affecting anemia therapy.

Blood Purif 2011;32:210–219

Original Article

Kidney Res Clin Pract 2020;39(1):103-111
pISSN: 2211-9132 • eISSN: 2211-9140
https://doi.org/10.23876/j.krcp.19.082

KIDNEY RESEARCH AND CLINICAL PRACTICE

Check for updates

Effects of online hemodiafiltration on anemia and nutritional status in chronic hemodialysis patients

Yu Ho Lee[1,*], Yoon Soo Shin[1,*], So-Young Lee[1], Yang Gyun Kim[2], Sang Ho Lee[2], Ju Young Moon[2], Kyung Hwan Jeong[3], Hyeon Seok Hwang[3], Shin Young Ahn[4], Hong Joo Lee[5], Dong-Young Lee[6], Eun-Jung Ko[7], Hye Jeong Cho[8], Dong Ho Yang[1], Hye Yun Jeong[1]

Table 3. **Multiple linear regression on the changes of anemia-related variables after HDF conversion in hemodialysis patients**

Laboratory measure	Patient groups	Changes after conversion	Univariate analysis		Multivariate analysis[a]	
			Unstandardized β (95% CI)	*P* value	Unstandardized β (95% CI)	*P* value
Hemoglobin (g/dL)	HD group	0.2 ± 1.3	Reference		Reference	
	OL-HDF group	0.6 ± 1.2	0.47 (0.04, 0.90)	0.034	0.74 (0.18, 1.30)	0.010
Ferritin (ng/mL)	HD group	93.2 ± 239.9	Reference		Reference	
	OL-HDF group	201.3 ± 493.1	108.1 (–1.9, 218.1)	0.054	106.6 (–7.1, 220.2)	0.066
TSAT (%)	HD group	–2.2 ± 15.4	Reference		Reference	
	OL-HDF group	–4.2 ± 18.7	–2.1 (–7.6, 3.5)	0.467	3.4 (–3.2, 10.0)	0.309
ESA dose (IU/kg/wk)[b]	HD group	–115.7 ± 189.7	Reference		Reference	
	OL-HDF group	–170.5 ± 257.1	–54.8 (–126.1, 16.5)	0.131	–46.6 (–119.1, 25.9)	0.206
Albumin (g/dL)	HD group	–0.1 ± 0.3	Reference		Reference	
	OL-HDF group	0.1 ± 0.3	0.20 (0.09, 0.30)	< 0.001	0.19 (0.08, 0.30)	< 0.001

[a]Adjusted for age, sex, etiology of end-stage renal disease, time on dialysis, single-pool Kt/V, high sensitivity C-reactive protein (hs-CRP), use of ESA, and use of intravenous iron. [b]For darbepoetin alfa and methoxy polyethylene glycol-epoetin beta, the dose per week was multiplied by 200 to convert the units from micrograms to international units (Ref. [14]).

Kidney Res Clin Pract 2020;39(1):103-111

Nephrol Dial Transplant (2003) 18 [Suppl 8]: viii29–viii35
DOI: 10.1093/ndt/gfg1089

Nephrology
Dialysis
Transplantation

Dialysis adequacy and response to erythropoietic agents: what is the evidence base?

Francesco Locatelli and Lucia Del Vecchio

Department of Nephrology and Dialysis, Ospedale A. Manzoni, Lecco, Italy

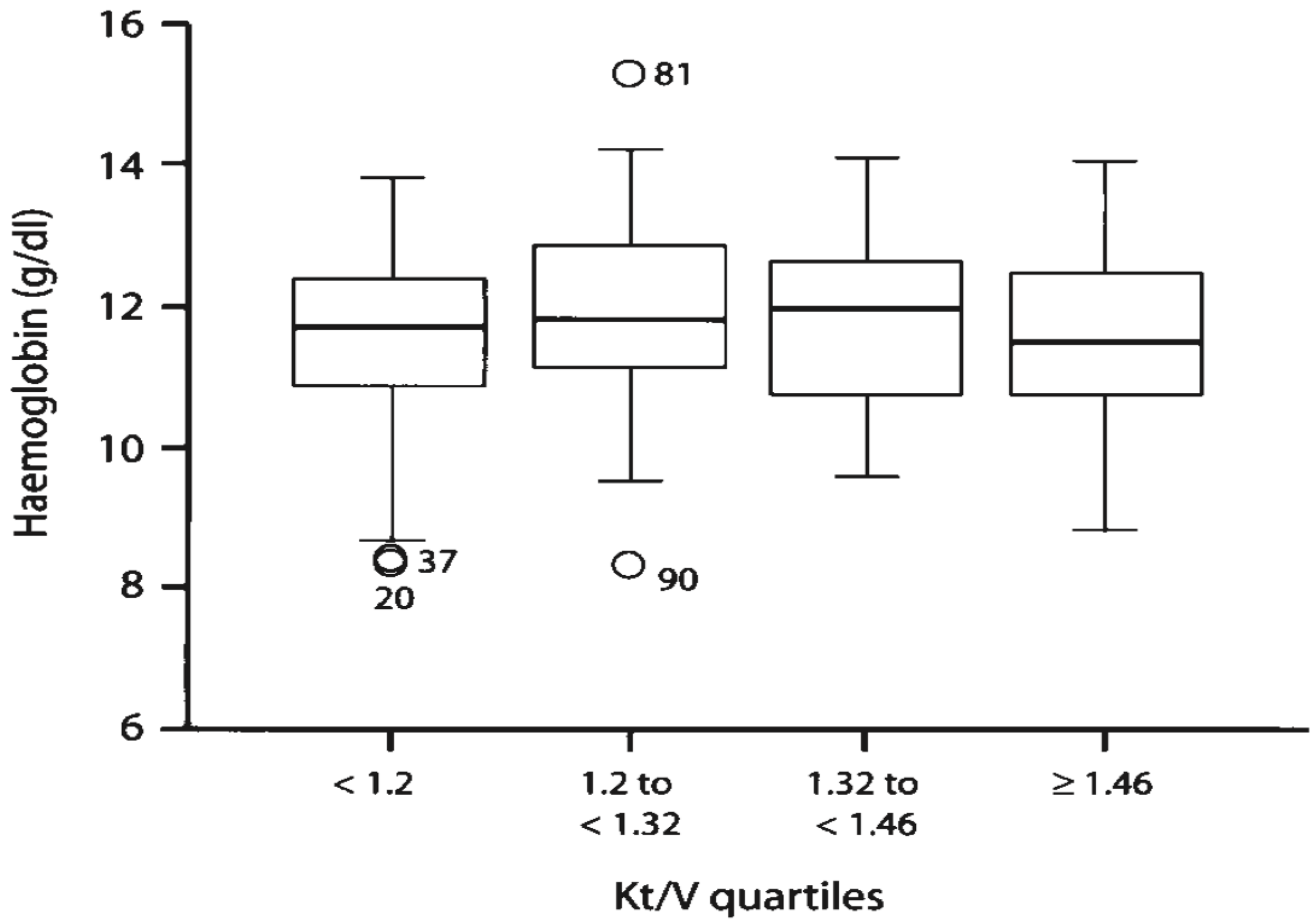

Fig. 1. The relationship between haemoglobin levels and Kt/V quartiles in 197 patients on long-term haemodialysis at Manzoni Hospital, Lecco, Italy. No relationship between haemoglobin levels and dialysis adequacy was found in this unselected population ($F = 0.83$, $P =$ not significant).

Nephrol Dial Transplant (2003) 18 [Suppl 8]: viii29–viii35

Nephrol Dial Transplant (2016) 31: 978–984
doi: 10.1093/ndt/gfv349
Advance Access publication 22 October 2015

Nephrology Dialysis Transplantation

Original Articles

Haemodiafiltration and mortality in end-stage kidney disease patients: a pooled individual participant data analysis from four randomized controlled trials

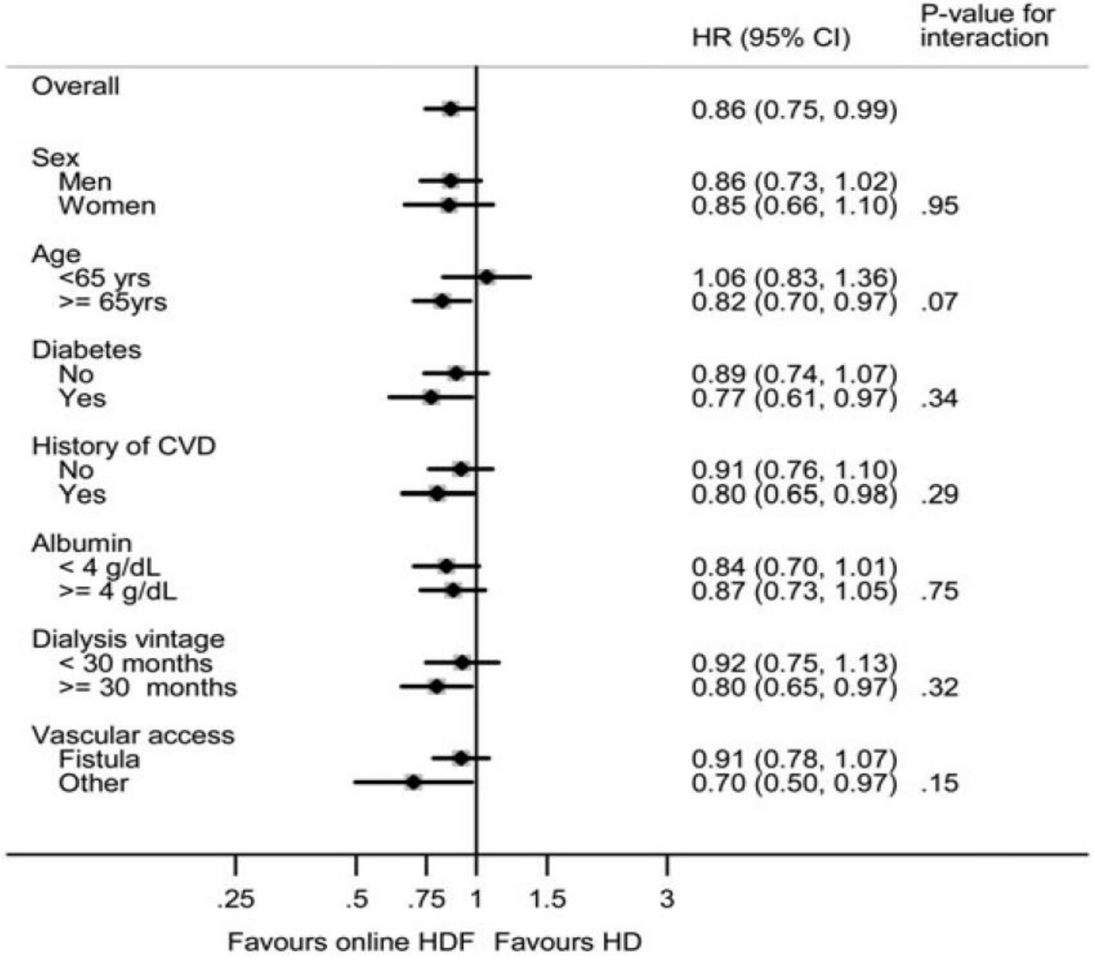

FIGURE 1: HRs (boxes) and 95% CI (bars) for all-cause mortality in patients receiving online HDF versus HD, overall and in subgroups.

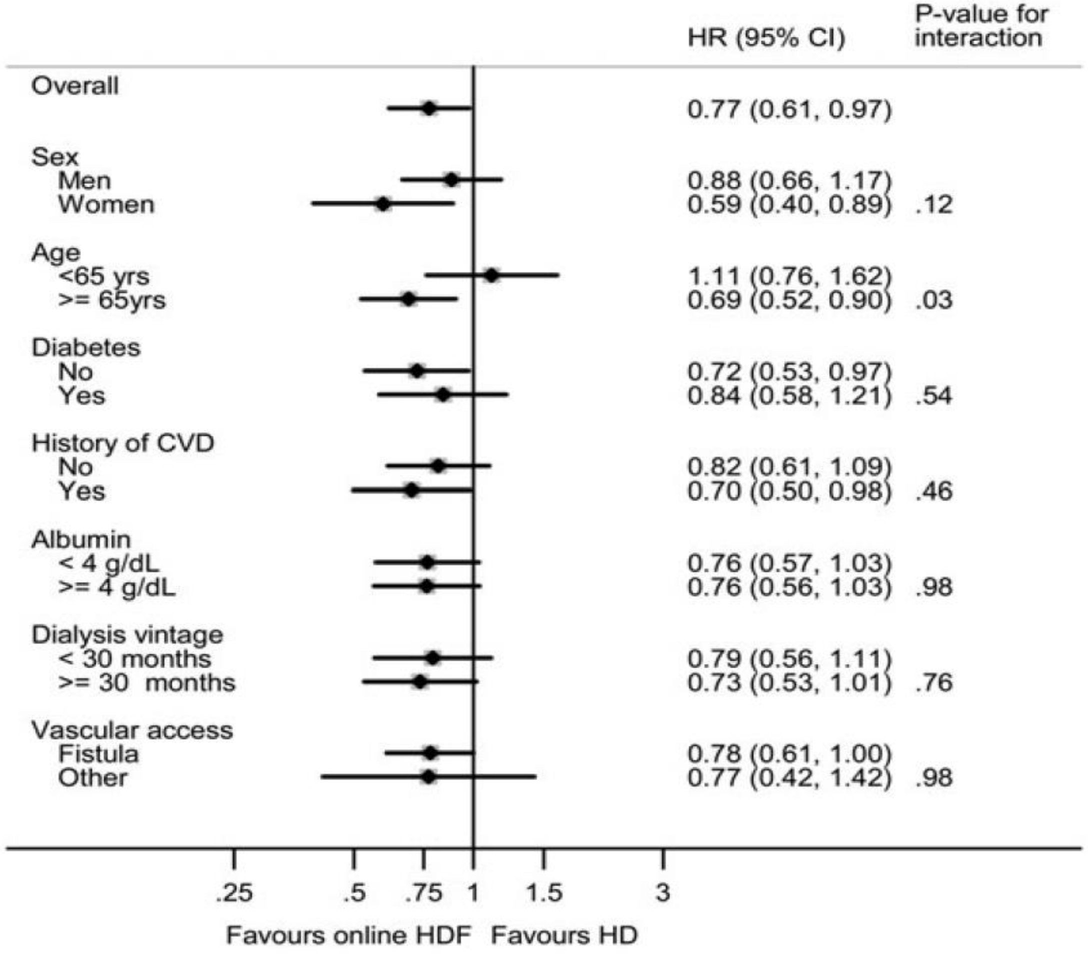

FIGURE 2: HRs (boxes) and 95% CI (bars) for cardiovascular mortality in patients receiving online HDF versus HD, overall and in subgroups.

Hindawi
Case Reports in Nephrology
Volume 2021, Article ID 5575928, 7 pages
https://doi.org/10.1155/2021/5575928

Hindawi

Case Series

Targeting Cytokine Storm in COVID-19: A Role of Online Hemodiafiltration with Asymmetric Cellulose Triacetate in Maintenance Hemodialysis Patients—A Report of 10 Cases

José C. De La Flor,[1] Francisco Valga,[2] Alexander Marschall,[3] Tania Monzon,[4] Cristina Albarracín,[1] Elisa Ruiz,[1] and Miguel Rodeles[1]

[1]*Department of Nephrology, Central Defense Gomez Ulla Hospital, Madrid, Spain*

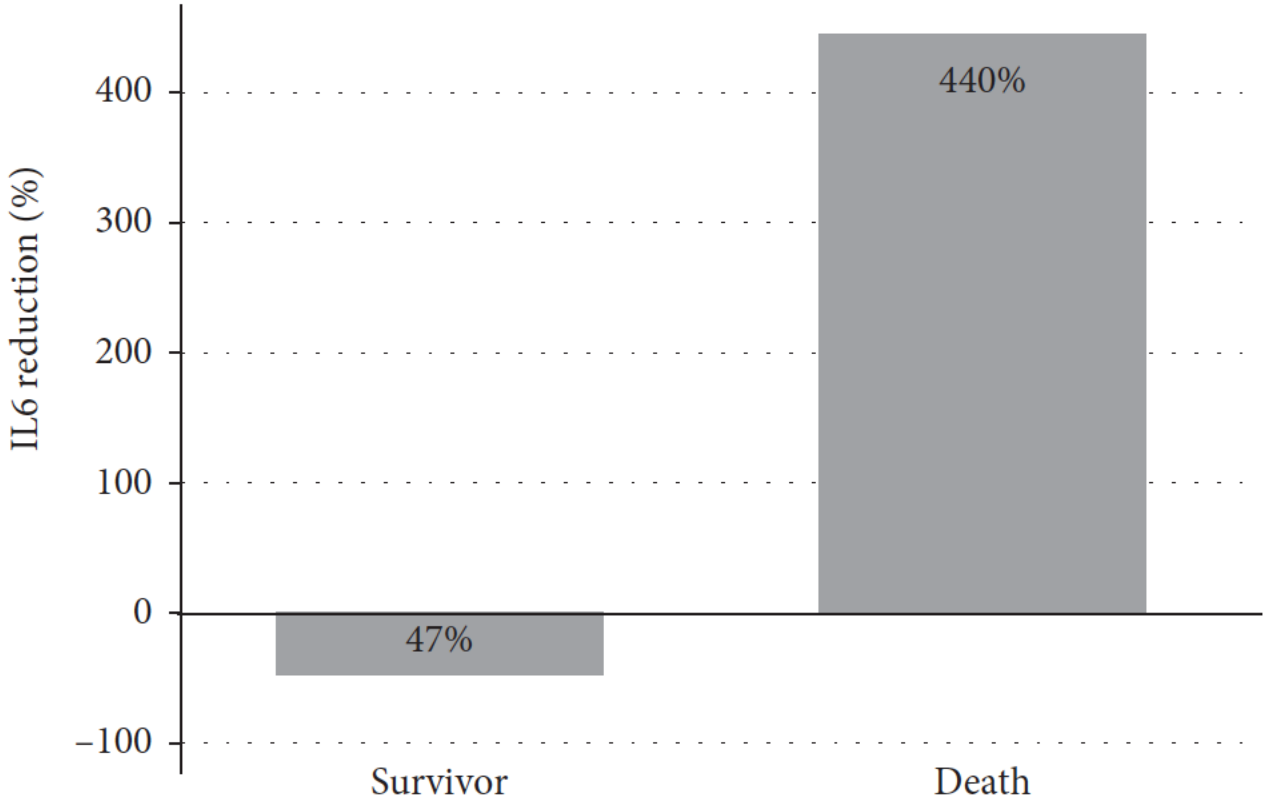

Figure 1: Interleukin-6 level reduction at 14 days according to vital status.

In conclusion
while clinical evidence is rising in favor of OL-HDF, new technological advances make this treatment safer, more reliable and economically sustainable.
It is likely that we will face a significant expansion of the utilization of OL-HDF and an increased number of countries adopting this technique in the years to come.

Thank You