How to evaluate the peritoneal membrane?

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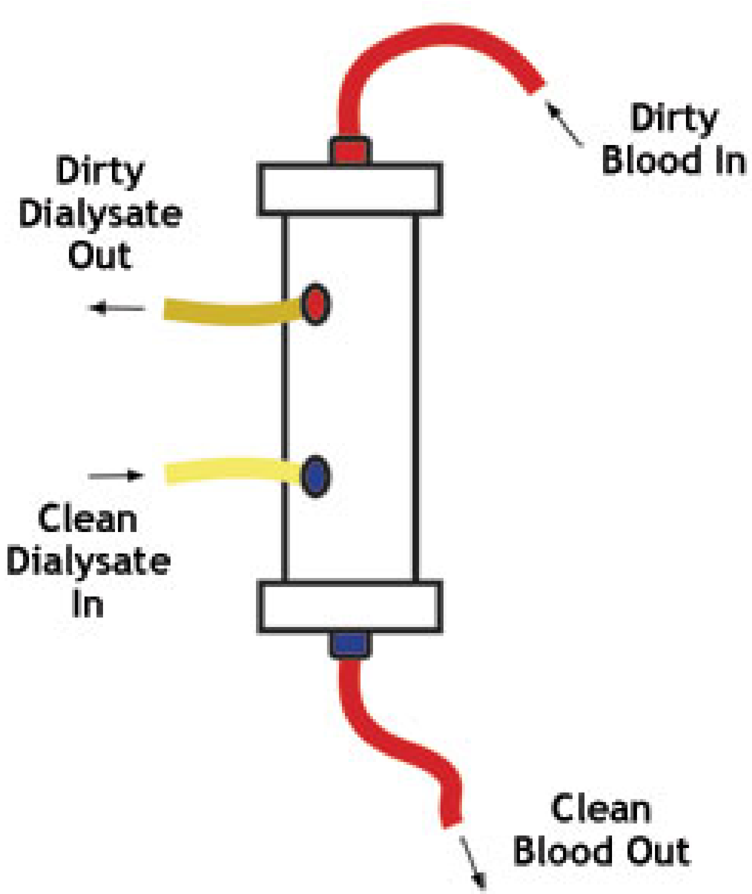
Brussels, May 12 2016
UZ LEUVEN
KU LEUVEN
BELGIUM

3rd self-care dialysis symposium
12th & 13th May 2016

self-care dialysis symposium

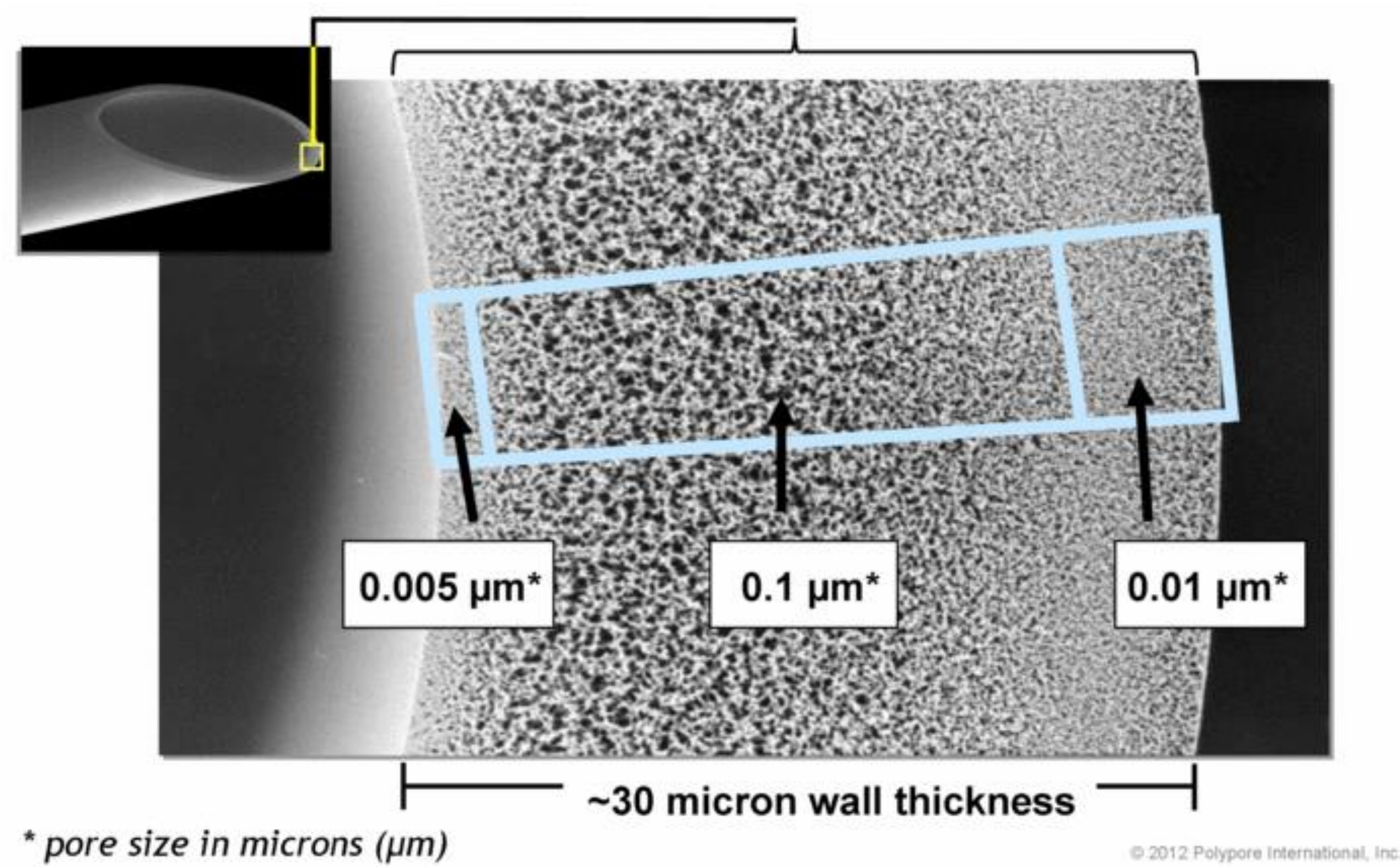
How to evaluate a hemodialyzer?

self-care dialysis symposium



How to evaluate a hemodialyzer?

self-care dialysis symposium



How to evaluate a hemodialyzer?

DEFINITIONS OF FLUX, PERMEABILITY, AND EFFICIENCY
Flux
Measure of ultrafiltration capacity
Low and high flux are based on the ultrafiltration coefficient (K_{uf})
Low flux: K_{uf} <10 mL/h/mm Hg
High flux: K_{uf} >20 mL/h/mm Hg
Permeability
Measure of the clearance of the middle molecular weight molecule (*eg*, β_2-microglobulin)
General correlation between flux and permeability
Low permeability: β_2-microglobulin clearance <10 mL/min
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Efficiency
Measure of urea clearance
Low and high efficiency are based on the urea K_0A value
Low efficiency: K_0A <500 mL/min
High efficiency: K_0A >600 mL/min

K_0—mass transfer coefficient; A—surface area.

From: Robert W. Schrier's Atlas of Diseases of the Kidney

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self-care dialysis symposium

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SOLUTE REMOVAL

pore size

surface area

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ULTRAFILTRATION

From: Robert W. Schrier's Atlas of Diseases of the Kidney

Hemodialyzer vs. peritoneum?

self-care dialysis
symposium

Performance Data

Sieving coefficients of FX CorDiax High-Flux Dialysers and Haemo*dia*filters	Molecular weight (Dalton)	
Albumin	66,500	< 0.001
Myoglobin	17,053	0.5
β_2-microglobulin	11,731	0.9
Inulin	5,200	1
Membrane material		Helixone® *plus*
Sterilisation method		INLINE steam
Housing material		Polypropylene

	REVACLEAR				REVACLEAR 300				REVACLEAR MAX					REVACLEAR 400				
Product Code:	110633				114745				110634					114746				
Hemodialysis Q_D =500 mL/min, UF=0 mL/min																		
Q_B (mL/min)	200	300	400	500	200	300	400	500	200	300	400	500	600	200	300	400	500	600
Urea	196	271	321	353	196	272	323	356	198	282	339	376	400	198	281	338	375	401
Creatinine	189	250	289	316	191	256	298	326	195	265	311	341	362	195	267	315	348	370
Phosphate	185	239	274	298	185	242	278	303	191	256	297	324	343	191	255	297	326	346
Vitamin B_{12}	144	170	186	197	146	174	191	204	158	191	211	225	235	158	191	213	228	240
Hemodialysis Q_D =800 mL/min, UF=0 mL/min																		
Q_B (mL/min)	200	300	400	500	200	300	400	500	200	300	400	500	600	200	300	400	500	600
Urea	199	286	355	408	199	286	355	408	200	293	371	432	479	199	292	369	430	477
Creatinine	194	269	324	364	195	273	330	373	197	281	345	393	430	198	283	348	398	437
Phosphate	191	259	307	343	191	260	309	345	196	273	330	373	406	195	272	330	373	406
Vitamin B_{12}	154	187	208	223	155	189	212	228	169	211	240	260	276	167	208	236	256	272

	REVACLEAR	REVACLEAR 300	REVACLEAR MAX	REVACLEAR 400
Specifications				
Blood flow rate (mL/min)	200-500	200-500	200-600	200-600
Dialysate flow (mL/min)	800	300-800	800	300-800
Membrane				
Material	PAES/PVP	PAES/PVP	PAES/PVP	PAES/PVP
Surface area (m²)	1.4	1.4	1.8	1.8
UF Coefficient in vitro (mL/h.mmHg) (Bovine blood, hematocrit=32%, protein=60 g/l, 37°C)	50	48	60	54
Priming volume (mL)	84	74	100	93
Residual blood volume (mL)	<1	<1	<1	<1
Fiber Dimensions				
Wall Thickness Membrane (µm)	35			
Inner Diameter Hollow Fiber (µm)	190			
Maximum TMP (mmHg)	600			
Sterilization agent	Steam			
Sieving Coefficient *in vitro*. **Typical values measured with REVACLEAR Dialyzer according to EN1283**				
Vitamin B_{12}	1.0			
Inulin	1.0			
β_2-microglobulin	0.7			
Albumin	<0.01			

vs.

+ the effects of
intercurrent disease
time
glucose exposure
…

Peritoneal membrane evaluation

Testing
the
membrane

Peritoneal membrane evaluation

self-care dialysis symposium

Testing the membrane

Test	Application/advantages	Limitations
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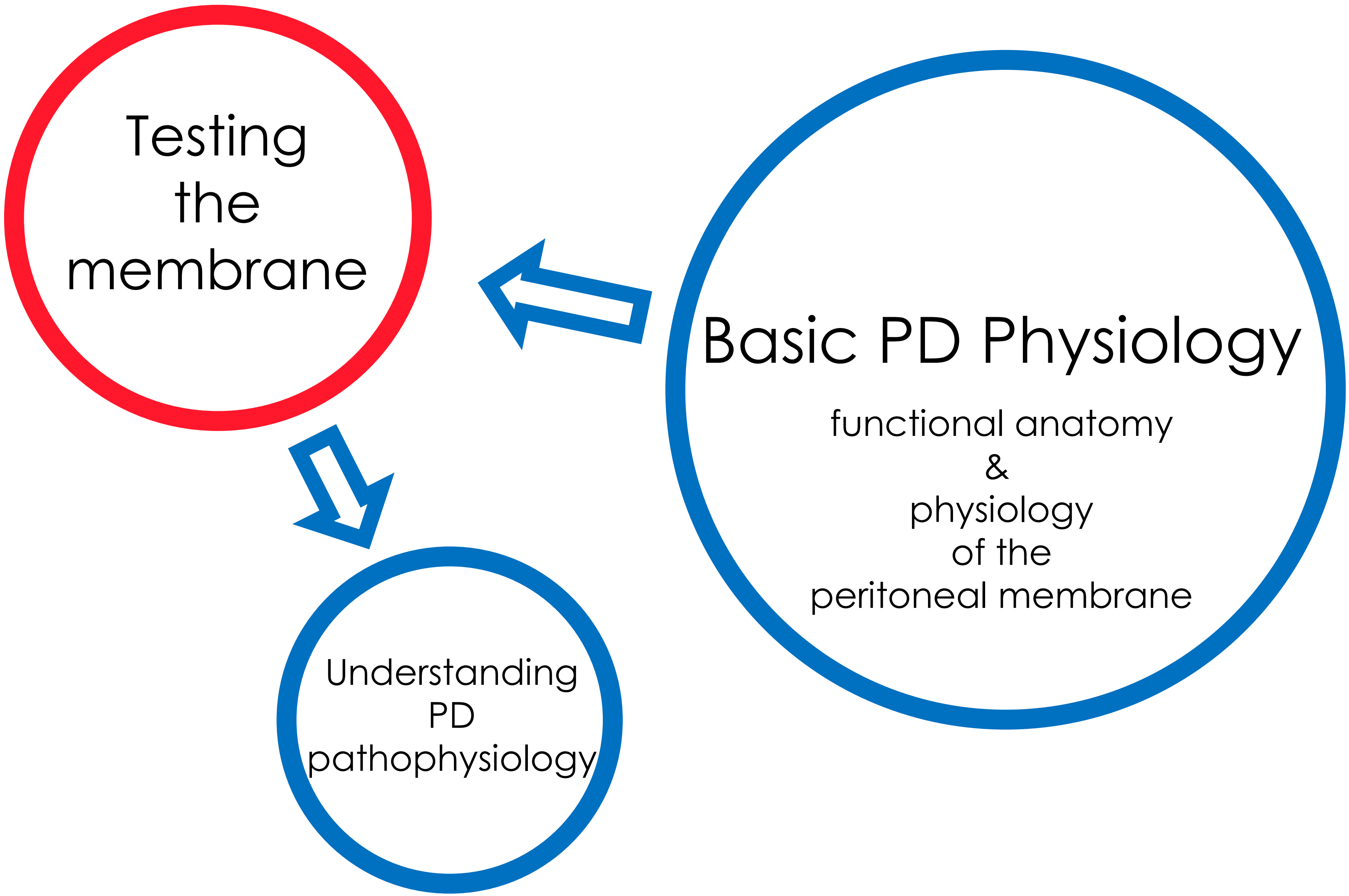
Modified PET with temporary drainage	Small-solute transport, expressed as D/P value Categories fast/average/slow should guide prescription management (see Table 1) Information on sodium sieving, FWT	No information on OC No information on peritoneal reabsorption rate

FWT, free water transport; OC, osmotic conductance.

van Biesen et al. Nephrol Dial Transplant 25: 2052-2062, 2010

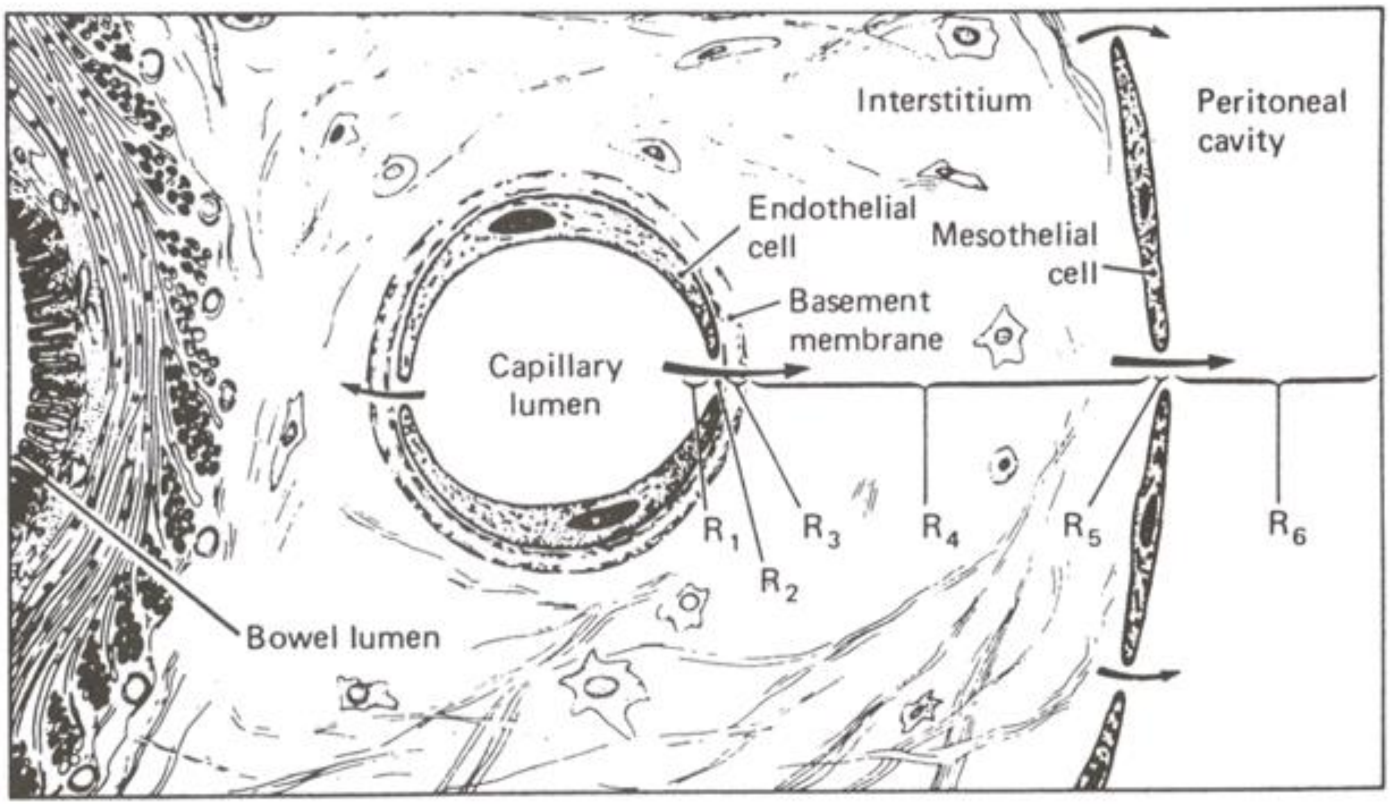
Peritoneal membrane evaluation

self-care dialysis symposium



‘6 barriers for transport’

Stagnant layers at mesothelial and capillary side: not relevant
Mesothelial cell layer: not relevant
Interstitial tissue: (minor) diffusive resistance
Capillary wall: most important restriction barrier

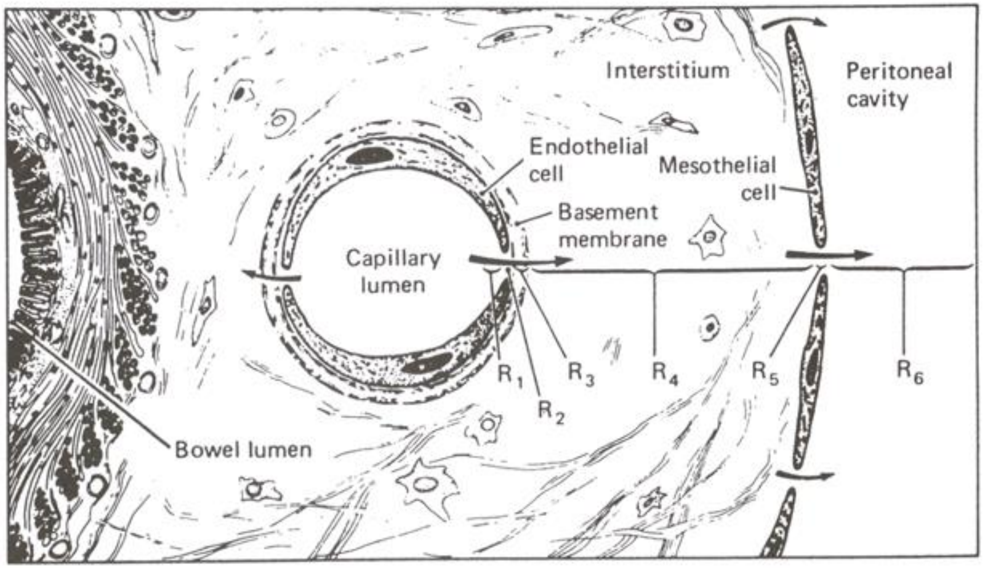


Nolph et al. Kidney Int 18 (Suppl 20): S111-S116, 1980
Flessner et al. J Am Soc Nephrol 2: 122-135, 1991

'2D membrane with pores'

Capillary wall is the most important restriction barrier and determines the peritoneal membrane's size-selectivity through a system of pores

→ the "PORE THEORIES"



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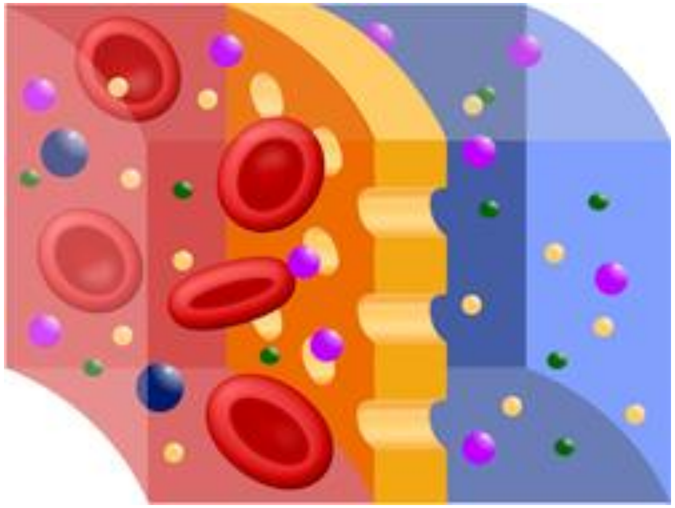

‘2D membrane with pores’

self-care dialysis symposium

SOLUTE REMOVAL | **ULTRAFILTRATION**

pore size **surface area**

How to evaluate a hemodialyzer?

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SOLUTE REMOVAL

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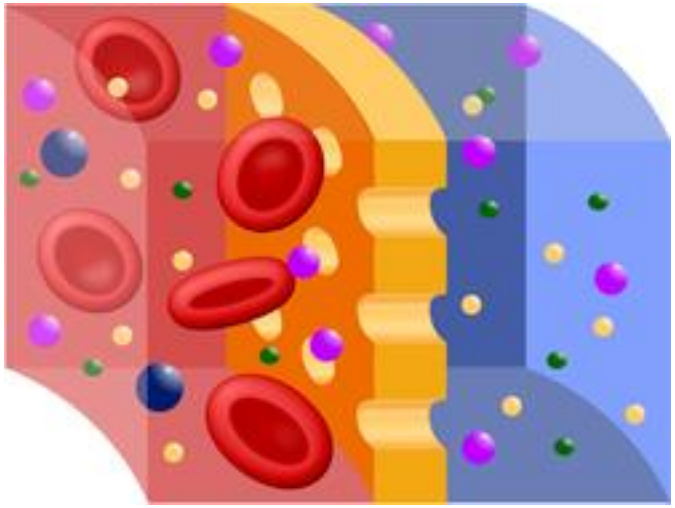


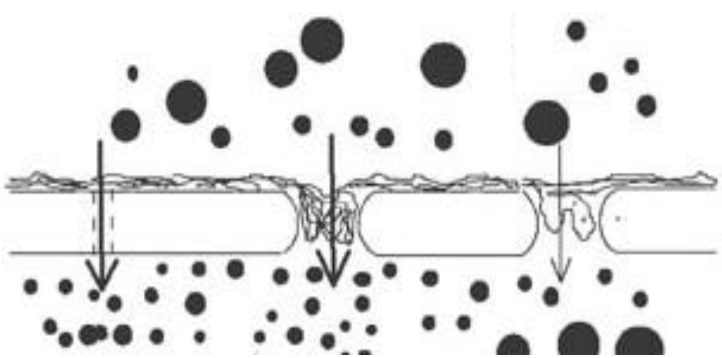
The THREE pore theory

self-care dialysis symposium

Small pores with constant radius 40-50Å
majority
for transport of low molecular weight solutes

Large pores with various radii, average > 150Å
minority (less than 0.1% of total pore count)
for transport of macromolecules

Ultra-small pores with radius 3-5Å
for transport of water only
accounts for 1/2 of transcapillary water transport



The THREE pore theory

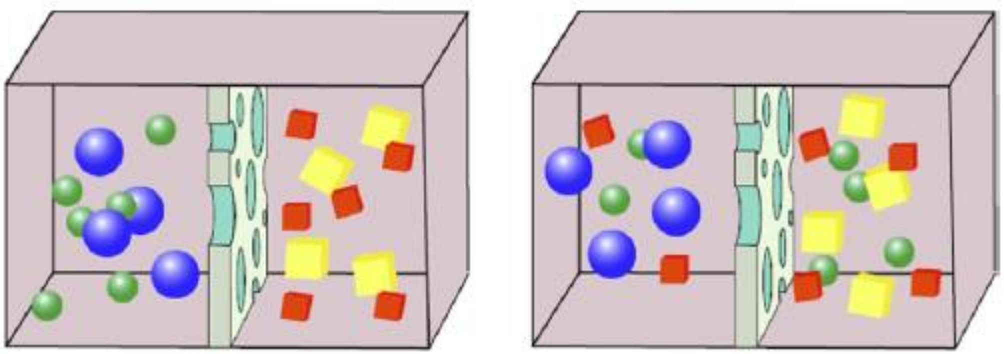
self-care dialysis
symposium

The pore theory explains the "classical" mechanisms of transmembrane transport of molecules.

SOLUTE REMOVAL

DIFFUSION

movement of solutes along their concentration gradient



Bammens Semin Nephrol 31: 127-137, 2011

Diffusive transport

self-care dialysis symposium

$$J_s = \frac{D_f}{\Delta x} . A . \Delta C$$

(Fick's first law of diffusion)

diffusive permeability (membrane- and solute-specific)

Diffusive transport

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diffusive permeability (membrane- and solute-specific)

surface area (membrane-specific)

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self-care dialysis symposium

$$J_s = \frac{D_f}{\Delta x} . A . \Delta C$$

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diffusive permeability (membrane- and solute-specific)

surface area (membrane-specific)

concentration difference between plasma and dialysate

Diffusive transport

self-care dialysis
symposium

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diffusive permeability (membrane- and solute-specific)

surface area (membrane-specific)

concentration di… …asma and dialysate

mass transfer area coefficient (MTAC)

Diffusive transport

self-care dialysis symposium

$$J_s = \frac{D_f}{\Delta x} . A . \Delta C$$

(Fick's first law of diffusion)

$$J_s = MTAC . \Delta C$$

Transport of small molecules up to MW of β_2M (11,8 kDa) NOT limited by size of the pores

⇩

MTAC for a given solute ONLY determined by
effective vascular peritoneal surface area (number of pores)

The THREE pore theory

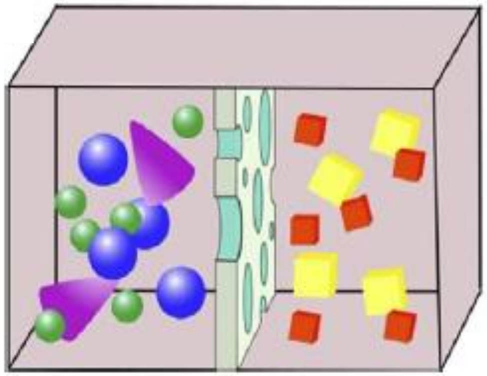
self-care dialysis symposium

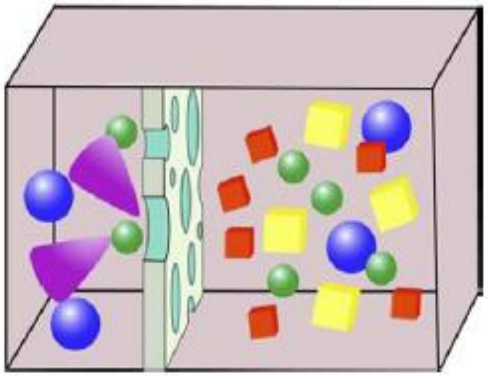
The pore theory explains the "classical" mechanisms of transmembrane transport of molecules.

SOLUTE REMOVAL

CONVECTION

movement of solutes along with fluid as it moves across the membrane (solvent drag)





Bammens Semin Nephrol 31: 127-137, 2011

Convective transport

$$J_s = J_v . \bar{C} . (1 - \sigma)$$

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water flux (membrane-specific)

Convective transport

$$J_s = J_v \cdot \bar{C} \cdot (1-\sigma)$$

water flux (membrane-specific)

mean solute concentration in the membrane (P+D)/2

Convective transport

$$J_s = J_v.\bar{C}.(1-\sigma)$$

water flux (membrane-specific)

mean solute concentration in the membrane (P+D)/2

Staverman's reflection coefficient
= *how difficult it is for a solute to be transported by solvent drag across a semi-permeable membrane*
(membrane- and solute-specific)

Convective transport

σ Staverman's reflection coefficient

= how difficult it is for a solute to be transported by solvent drag across a semi-permeable membrane

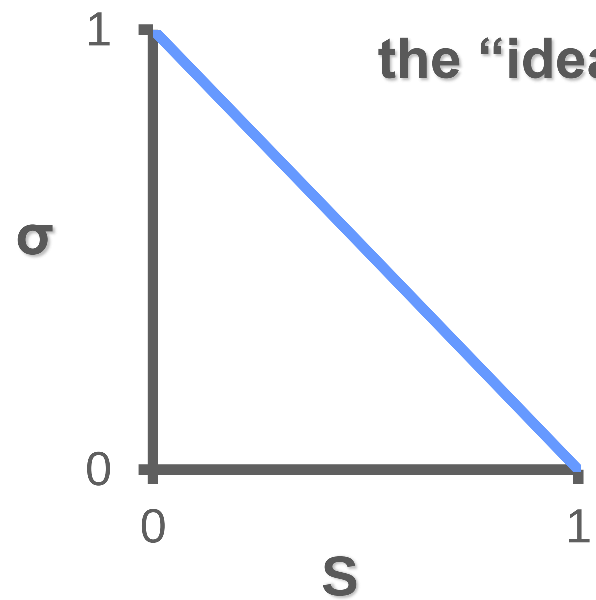
⇕

S sieving coefficient

= how easy it is for a solute to be transported by solvent drag across a semi-permeable membrane

Convective transport

For a semi-permeable membrane, S and σ are expected to be perfectly interchangeable concepts!



the "ideal" two-pore membrane

$S = 1 - \sigma$

Convective transport

σ Staverman's reflection coefficient

= how difficult it is for a solute to be transported by solvent drag across a semi-permeable membrane

= fraction of maximal osmotic pressure a solute can exert across a semi-permeable membrane

⇕

S sieving coefficient

= how easy it is for a solute to be transported by solvent drag across a semi-permeable membrane

= fraction of maximal solute transport by solvent drag across a semi-permeable membrane

Convective transport

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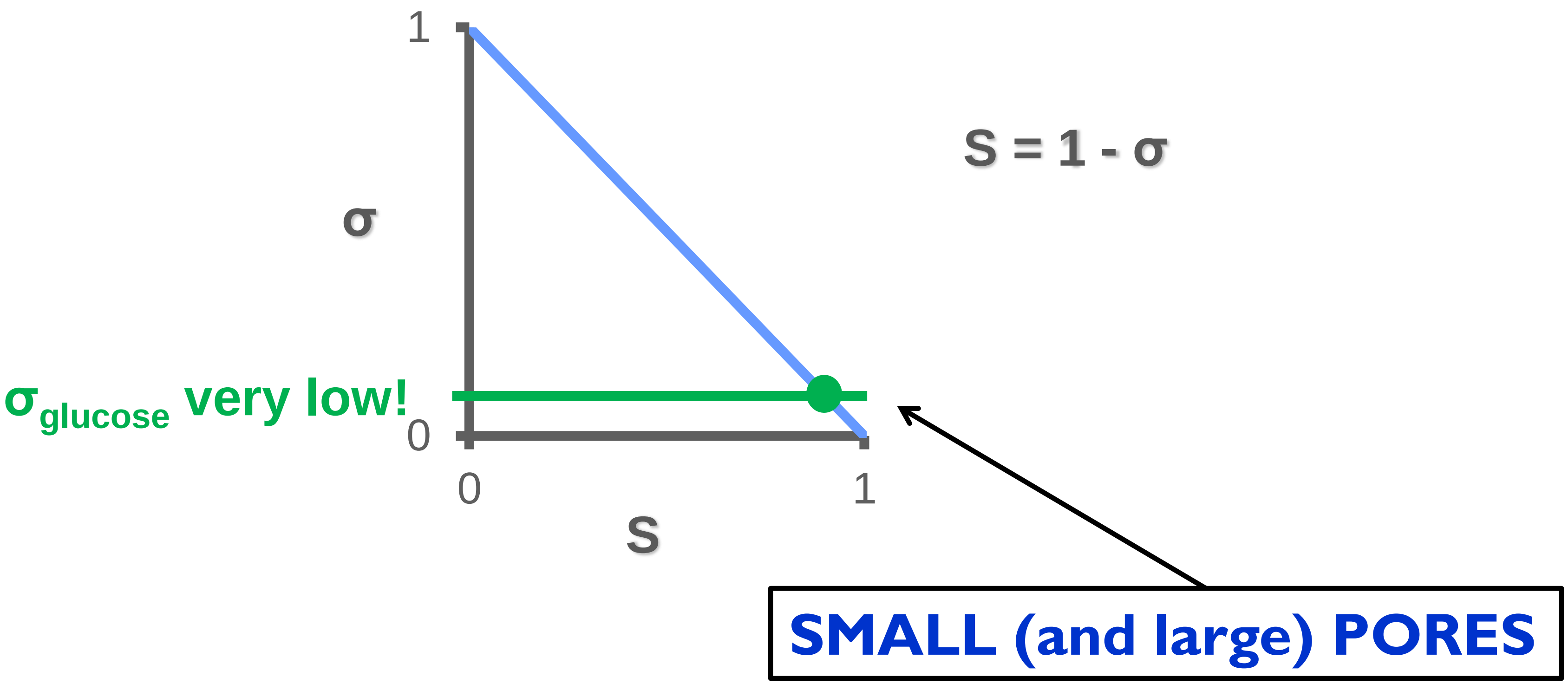

Apparent $\sigma_{glucose}$ = higher

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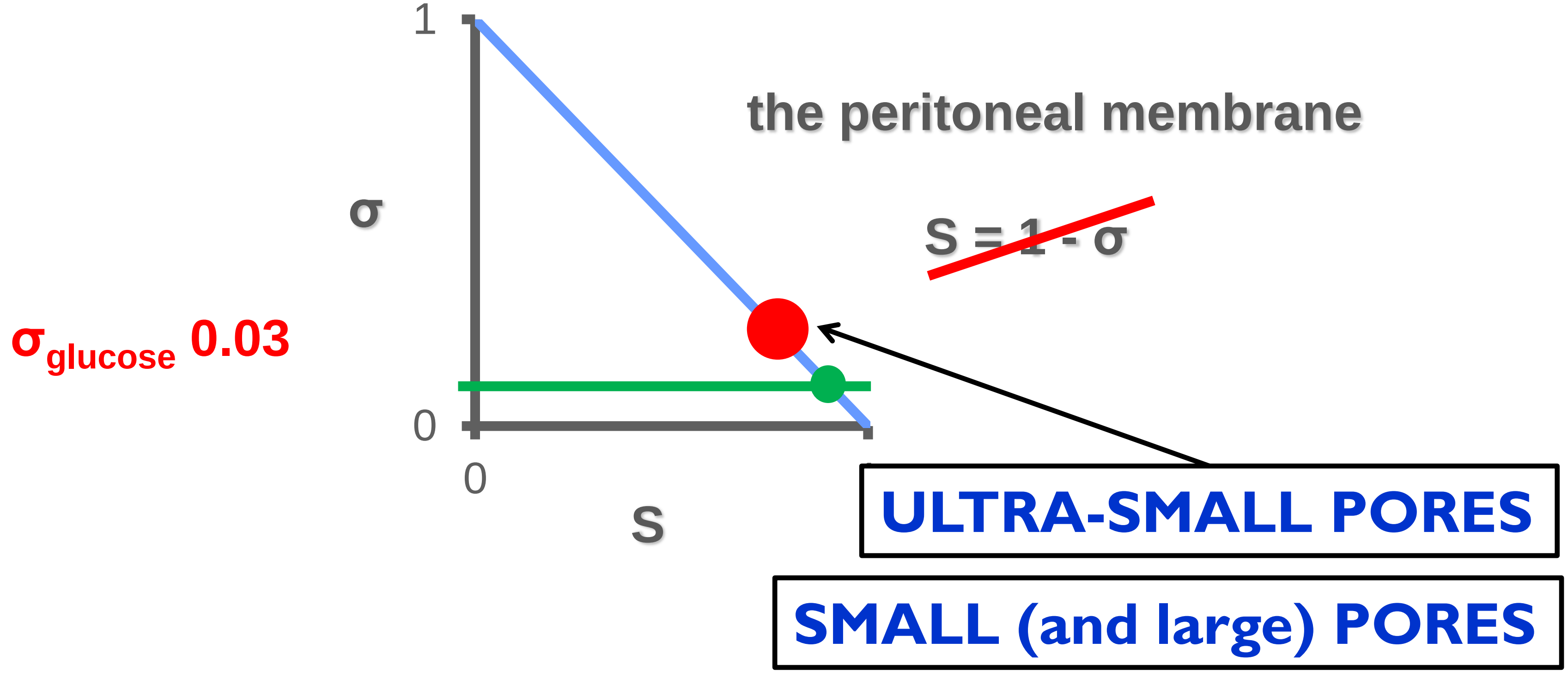
For a semi-permeable membrane, S and σ are expected to be perfectly interchangeable concepts!

However, the water-only channels make the peritoneal membrane "more than a semi-permeable membrane"!



The THREE pore theory

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Ultra-small pores with radius 3-5Å

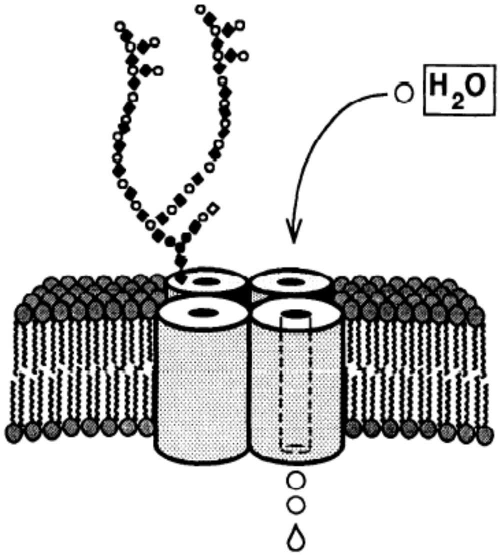
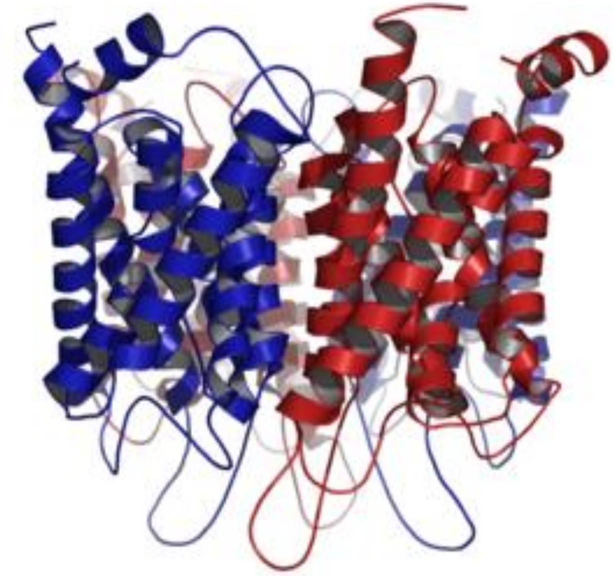


Fig. 1. Schematic model representing CHIP integral membrane protein within the membrane lipid bilayer. Notable features include *1*) homotetrameric complex with 1 subunit bearing a polylactosaminoglycan, *2*) minimal polypeptide mass extending above or below the lipid bilayer, and *3*) possible individual water pore within each subunit.

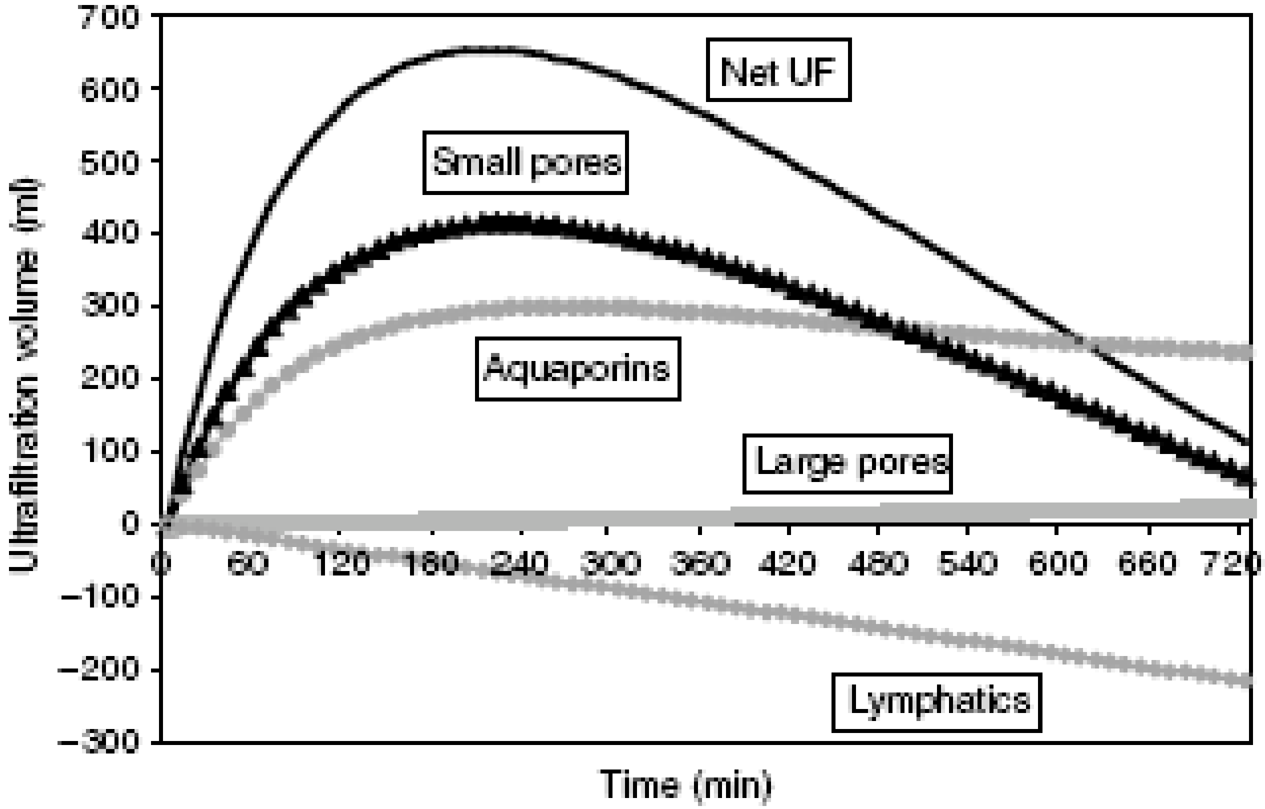
AQUAPORIN-1



Agre et al. Am J Physiol 265: F463-F476, 1993

The THREE pore theory

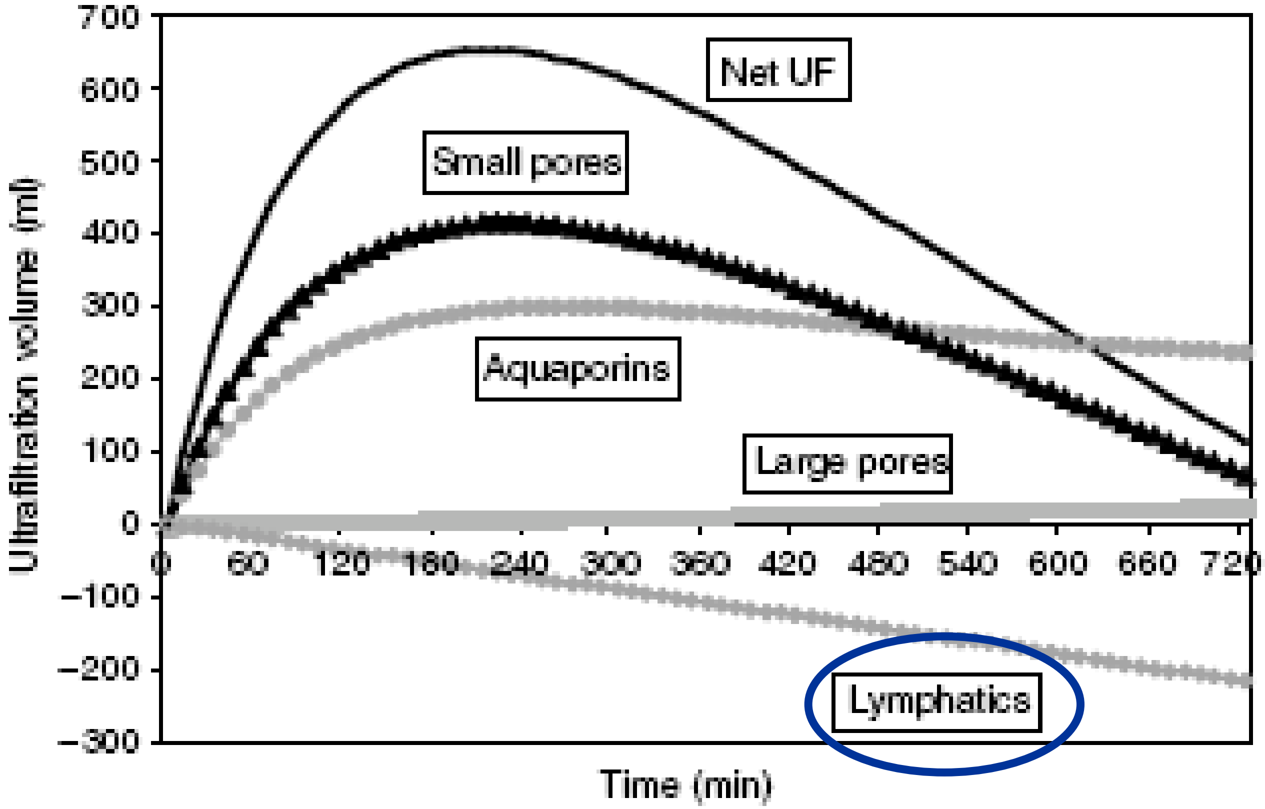
ULTRAFILTRATION



Davies Kidney Int 70 (Suppl 103): 76-83, 2006

The THREE pore theory

ULTRAFILTRATION



Davies Kidney Int 70 (Suppl 103): 76-83, 2006

Ultrafiltration

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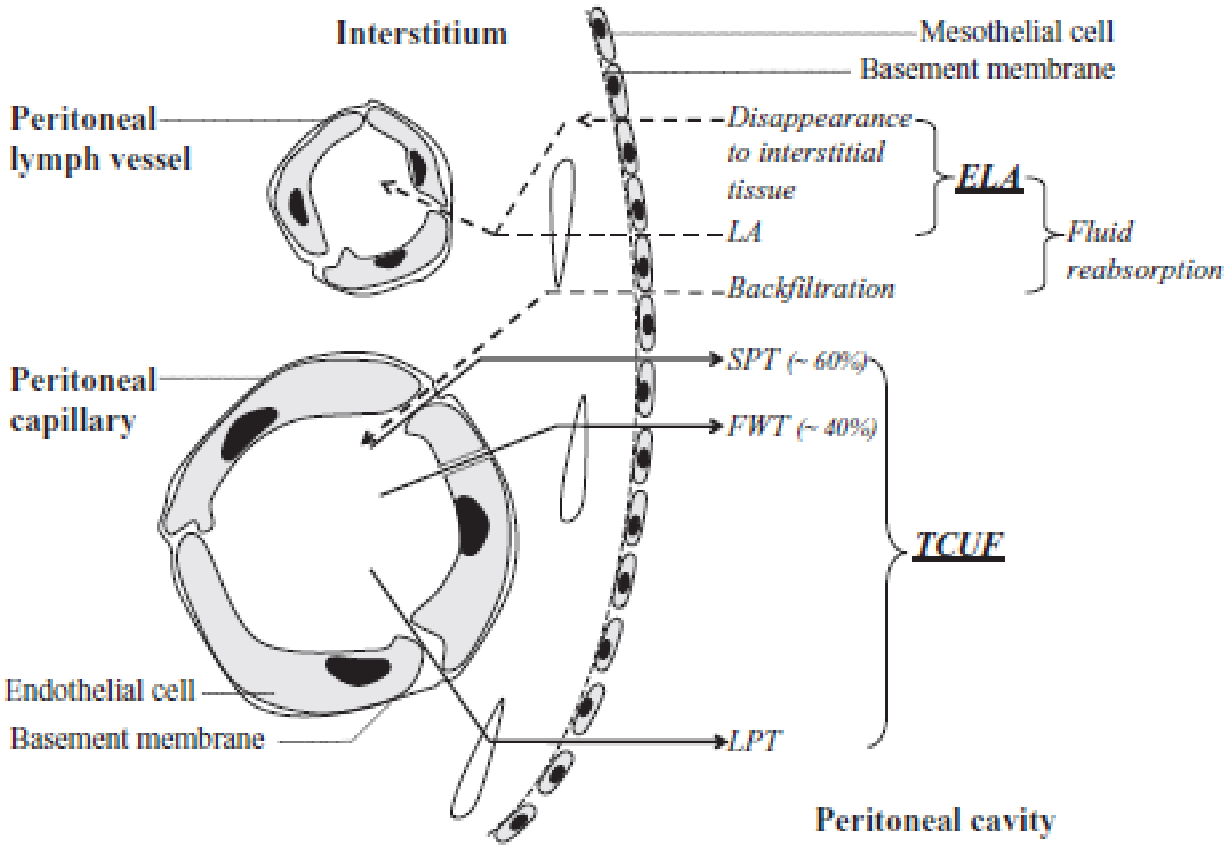
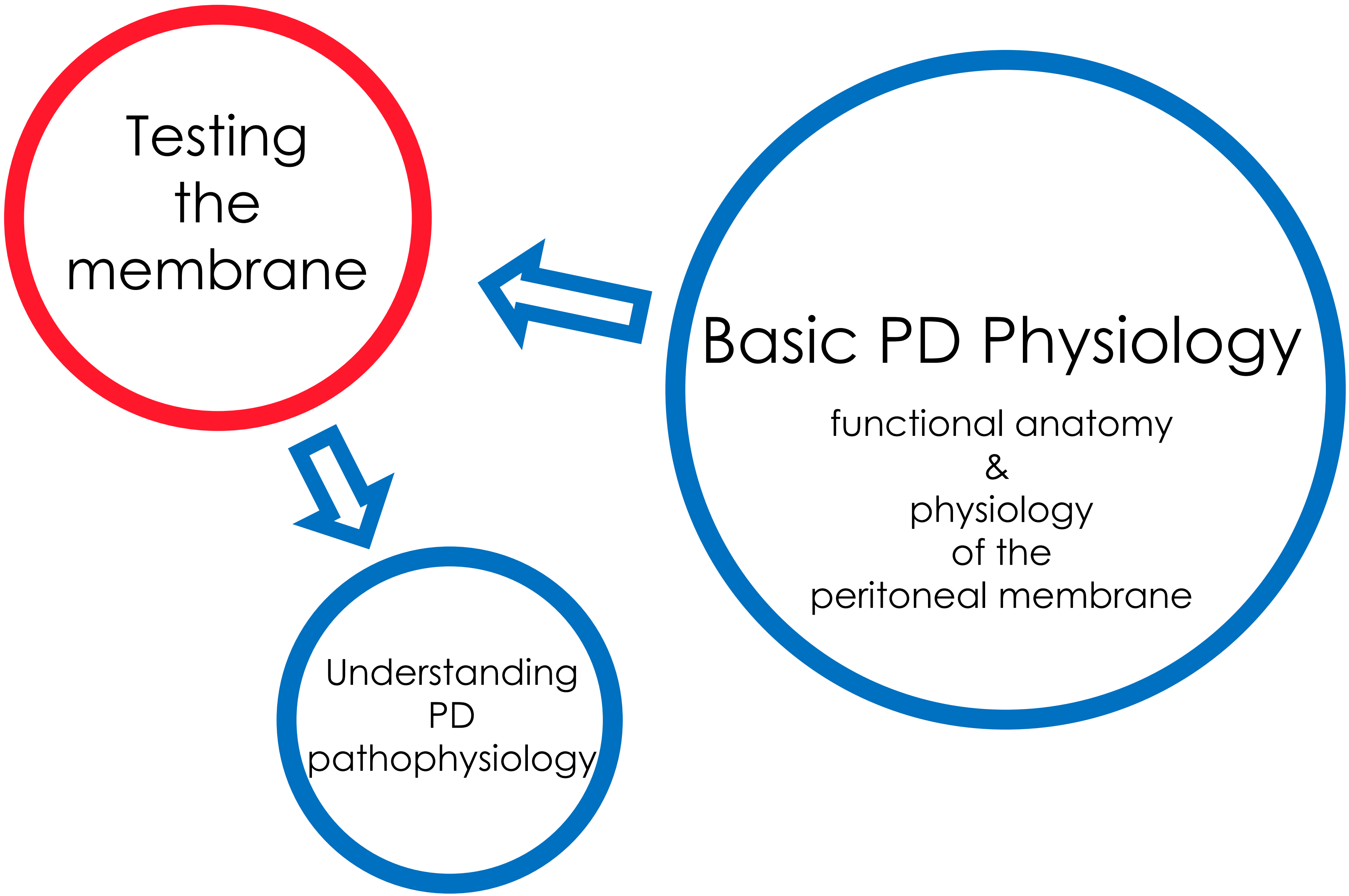


NUF = ΔIPV = TCUF – ELA

Coester et al. NDT Plus 2: 104-110, 2009

Peritoneal membrane evaluation



Peritoneal membrane evaluation

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van Biesen et al. Nephrol Dial Transplant 25: 2052-2062, 2010

Peritoneal membrane evaluation

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CARI
Caring for Australasians with Renal Impairment

CARI Guidelines 2005

Canadian Society of Nephrology/
Société Canadienne De Néphrologie
CSN/SCN

Canadian Society of Nephrology, PDI 31: 218-239, 2011

National Kidney Foundation™

NKF K/DOQI Am J Kidney Dis 48 (Suppl 1): S138-S142, 2006

THE RENAL ASSOCIATION
founded 1950

UK Renal Association, Guidelines 2010 (review due 2013)

Peritoneal membrane evaluation

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ISPD GUIDELINES/RECOMMENDATIONS

GUIDELINE ON TARGETS FOR SOLUTE AND FLUID REMOVAL IN ADULT PATIENTS ON CHRONIC PERITONEAL DIALYSIS

SOLUTE REMOVAL

3. For small solute removal, the total (renal + peritoneal) Kt/V urea should not be less than 1.7 at any time (*Evidence level A*). That means, in anuric patients, peritoneal Kt/V urea has to be above 1.7. In the presence of residual renal function, the contributions of renal and peritoneal clearances may be added for practical purposes, although, as mentioned previously, renal and peritoneal clearances may not be truly additive (*Opinion*). Solute removal above this level should not be equated with "adequate dialysis." Knowledge of the transport characteristics of the patient's peritoneal membrane by peritoneal equilibration test or other tests may help to optimize the prescription to meet this target.

ISPD PDI 26: 520-522, 2006

Peritoneal membrane evaluation

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ISPD GUIDELINES/RECOMMENDATIONS

EVALUATION AND MANAGEMENT OF ULTRAFILTRATION PROBLEMS IN PERITONEAL DIALYSIS

ULTRAFILTRATION

Recommendations:

- Adherence to sound physiologic principles in the design and implementation of PD prescriptions is essential to prevent the emergence of fluid overload. The most frequently ignored principles in PD that lead to UF difficulties, are the need to avoid long dwells in high transporters, and balancing glucose concentration and dwell time. Prescription setting must take these into account.

ISPD PDI 20 (Suppl 4): S5-S21, 2000

Peritoneal membrane evaluation

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The original 2.27% PET test

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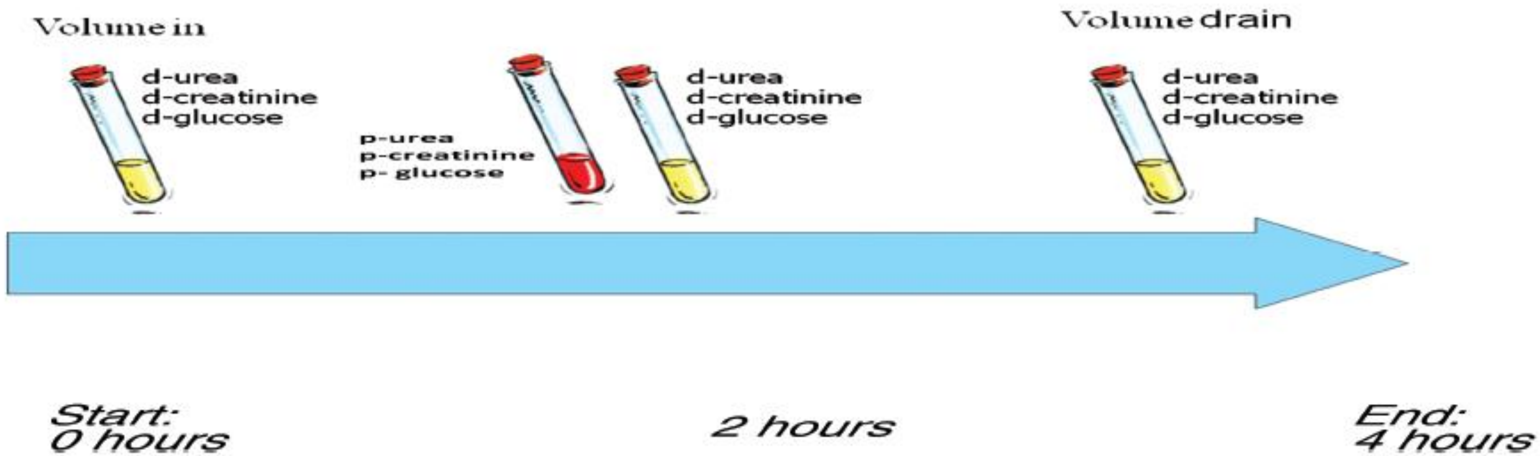
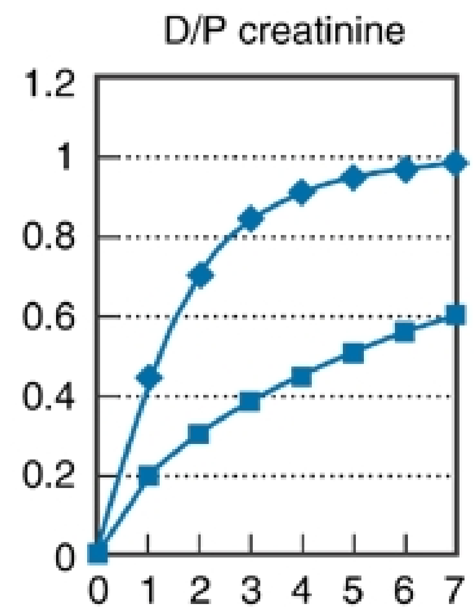


SOLUTE TRANSPORT



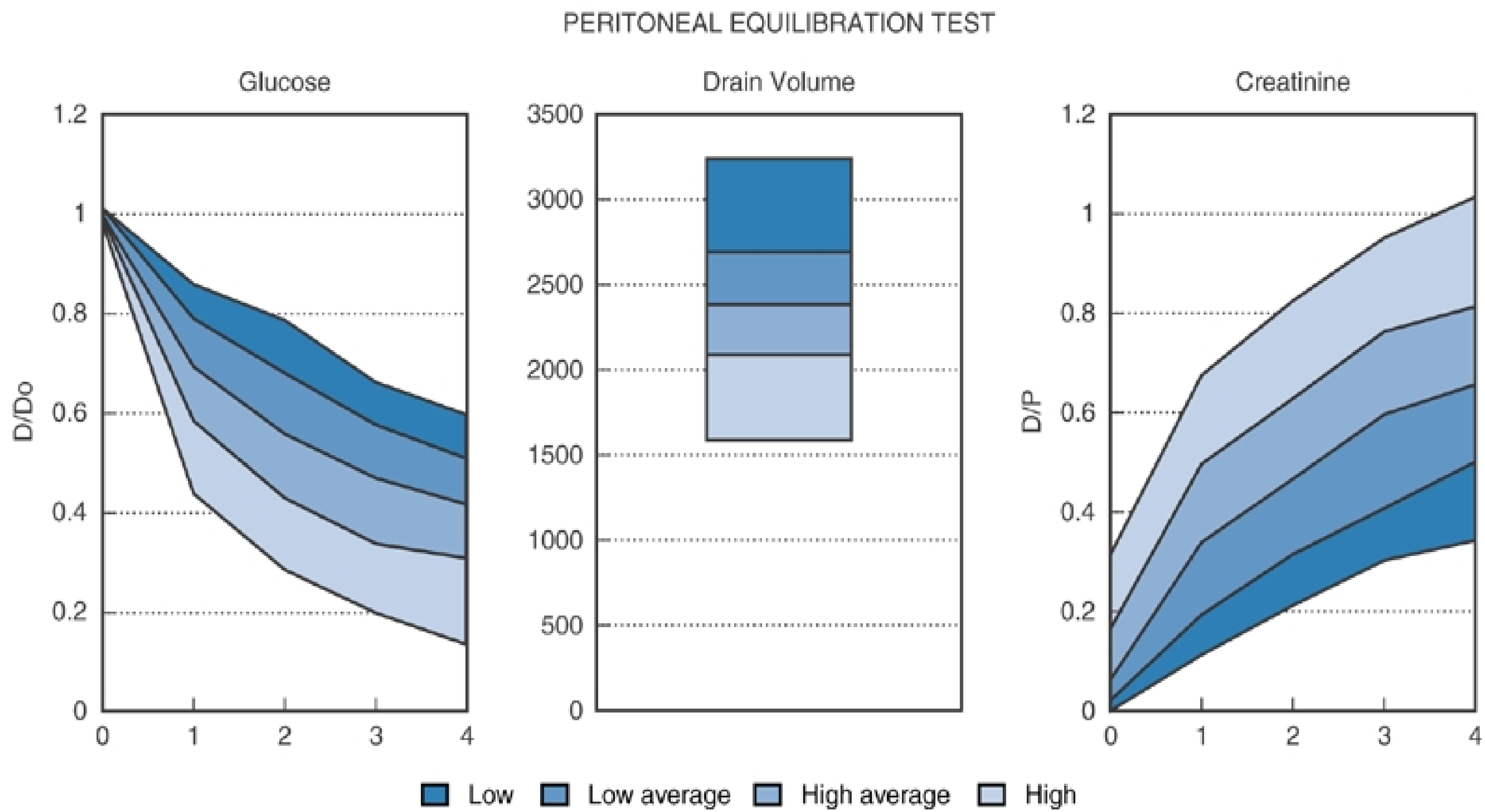
(D/Pcreatinine reflects effective vascular surface area, rather than the intrinsic permeability of the membrane!)

Twardowski Blood Purif 7: 95-108, 1989

The original 2.27% PET test

self-care dialysis symposium

SOLUTE TRANSPORT

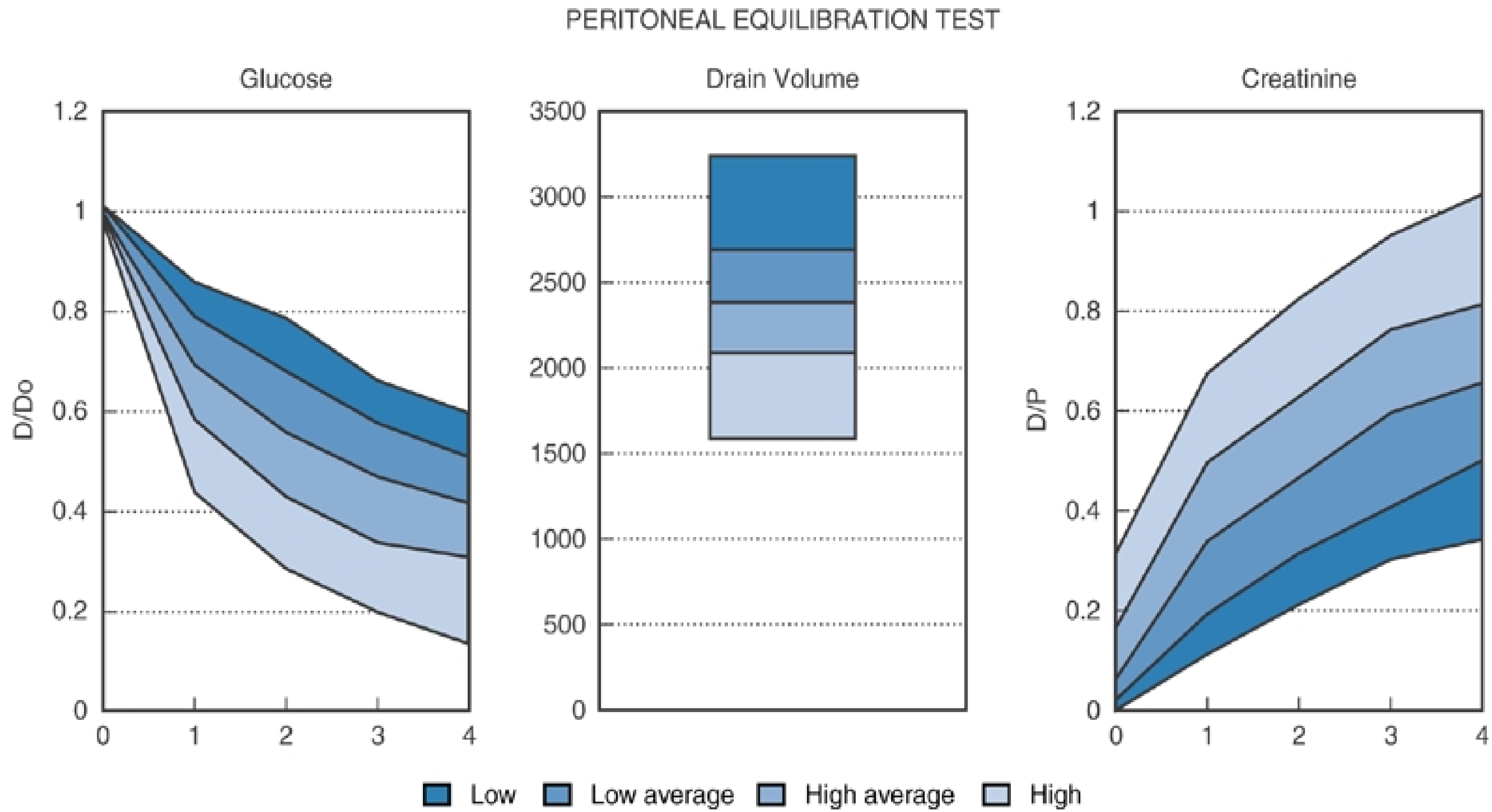


Twardowski Blood Purif 7: 95-108, 1989

The original 2.27% PET test

ULTRAFILTRATION

SOLUTE TRANSPORT



Twardowski Blood Purif 7: 95-108, 1989

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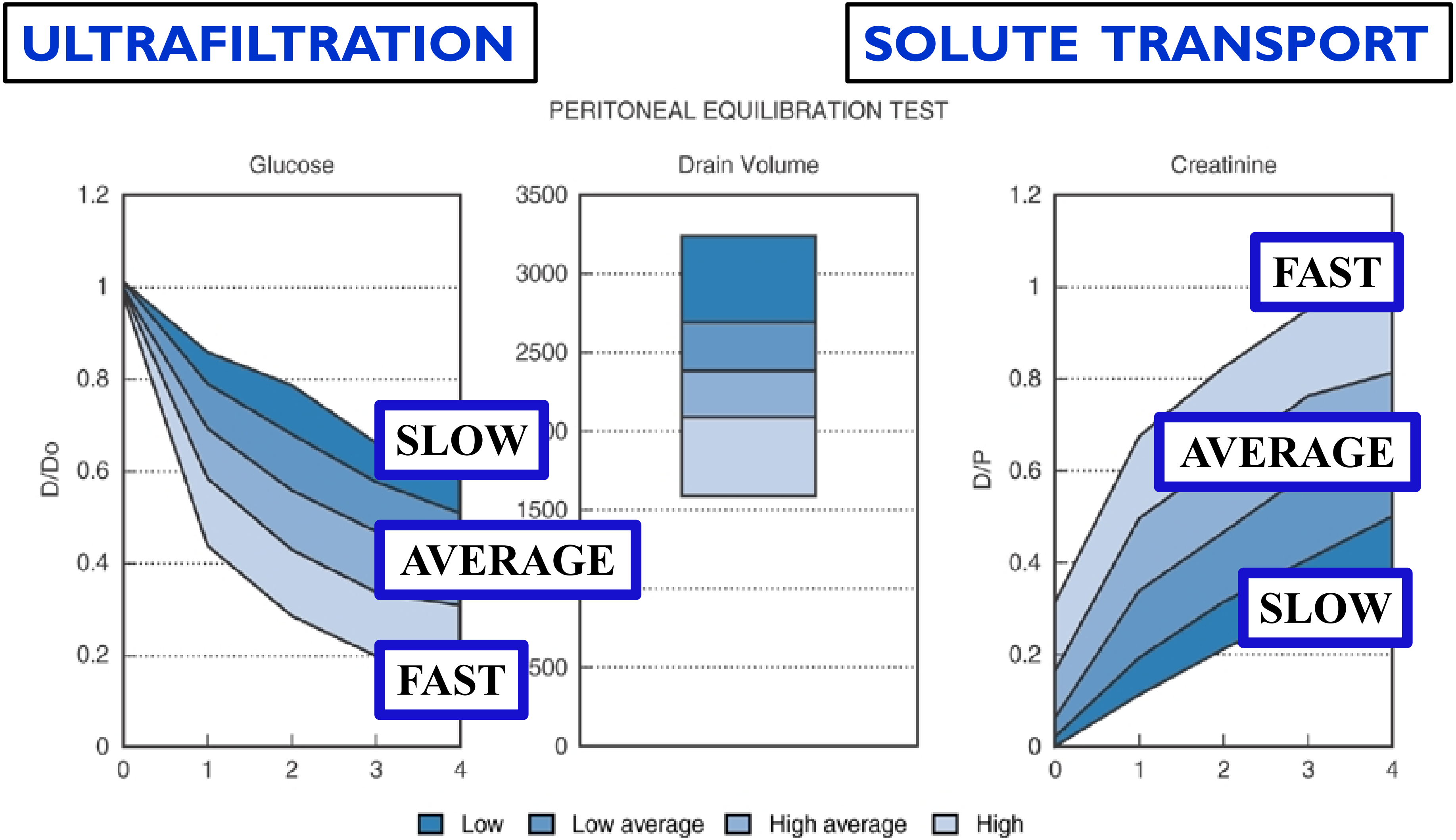


Twardowski Blood Purif 7: 95-108, 1989

Fast/slow: need a test?

Table 1. Peritoneal membrane transport types and their consequences for clinical management

Transport type	Properties	Recommendations
Fast transporter **FAST**	Fast, hyperbolic, equilibration of creatinine, typically with a D/P_{creat} >0.80 after 4 h	Short dwells, preferably shorter than 180 min
	Fast dissipation of glucose from the peritoneal cavity, with negative ultrafiltration in dwells with 1.36% glucose longer than 180 min	Icodextrin to be considered for longest dwell, unless sufficient residual diuresis
	Limited sodium sieving, with 3.86% PET and small (<5 mmol/l) delta D_{sodium} (difference between the D_{sodium} at start and after 1 h)	Check inflammatory status (peritoneal protein loss). When negative, check transport status using larger fill volumes
Average transporter **AVERAGE**	Moderately fast equilibration of creatinine, with a steeper slope in the beginning than at the end of the dwell	Too short (<120 min) and too long dwells (>300 min) should be avoided, except for one exchange/day (the 'long dwell')
	Moderately fast disappearance of osmotic agent. Negative ultrafiltration only in too long dwells (>240 min)	
Slow transporter **SLOW**	Slow, semi-linear equilibration of creatinine, typically with a D/P_{creat} <0.55–0.60 after 4 h	Long dwells, preferably longer than 240 min
	Sustained ultrafiltration even in dwells longer than 240 min	Use larger volumes rather than more dwells
	Important sodium sieving, with 3.86%-PET and substantial delta D_{sodium} (>5 mmol/l) after 1 h (the peak of delta D_{sodium} could occur later in the dwell)	Icodextrin probably not necessary for longest dwell. Be aware of sodium sieving when using dwells shorter than 180 min

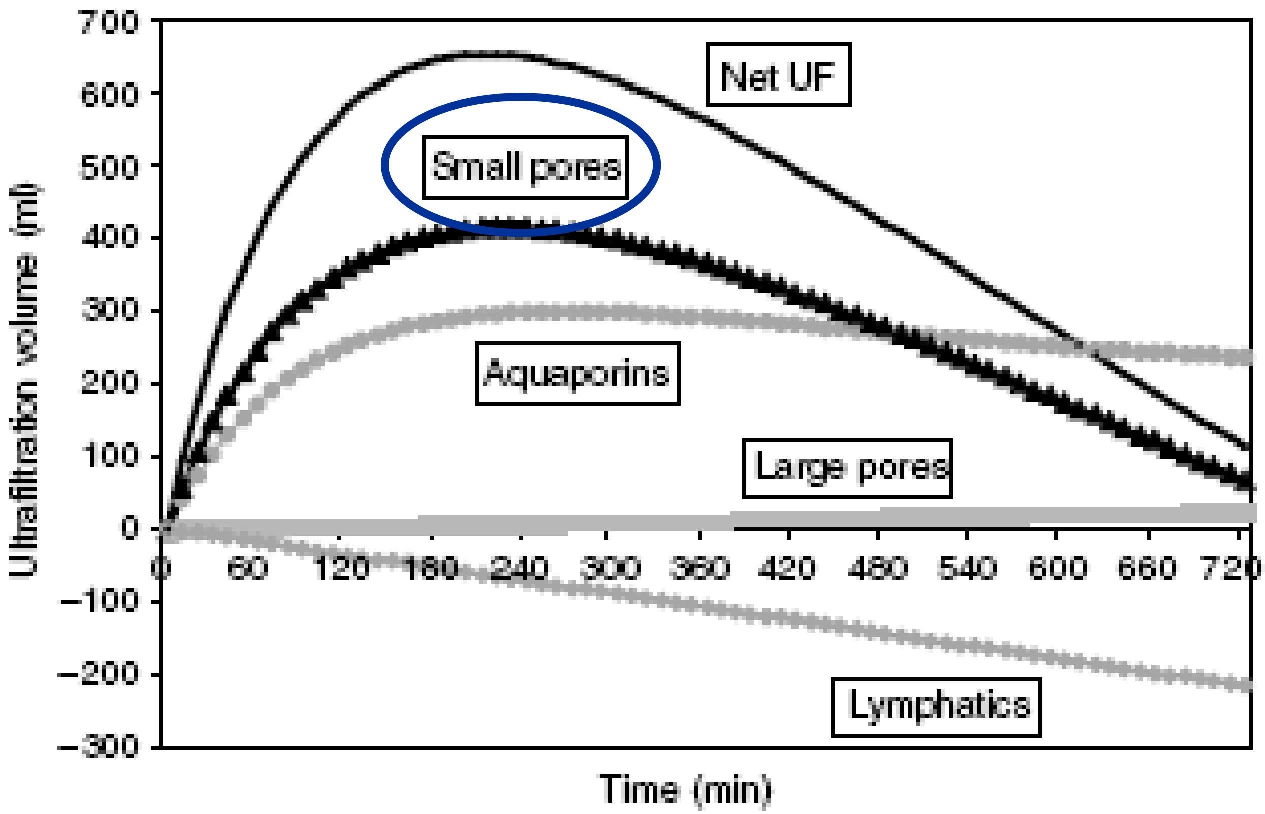
Can be derived from clinical observation without need of formal testing!

van Biesen *et al.* Nephrol Dial Transplant 25: 2052-2062, 2010

The original 2.27% PET test

self-care dialysis symposium

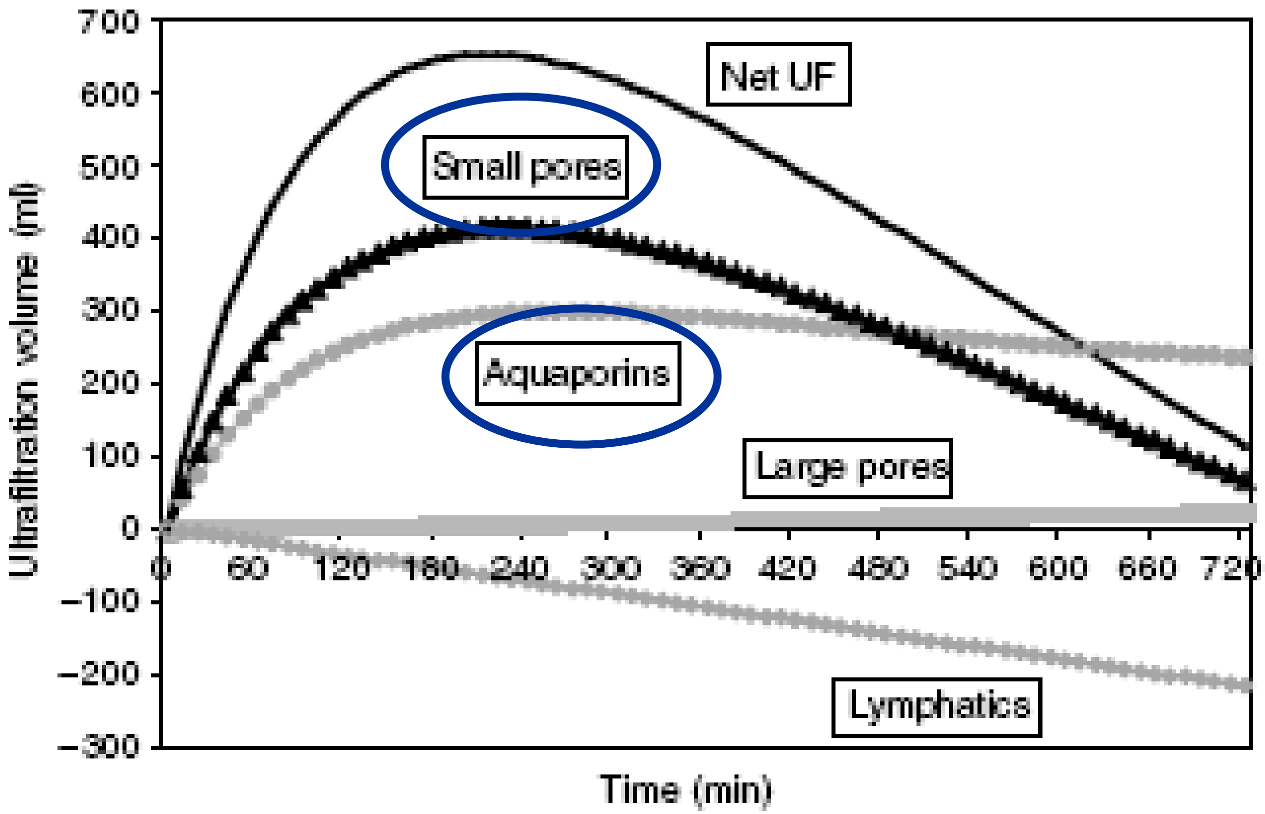
ULTRAFILTRATION



Davies Kidney Int 70 (Suppl 103): 76-83, 2006

The aquaporins?

ULTRAFILTRATION

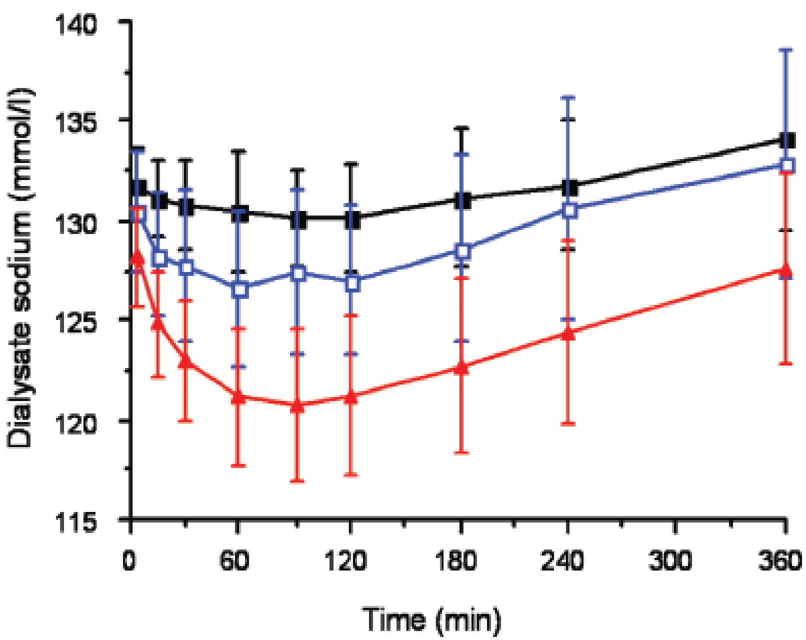


Davies Kidney Int 70 (Suppl 103): 76-83, 2006

Modified (3.86%) PET test

With a hypertonic dialysate solution, dialysate Na^+ concentration will decrease initially due to water-only transport across aquaporins.

= SODIUM SIEVING



Black: 1.36%; blue: 2.27%; red: 3.86% glucose solution

Time profile D/P_{sodium}, D_{sodium}
(or D/D0 or ΔD_{sodium} at 1 hour)
CAN BE USED TO ASSESS THE CONTRIBUTION OF AQUAPORIN TRANSPORT TO ULTRAFILTRATION

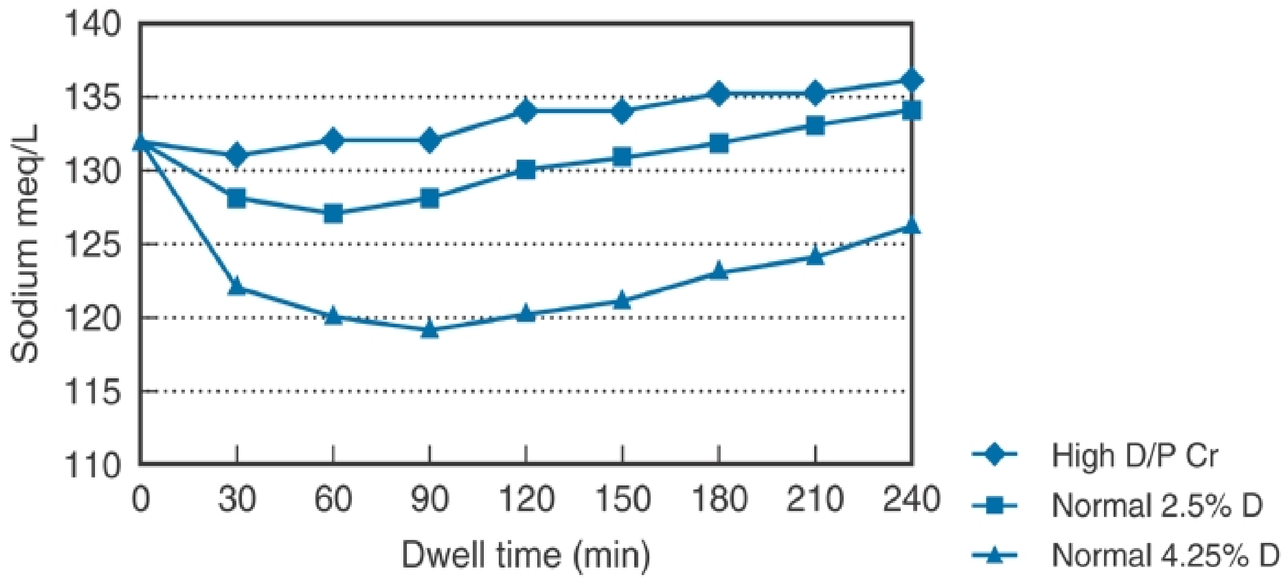
ISPD definition of UF failure =
< 400ml UF after 4 hours of 3.86% glucose

Modified (3.86%) PET test

self-care dialysis symposium

BUT:
A flat SODIUM SIEVING profile may have different meanings!
(at least theoretically)

aquaporin deficiency
“very very fast” small solute transport (small pores)



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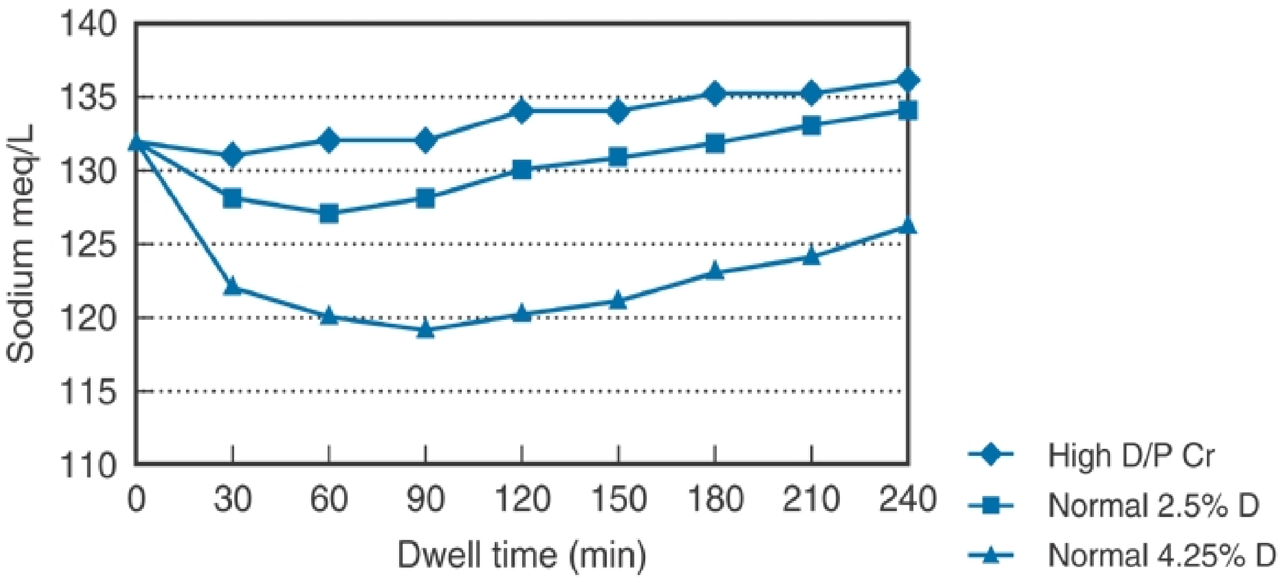
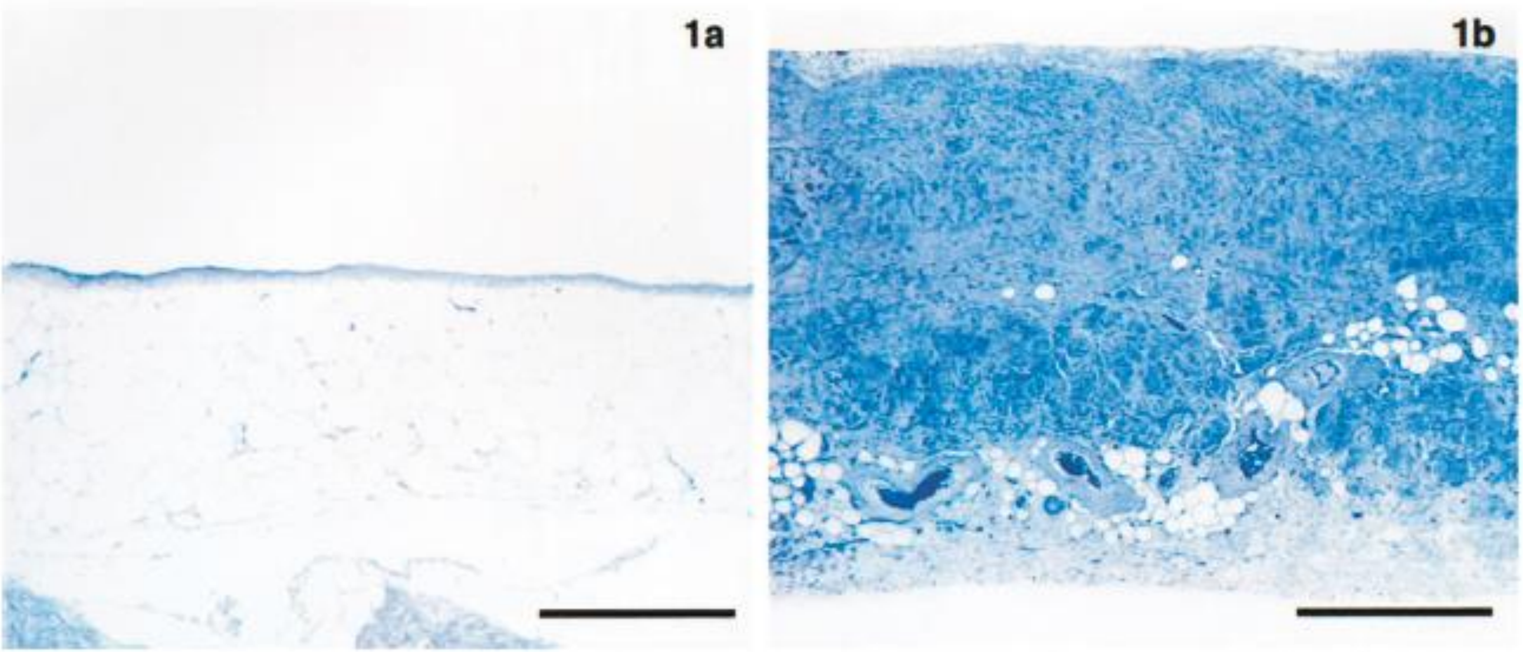


Pore models: interstitium?

Morphological changes in peritoneal membrane
THICKNESS OF SUBMESOTHELIAL COMPACT ZONE



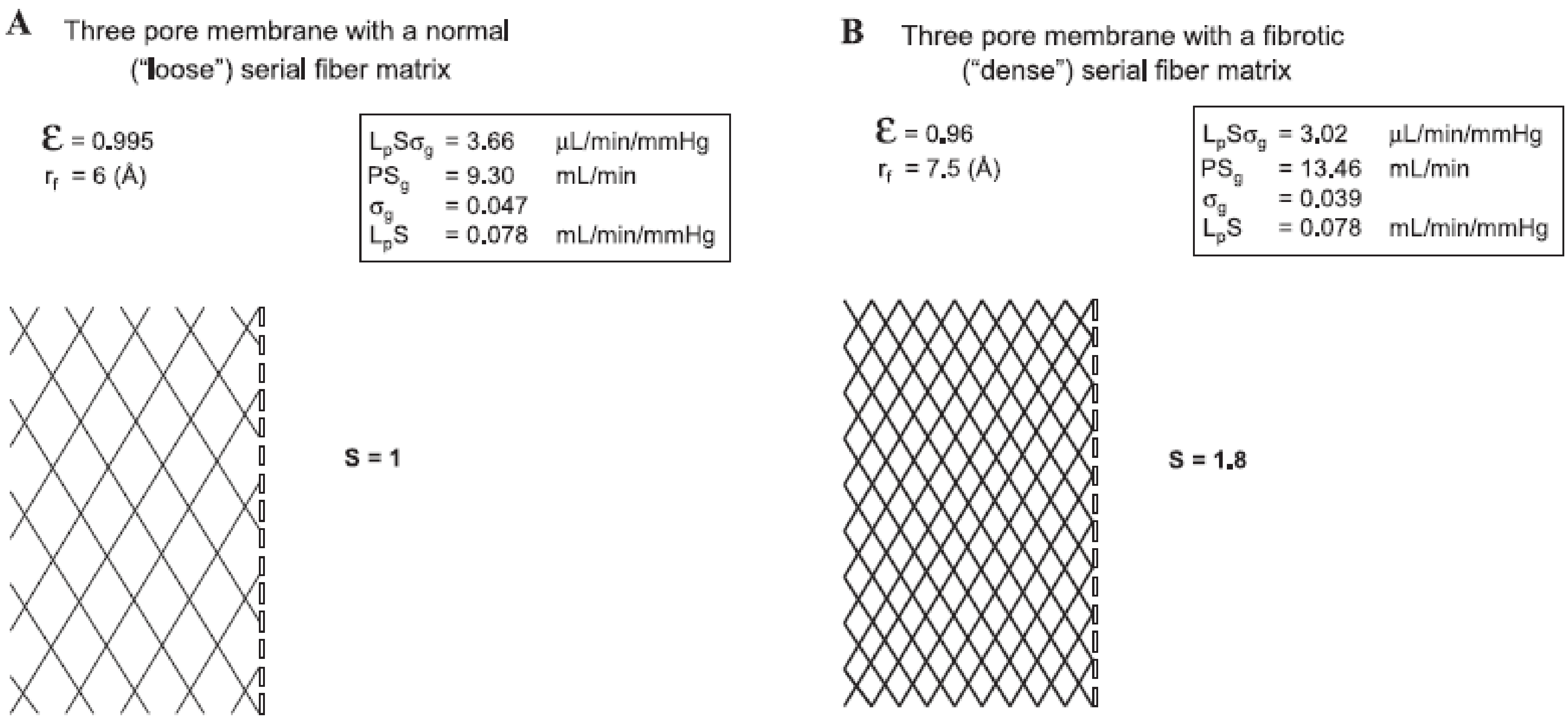
Normal

After 9 years of PD

Williams et al. J Am Soc Nephrol 13: 470-479, 2002

Pore models: interstitium?

the serial three-pore membrane/fiber matrix model



Rippe et al. Am J Physiol Renal Physiol 292: F1035-F1043, 2007

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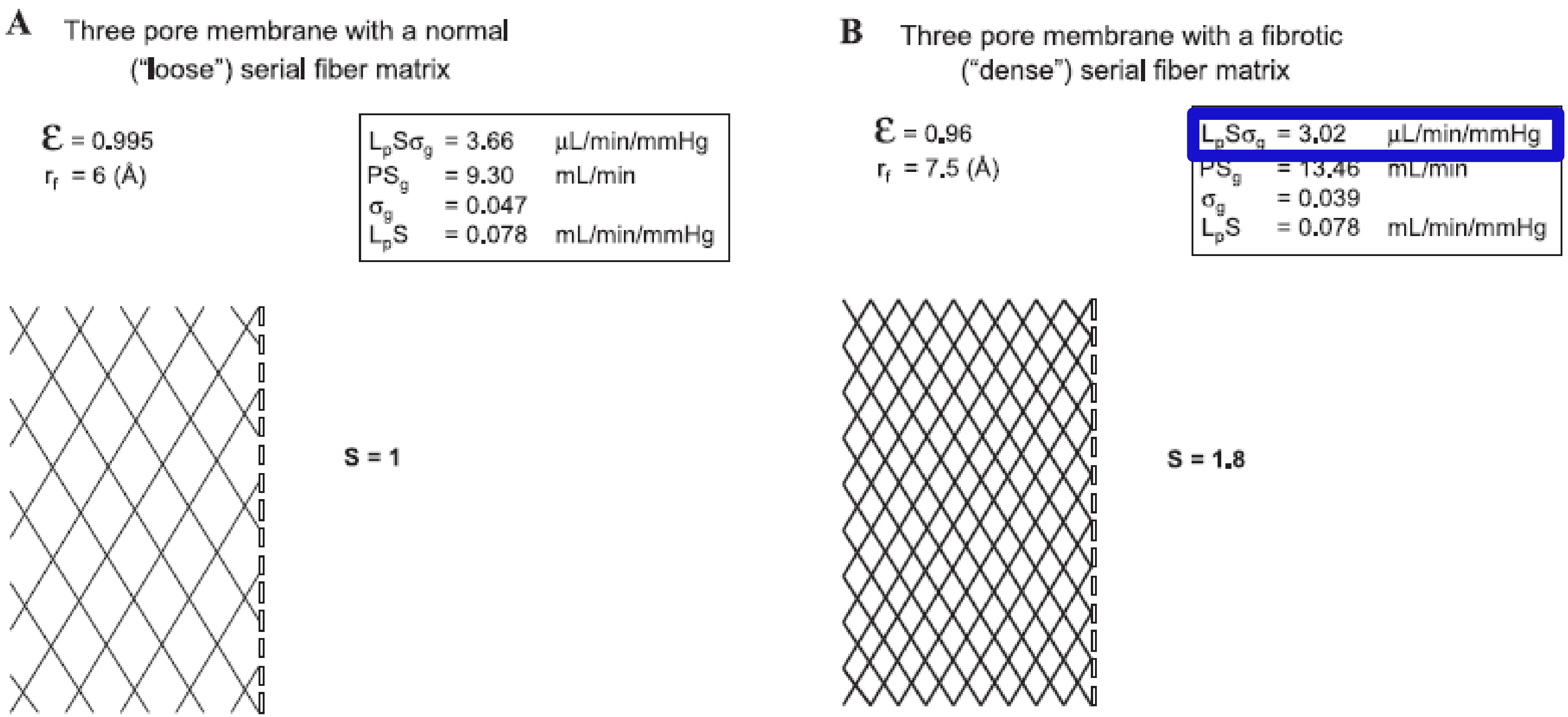


Rippe et al. Am J Physiol Renal Physiol 292: F1035-F1043, 2007

The concept of OCG

self-care dialysis symposium

The Osmotic Conductance to Glucose

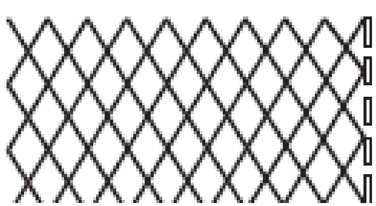
= the ability of glucose to exert an osmotic pressure sufficient to cause transperitoneal ultrafiltration

= $L_p.S.\sigma$ (µl/min/mmHg)

B Three pore membrane with a fibrotic ("dense") serial fiber matrix

ε = 0.96
r_f = 7.5 (Å)

$L_pS\sigma_g$	= 3.02	µL/min/mmHg
PS_g	= 13.46	mL/min
σ_g	= 0.039	
L_pS	= 0.078	mL/min/mmHg



Rippe et al. Am J Physiol Renal Physiol 292: F1035-F1043, 2007

OCG: the Dummy's view

$L_p.S.\sigma$ (µl/min/mmHg)

Reflection coefficient of glucose

= lower in case of aquaporin dysfunction

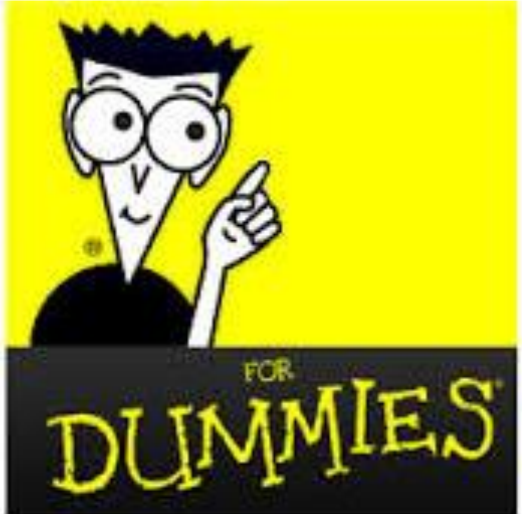
= lower in case of increased small solute transport

Surface area

= higher in case of increased small solute transport

Hydraulic conductivity

= lower in case of fibrosis



OCG: the Dummy's view

A flat SODIUM SIEVING profile may have different meanings! (at least theoretically)

$L_p.S.\sigma$ (µl/min/mmHg)

aquaporin deficiency

"very very fast" small solute transport (small pores)

fibrotic peritoneal interstitium ("closed membrane", uncoupling)

	OCG	Free water transport	Small pore water transport
Reference	normal	normal	normal
Increased small solute transport	normal	normal	low
Aquaporin dysfunction	low	low	normal
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(double) mini-PET

A flat SODIUM SIEVING profile may have different meanings! (at least theoretically)

aquaporin deficiency
"very very fast" small solute transport (small pores)
fibrotic peritoneal interstitium ("closed membrane", uncoupling)

Mini-PET added value:
quantitative assessment of free water transport and small pore water transport

Double mini-PET added value:
quantitative assessment of free water transport and small pore water transport
+
assessment of osmotic conductance to glucose

(double) mini-PET

self-care dialysis symposium

Mini-PET
1 hour of 3.86%
assessment of $D/P_{creatinin}$, $D/P_{glucose}$, D/D0 or ΔD_{sodium}
calculation of free & small pore water transport

Free water transport (FWT):

$$FWT\ (ml) = UFT\ (ml) - UFSP\ (ml)$$

Ultrafiltration over the small pores (UFSP) is assessed using the Na clearance:

$$UFSP\ (ml) = [NaR\ (mmol)1000]/Na_p(mmol/l)$$

NaR (mmol) is the Na removed during the second part of the test with the 3.86% solution. NaR is calculated as follows:

NaR (mmol) = [Drained dialysate volume (l) • Na concentration (mmol/l) in the drained dialysate] − [Volume of dialysate before infusion (l) • Na concentration (mmol/l) in dialysate before infusion]

Na_p = plasma sodium.

Smit *et al.* Perit Dial Int 23: 440-449, 2003
La Milia *et al.* Kidney Int 68: 840-846, 2005

(double) mini-PET

Mini-PET
1 hour of 3.86%
assessment of *D/P*$_{creatinin}$, *D/P*$_{glucose}$, D/D0 or ΔD$_{sodium}$
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Smit *et al.* Perit Dial Int 23: 440-449, 2003
La Milia *et al.* Kidney Int 68: 840-846, 2005

(double) mini-PET

Double mini-PET
1 hour of 1.36%, followed by 1 hour of 3.86%

From the 3.86% hour:
assessment of $D/P_{creatinin}$, $D/P_{glucose}$, D/D0 or ΔD_{sodium}
calculation of free & small pore water transport

From the two consecutive dwells of 1 hour:

Osmotic Glucose Conductance (OCG) (ml/min/mmHg)

$$OCG = ((V_{3.86} - V_{1.36})/(19.3(G_{3.86} - G_{1.36})60))1.7$$

La Milia *et al.* Kidney Int 72: 643-650, 2007

(double) mini-PET ⟶ uni-PET

self-care dialysis symposium

Double mini-PET

$D/P_{creatinin}$, $D/P_{glucose}$
cannot be extrapolated to the classical or modified PET result

Ultrafiltration volume after 1 hour 3.86%
cannot be referenced to the ISPD definition of UF failure

Rodriguez et al. Blood Purif 25: 497-504, 2007
Waniewski et al. ASAJO J 42: 518-523, 1998
Imholtz et al. Kidney Int 46: 333-340, 1994

(double) mini-PET → uni-PET

Uni-PET

1 hour of 1.36%,
followed by 4 hours of 3.86%,

but with temporary drainage after 1 hour

UNI-PET naam: datum:

Con-centratie dialysaat	Tijd	Procedure UNI-PET	volume In	volume uit	naam dialysaat staal uit	bloed staal
2,27% 2l	s'avonds	. wegen zak+ emmer+klemmen		in dagboek pat		
		. 8-10u terplaatse				
		Na 8-10 u verblijftijd 2,27 %				
1,36%2L	T0	. wegen 1,36% zak +emmer+klemmen				
		. rechtopstaande uitloop over 20min				
		. inloop over 10 min, liggende houding				
		rotatie om 400ml				
		.dialysaatstaal direct na inloop 1,36%			Dt-60	
		(100ml uit, staalname en reinfusion)				
		. wegen uitloop nacht				
		60 min verblijftijd start na inloop				
		Na 60 min verblijftijd 1,36%				
3,86%2l	T0	. wegen 3,86% zak+emmer+klemmen				
		. uitloop 1,36% over 20 min				
		. Inloop 3,86% over 10min				
		. dialysaatstaal uitloop 1,36%			Dref	
		. dialysaatstaal direct na inloop 3,86%			DT0	
		(100 ml uit, staalname en reinfusion)				
		. Wegen uitloop 1,36%				
		60 min verblijftijd start na inloop				
		Na 60 min verblijftijd 3,86 %				
	T60	. **volledige** uitloop over 20min				
		in enkelvoudige uitloopzak				
		. wegen uitloop				
		. uitloop terug laten inlopen, 10ml in			DT60	
		zak laten voor staalname dialysaat				
		. bloedstaal				PT60
		120 min verblijftijd start na inloop				
		Na 120min verblijftijd 3,86 %				
	T120	**. dialysaatstaal (100ml uit,**			DT120	
		staalname en reinfusion)				
		. Na 240 min verblijftijd 3,86%				
dialysaat	T240	wegen dialysaatzak+emmer+klemmen	in dagboek pat			
zie						
voor-		. uitloop over 20 min				
schrift		**. staal uitloop**			DT240	
		. inloop (zie voorschrift)				
		. wegen uitloop				

La Milia *et al.* J Nephrol 23: 633-647, 2010

OCG: the Dummy's view

self-care dialysis symposium

A flat SODIUM SIEVING profile may have different meanings! (at least theoretically)

$L_p.S.\sigma$ (µl/min/mmHg)

aquaporin deficiency
"very very fast" small solute transport (small pores)
fibrotic peritoneal interstitium ("closed membrane", uncoupling)

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OCG: what does it mean?

self-care dialysis symposium

Parameters	Transport groups			
	Slow-average, $n = 6$	Fast-average, $n = 13$	Fast, $n = 5$	ANOVA, P
L_pS (mL/min/mmHg)	0.023 ± 0.023	0.030 ± 0.024	0.043 ± 0.046	0.53
σ_G	0.139 ± 0.060	0.117 ± 0.078	0.101 ± 0.055	0.60
OCG (mL/min/mmHg)	0.0022 ± 0.0007	0.0023 ± 0.0008	0.0031 ± 0.0015	0.49

increasing/fast small solute transport

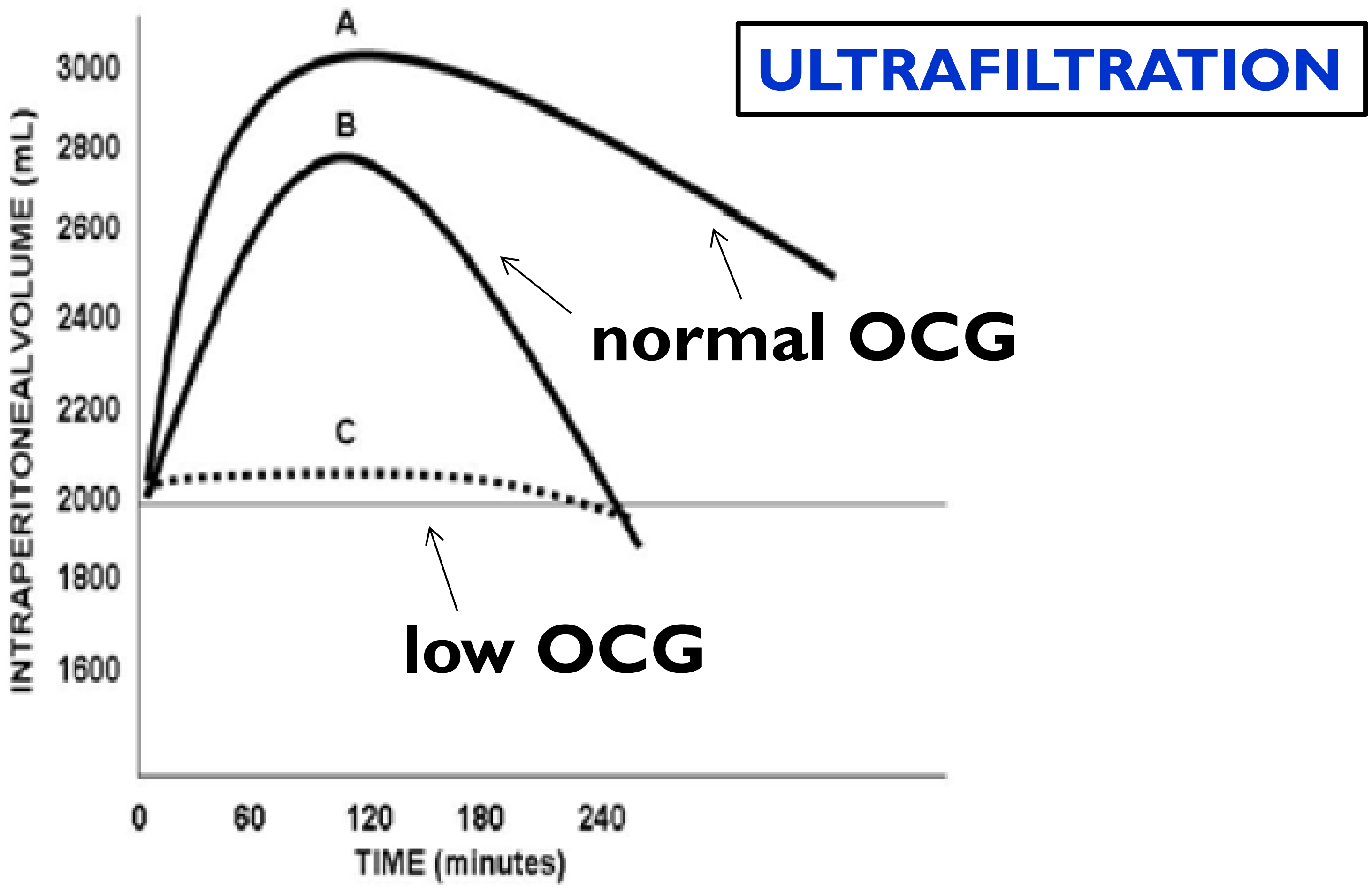
≠

low osmotic conductance to glucose

R	nUF60	UFSP60	FWT60	FWF60	nUF240	$A_0/\Delta x$	D/PCr240	D/D0G240	D/PNa60	DipNa60
OCG	**0.91** **P < 0.001**	**0.84** **P < 0.001**	0.11 P = 0.61	**−0.50** **P < 0.05**	−0.09 P = 0.67	0.24 P = 0.26	0.10 P = 0.65	−0.09 P = 0.67	−0.01 P = 0.97	−0.06 P = 0.77

Galach *et al.* Nephrol Dial Transplant 28: 447-454, 2013

OCG: what does it mean?

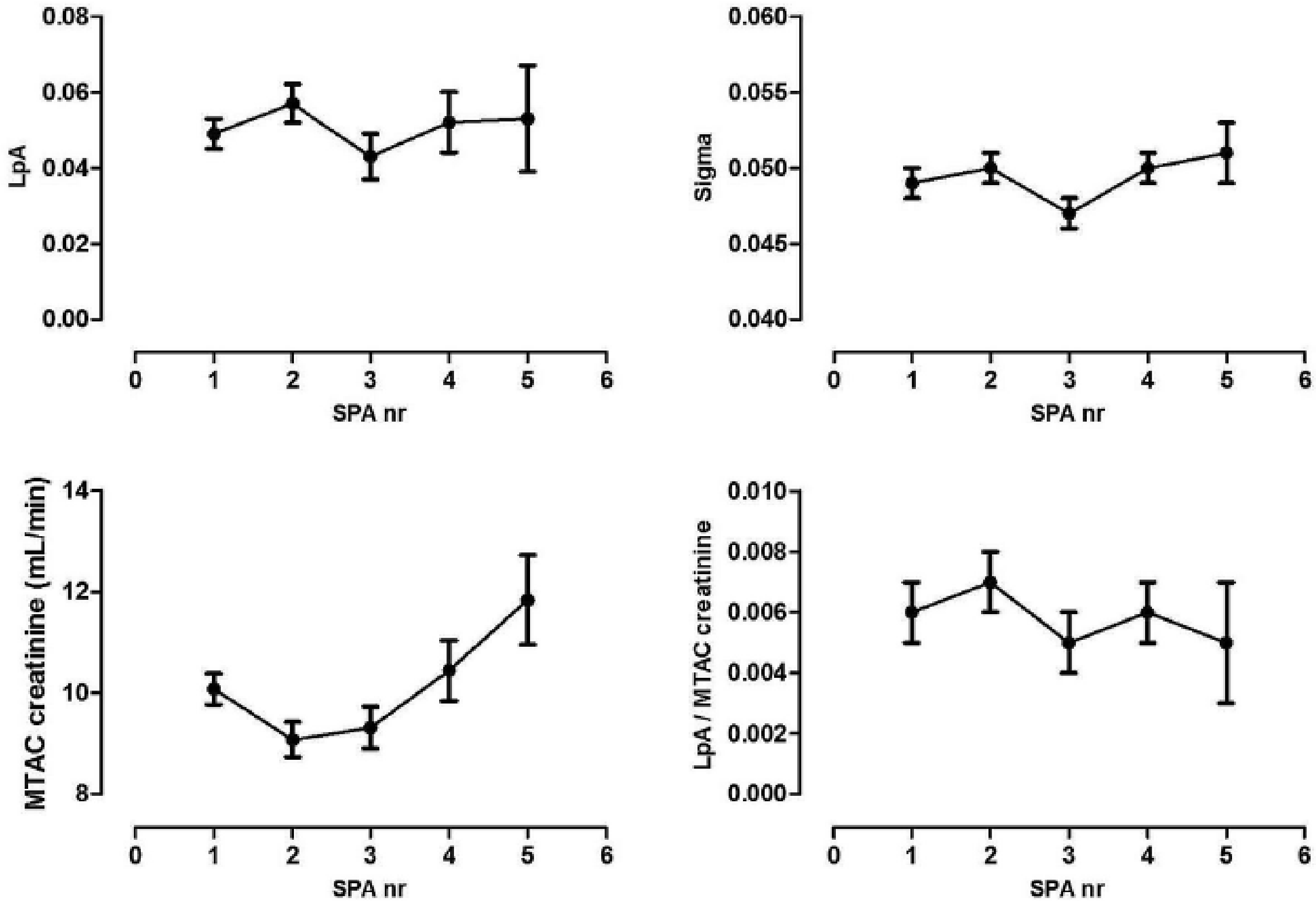


La Milia *et al.* J Nephrol 23: 633-647, 2010

OCG: what does it mean?

self-care dialysis symposium

Low osmotic conductance to glucose is particularly seen in late ultrafiltration failure.



Coester *et al.* Perit Dial Int 34: 195-203, 2014

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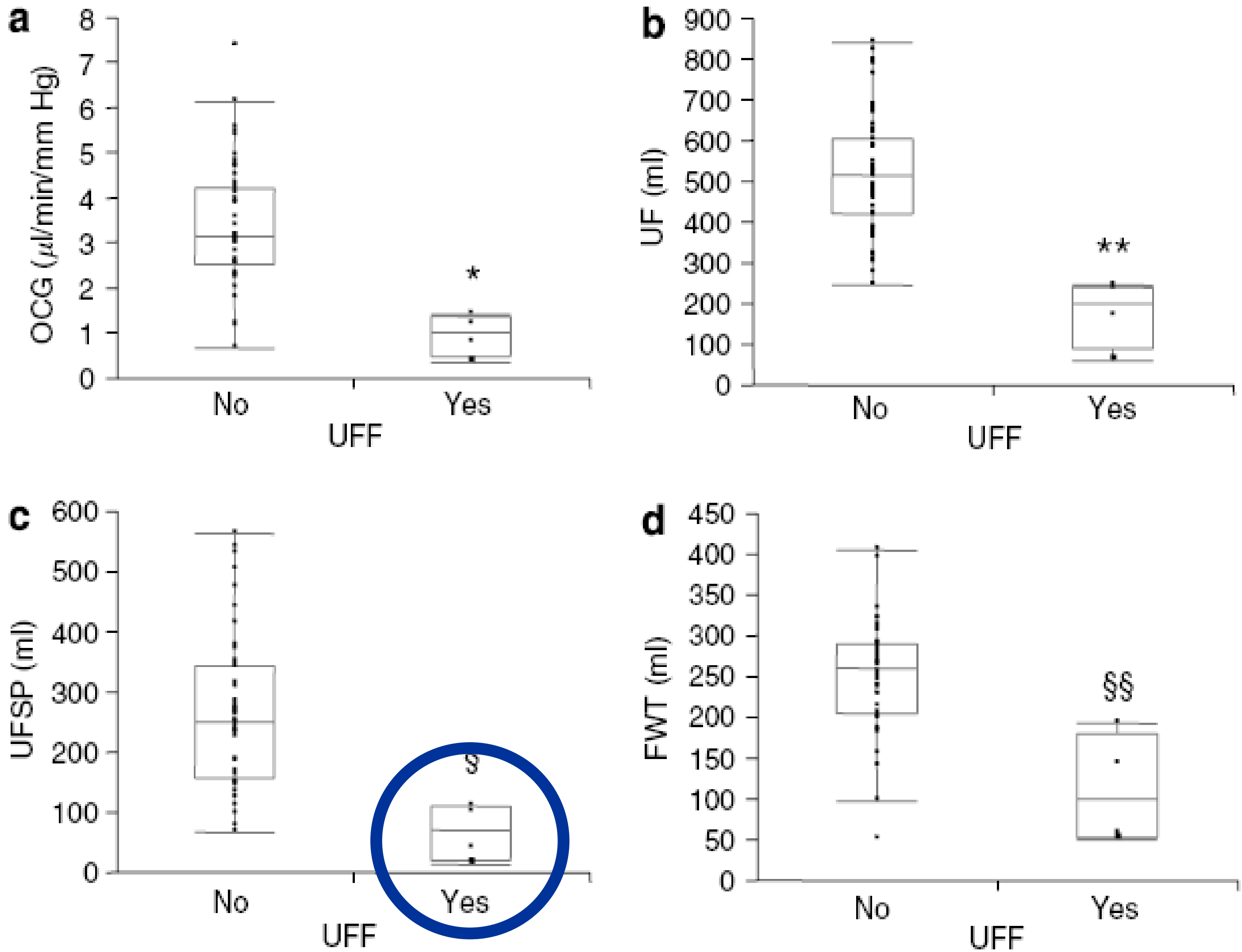
'isolated aquaporin dysfunction probably non-existent' (Rippe a.o.)

OCG: what does it mean?

self-care dialysis symposium



Double mini-PET test

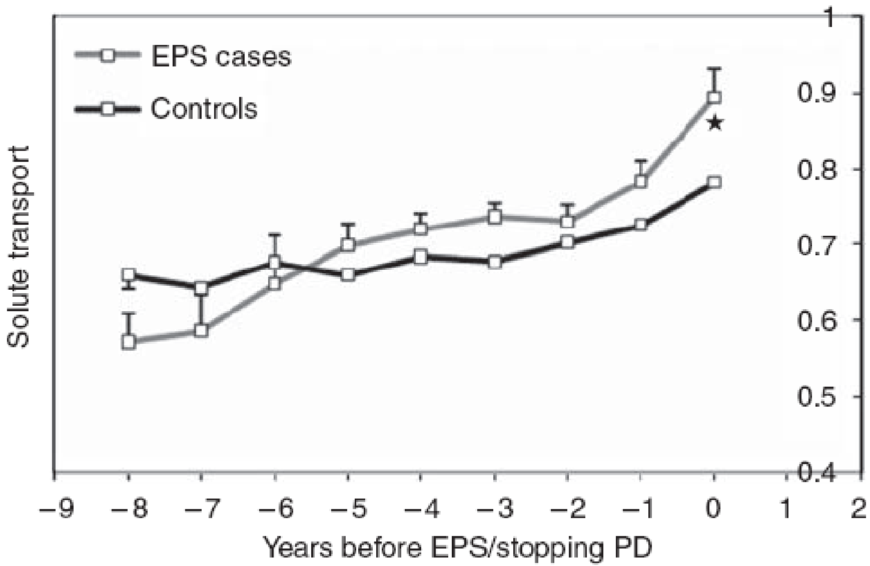
La Milia *et al.* Kidney Int 72: 643-650, 2007

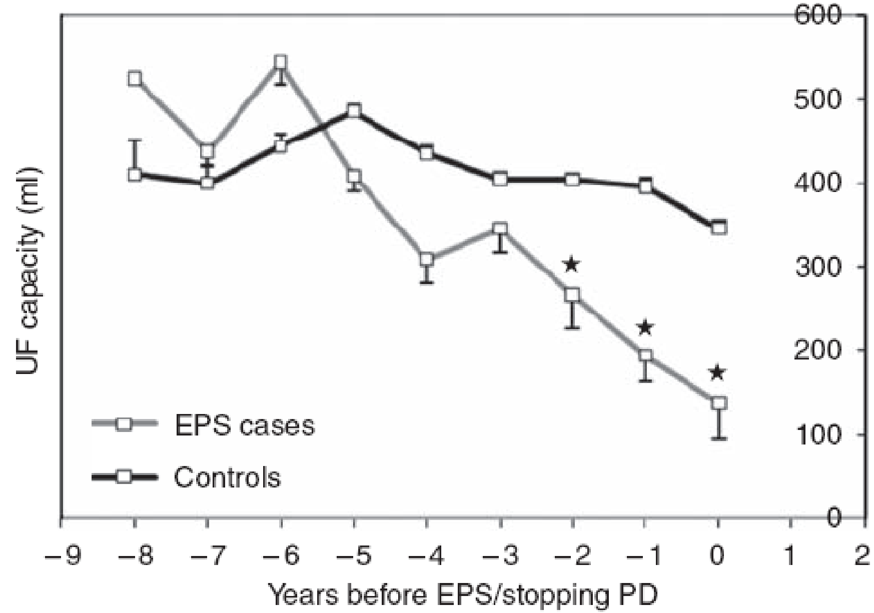
OCG: what does it mean?

self-care dialysis symposium

The peritoneal osmotic conductance is low well before the diagnosis of encapsulating peritoneal sclerosis is made

Mark L. Lambie[1,2], Biju John[1,2], Lily Mushahar[1,2], Christopher Huckvale[1,2] and Simon J. Davies[1,2]





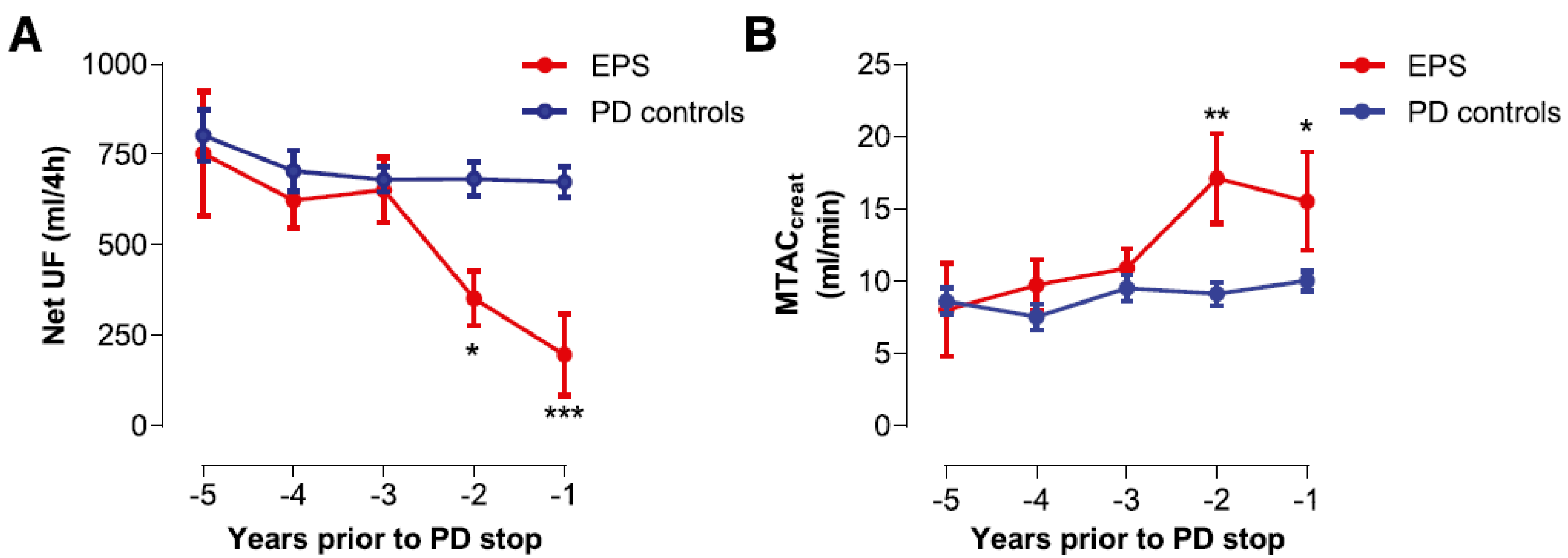
Lambie *et al.* Kidney Int 78: 611-618, 2010

OCG: what does it mean?

self-care dialysis symposium

Interstitial Fibrosis Restricts Osmotic Water Transport in Encapsulating Peritoneal Sclerosis

Johann Morelle,* Amadou Sow,* Nicolas Hautem,* Caroline Bouzin,† Ralph Crott,‡ Olivier Devuyst,*§ and Eric Goffin*



Morelle *et al.* J Am Soc Nephrol 20: 2521-2533, 2015

OCG: what does it mean?

self-care dialysis symposium

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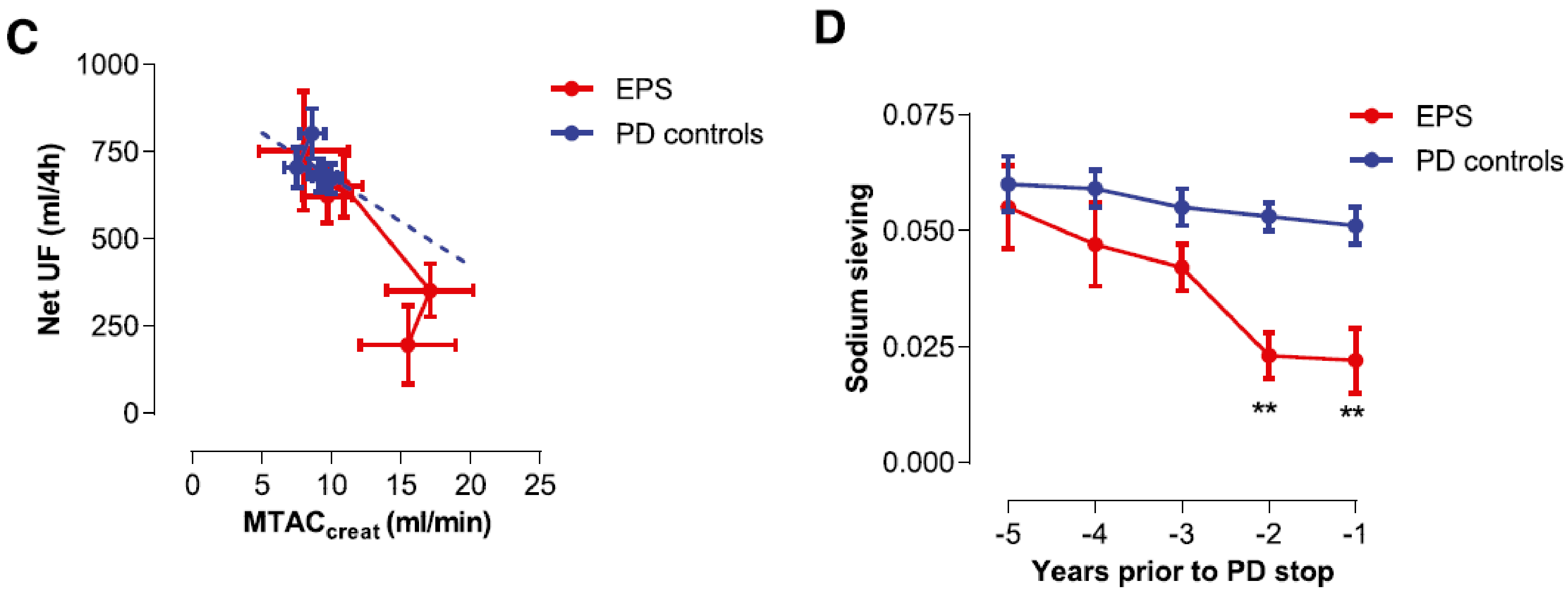

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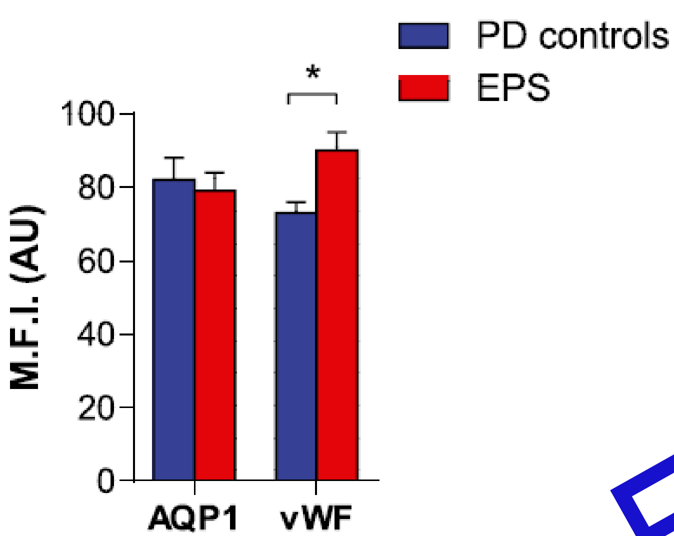
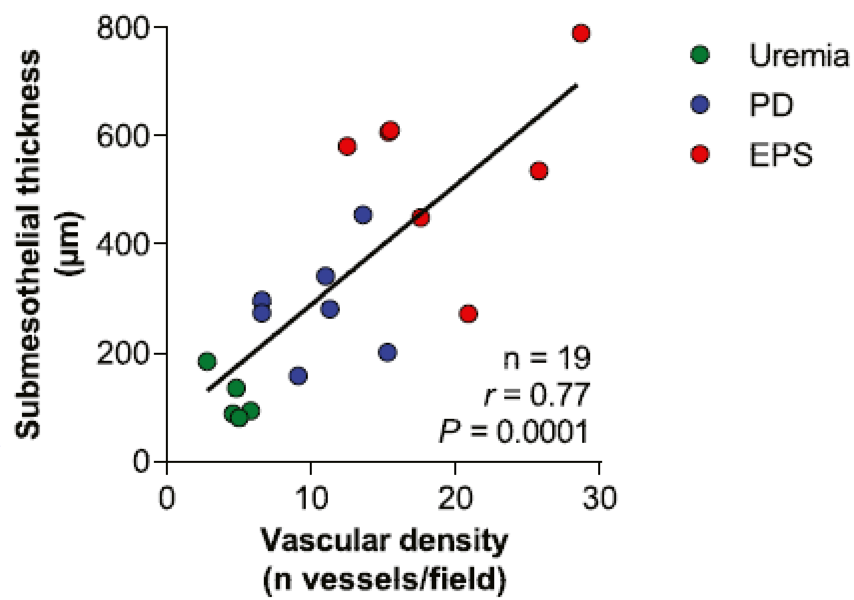


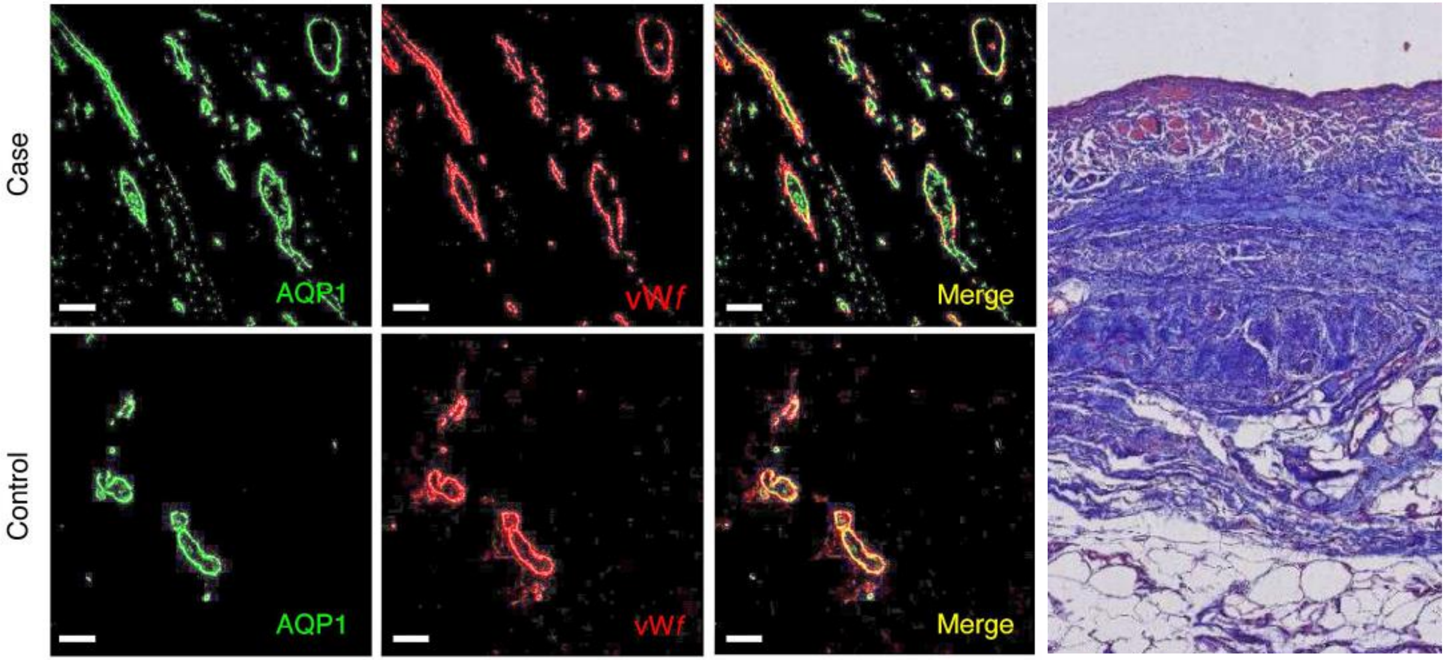


Morelle *et al.* J Am Soc Nephrol 20: 2521-2533, 2015

OCG: what does it mean?

self-care dialysis
symposium

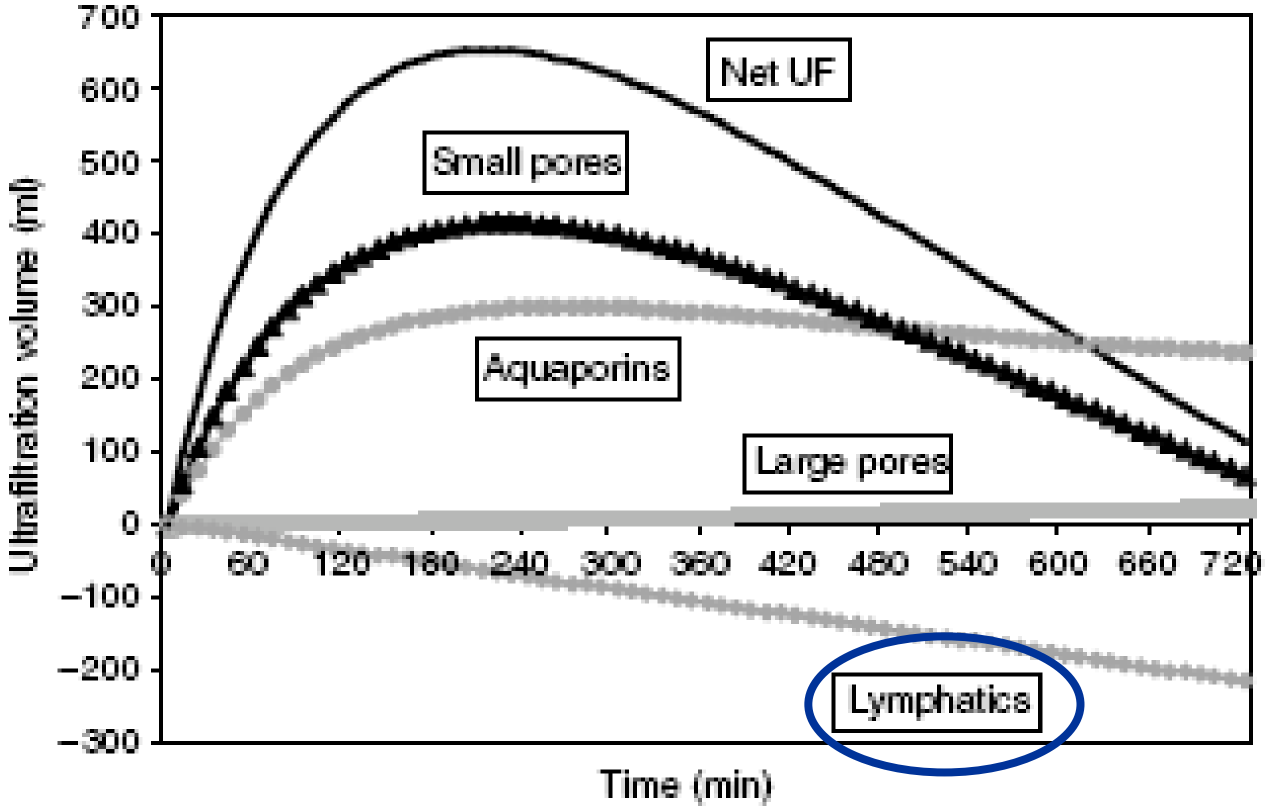
Ultrafiltration Failure and Impaired Sodium Sieving During Long-Term Peritoneal Dialysis: More Than Aquaporin Dysfunction?



Morelle *et al.* Perit Dial Int 36: 227-231, 2016

The THREE pore theory

ULTRAFILTRATION



Davies Kidney Int 70 (Suppl 103): 76-83, 2006

The SPA test

self-care dialysis symposium

The standard peritoneal permeability analysis: A tool for the assessment of peritoneal permeability characteristics in CAPD patients

MARJA M. PANNEKEET, ALEXANDER L.T. IMHOLZ, DICK G. STRUIJK, GER C.M. KOOMEN, MONIQUE J. LANGEDIJK, NATALIE SCHOUTEN, RUDI DE WAART, JOHAN HIRALALL, and RAYMOND T. KREDIET

1.36% glucose solution + Dextran 70 (1g/L)

allows calculation of

- **MTAC (i.e. D/P) of creatinin, urea, urate**
- **glucose absorption rate**
- **net ultrafiltration**

but also

- **effective lymphatic absorption rate**
- **clearances of other molecules (β_2M, IgG,...)**

Pannekeet et al. Kidney Int 48: 866-875, 1995

Now you know
how to evaluate the peritoneal membrane!

BUT…

…IS IT NOT USEFUL ANYMORE?

…IS IT STILL MANDATORY?

WHO KNOWS THE ANSWER?

How to evaluate the peritoneal membrane?

B. Bammens

Brussels, May 12 2016

UZ LEUVEN

KU LEUVEN

BELGIUM

3rd self-care dialysis symposium

12th & 13th May 2016

self-care dialysis symposium