Faculté de médecine

Les Hôpitaux Universitaires de STRASBOURG

UNIVERSITÉ DE STRASBOURG

Daily management of PD: introduction and maintenance

Fundamental of pediatric dialysis
October 21st 2021

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pédiatrie 1

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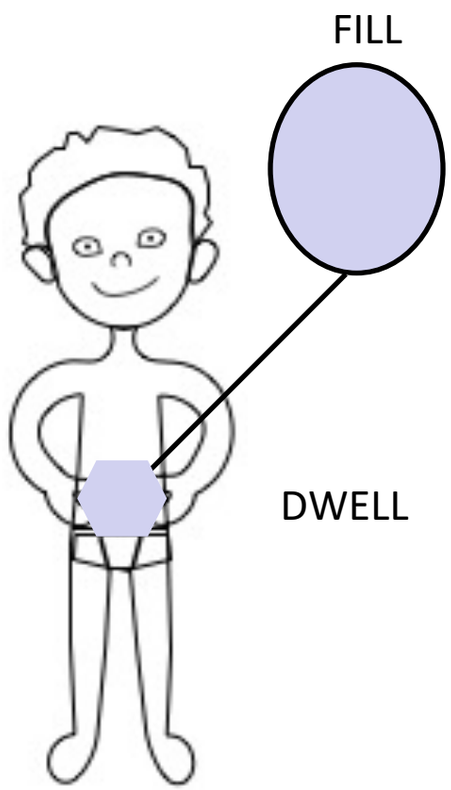
PARAMETERS IN PD PRESCRIPTION

- Peritoneal dialysis and adequacy is dependent on the choice of PD fluid, IP fill volume and contact time =>patient specificity and acceptability



PD fluid and material
(biocompatibility, osmotic power, less GDP)

IP fill volume

1) **Large**=> surface recruited increased, more solute removal and osmotic charge
2) **Too large**=> bad tolerance and loss of UF "back filtration"

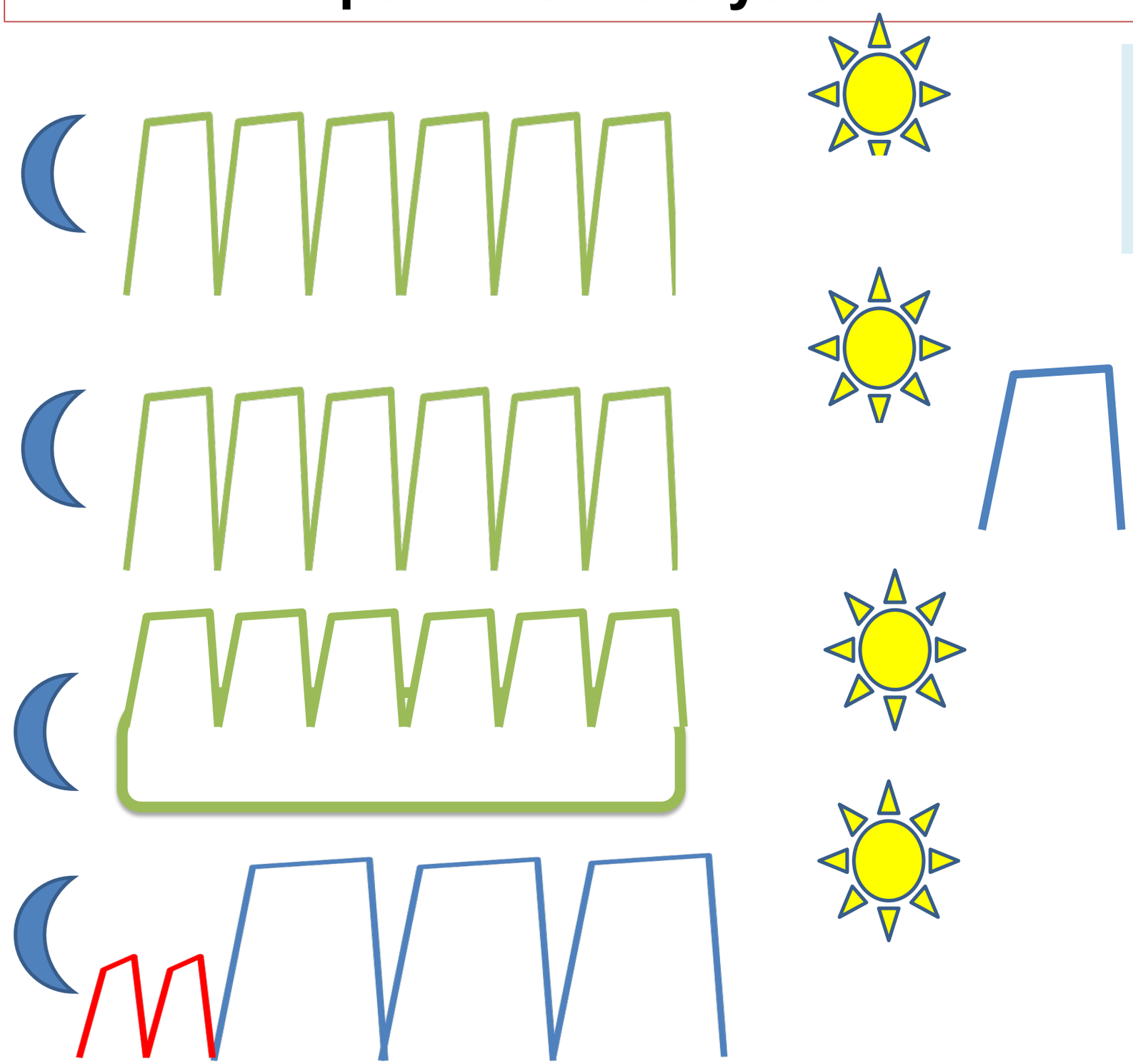
Dwell time

1) **short** => conservation of UF (osmotic gradient)= aquaporine exchange
2) **long** =>purification time small pore, loss of osmotic gradient

PD PRESCRIPTION

Continuous ambulatory peritoneal dialysis CAPD ->Manually operated

Automated peritoneal dialysis APD-> Machine best option



Intermittent peritoneal dialysis (IPD)
Dry cavity during day

Continuous cyclic PD (CCPD)-> day dwell

DP Plus additional exchange late afternoon or evening

Tidal peritoneal dialysis partial drain

Adapted PD: variation of dwell volume and duration

INITIAL PD PRESCRITION

- If possible no use of catheter just after insertion (wait 1 to 2 weeks)
- Volumes: start with low volumes 10 ml/kg, **progressive increase**

Aim: child > 2 years 1200 ml to 1400 ml/m2, < 2 years 800 -900 ml/m^2

- NIPD is possible if residual urine or CCPD with initially half fill volume during the day
- Number of exchanges

5-15 cycles (sometimes 24 hours first days)

- Duration of a session

9-12 hours (patient acceptability)

INITIAL PD PRESCRITION

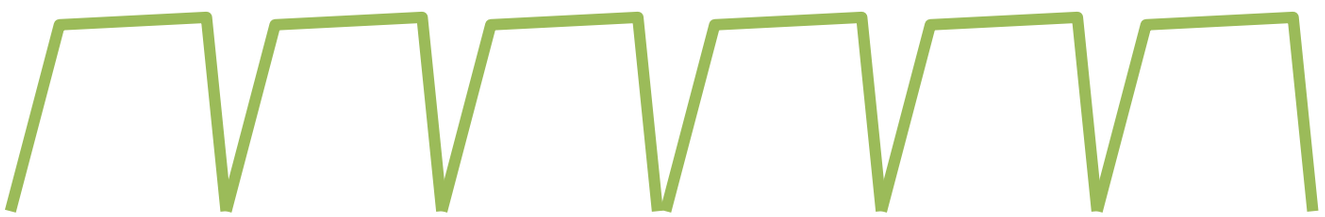
- Dwell time

1 hour (20-30 min if important overhydration and young children at the beginning)

- Initially can be performed manual sometimes continuous

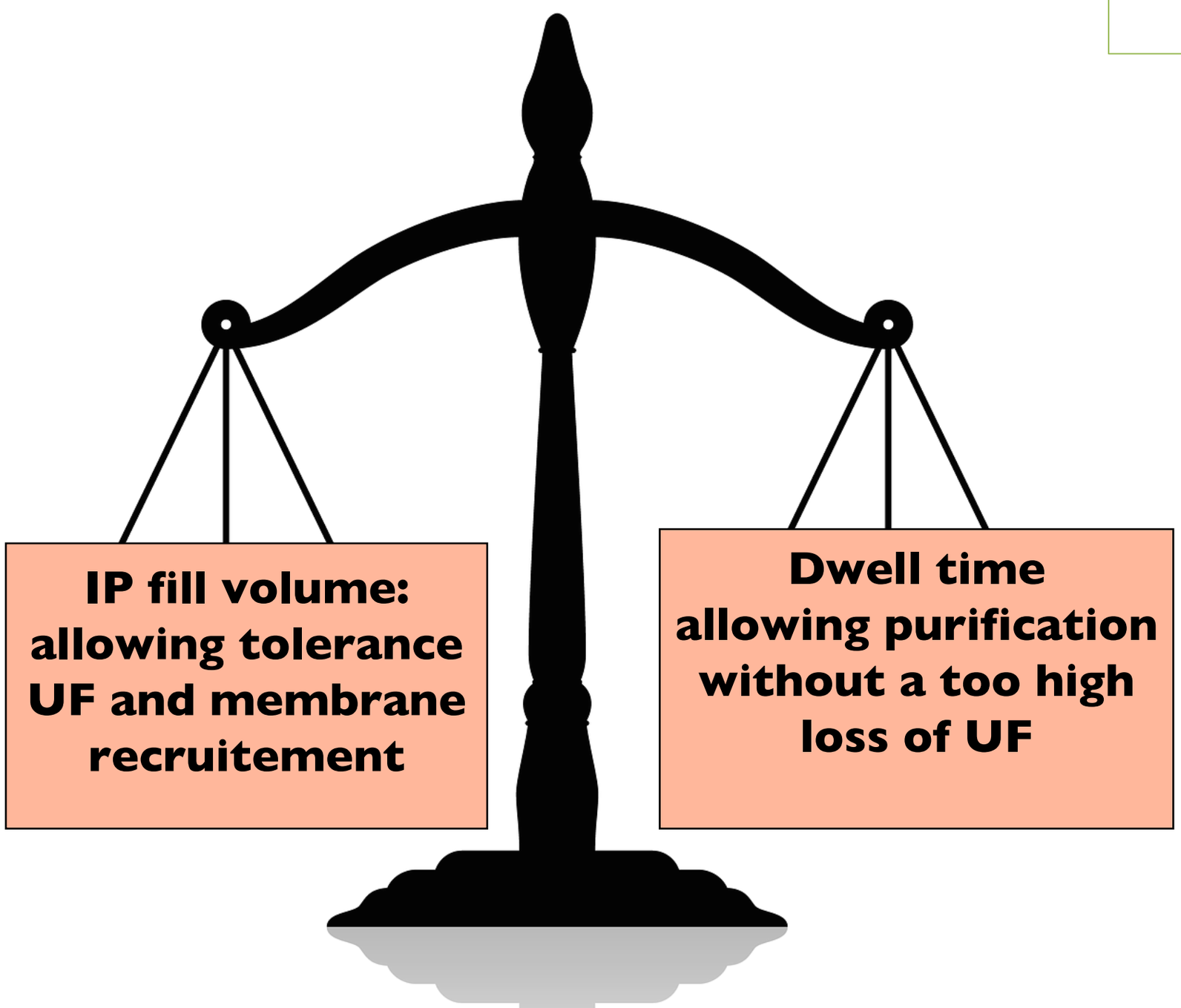
For initial small volumes

PD PRESCRITION



Standard **APD:**
repetition of identical cycles with the same dwell time and the same fill volume

Need of **UF and purification** with one kind of cycle



ADAPTATION OF PD PRESCRITION

- If an increased dialysis dose is required

Increase the total amount of fill volume if IPP acceptable and clinical tolerance

Increase duration of overnight cycles (duration of cycle)

Or add a day dwell (CCPD) or DP plus

- If an increased of UF is required or in case of bad sodium and volume control

Shorter cycles, but sodium control not improved

Add day dwell with icodextrine

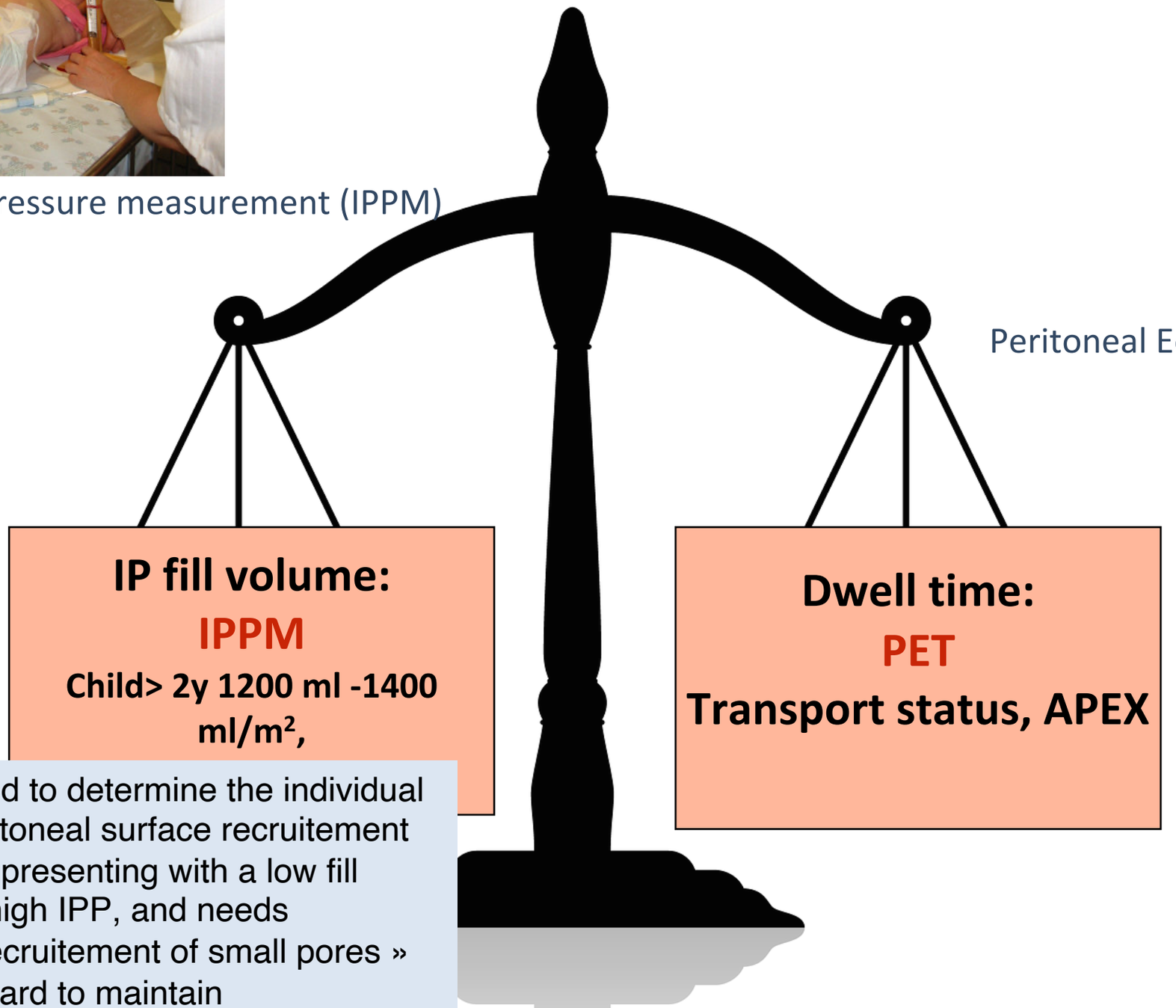
Adapted APD

Use of solution with higher glucose content (if no other choice)

PERITONEAL DIALYSIS PRESCRIPTION AND TOOLS

Intraperitoneal pressure measurement (IPPM)

Peritoneal Equilbration Test (PET)



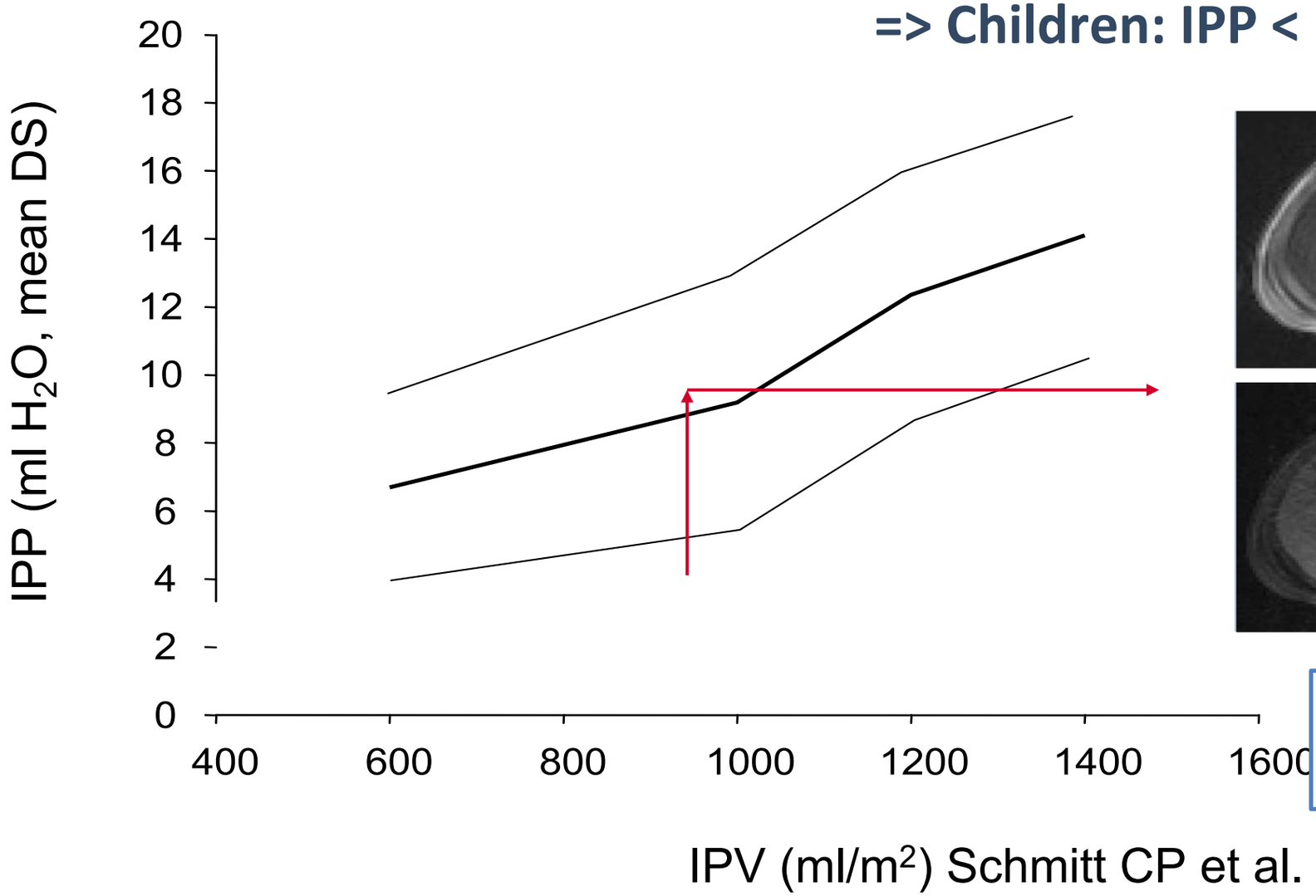
IPP can be used to determine the individual capacity of peritoneal surface recruitement
If the patient is presenting with a low fill volume and a high IPP, and needs purification « recruitement of small pores »
=>PD will be hard to maintain

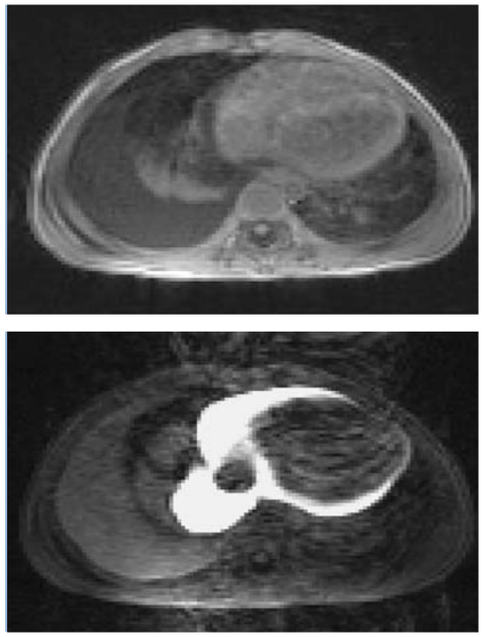
IPP MEASUREMENT

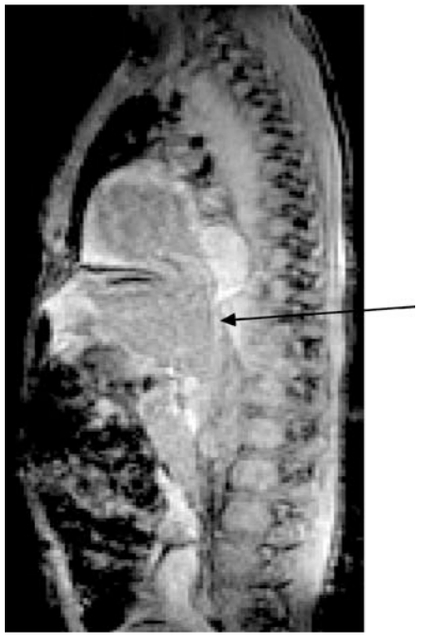
IPP AND VOLUMES

=> Infants: IPP < 8-10 cm H_2O

=> Children: IPP < 12-14 cm H_2O







Dialysate leackage in pericardiium
Borzych et al 2008

- Never > 18 cm H_2o pain or dyspnea

Schmitt CP et al, International Journal of Nephrology 2011
Borzych B, Schmitt CP, Ped Neph, 2008
Fischbach et al. PDI 2000

IPP OUTCOMES

Mechanicals complications:

6.6% of pediatric PD patients develop hernia leakage
Risks factors: organomegaly, adhesions, constipation, malnutrition surgery, pain)

Correlation with hernia:

(Arranda et al. Ped nephrol 2000)

UF and clearance

-**Reduces overall UF** =>70 ml for 1 cm H_2O (Durand et al. 1996, Fischbach et al. NDT 2002)**-> Backfiltation**

-**Decrease in UF and transport** (Imholz et al. KI 1994)

Increased IPP

Peritonitis

IPP > 14 cm H_2O

Dejardin et al. NDT 2007

Tolerance

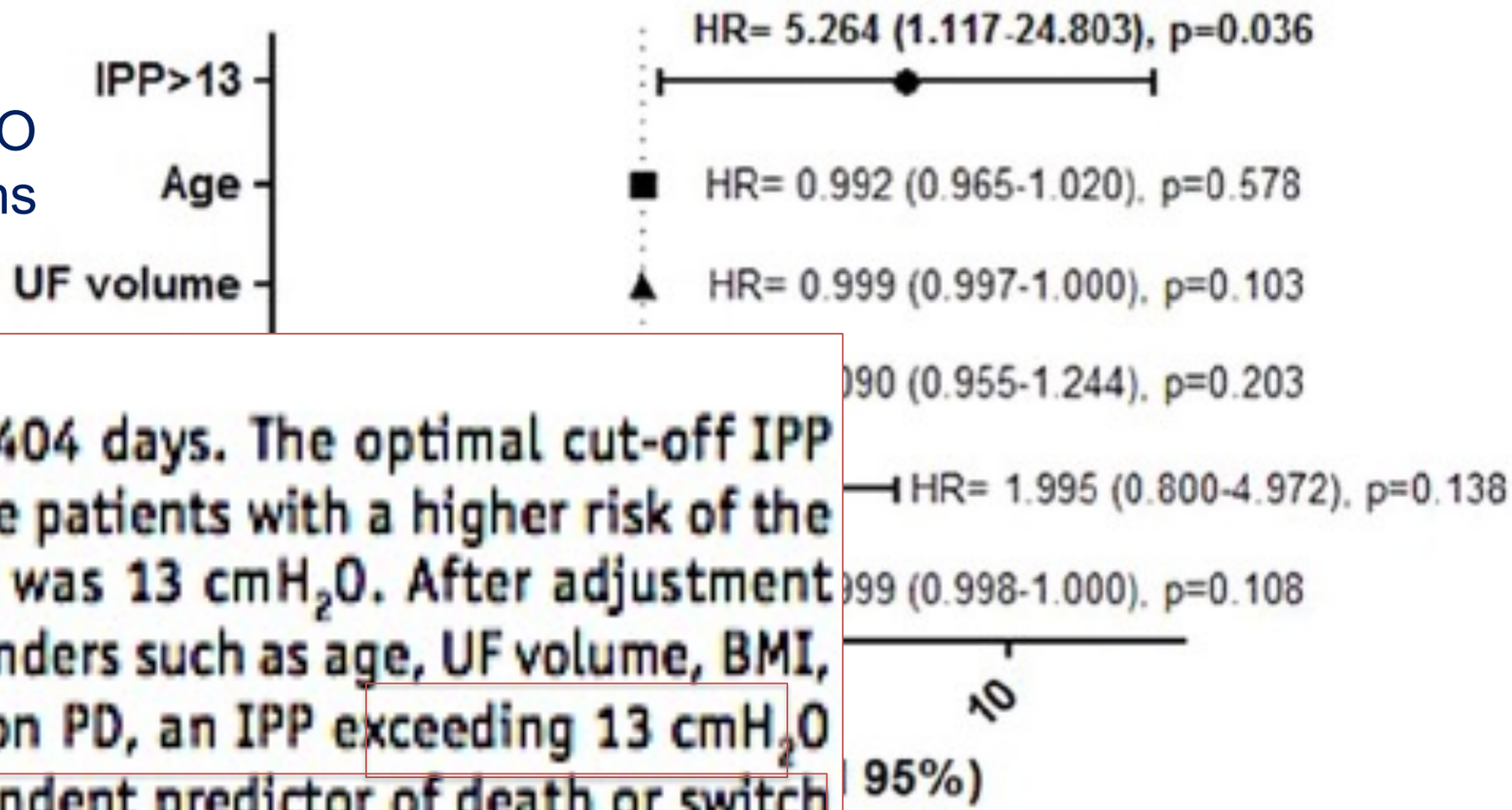
Patients perception of IPP is mostly "incorrect", objective numbers needed

Bad tolerance for IPP > 18 cm of H_2O

Better tolerance in supine position

IPP OUTCOMES

n=54, APD
IPP 18.8 ± 5.2cm H_2O
PD: 5.5 (2-19) months



follow-up of 744 ± 404 days. The optimal cut-off IPP value to discriminate patients with a higher risk of the composite outcome was 13 cmH_2O. After adjustment for potential confounders such as age, UF volume, BMI, diabetes, and time on PD, an IPP exceeding 13 cmH_2O was the only independent predictor of death or switch to HD by multivariate analysis (hazard ratio: 5.26; 95% confidence interval: 1.12 to 24.80; $p = 0.036$; Figure 1).

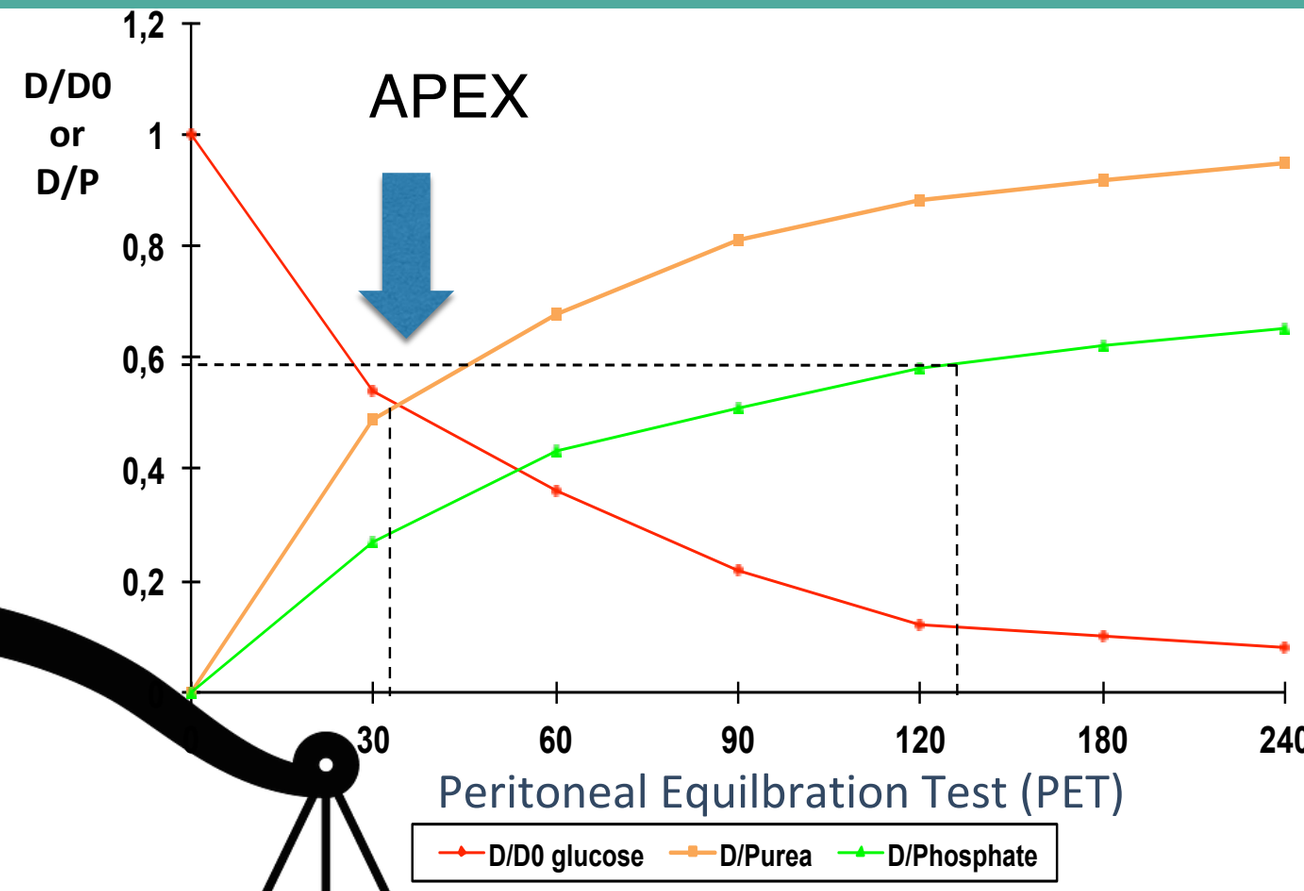
predictors of death or switch
neal pressure; UF = ultrafil-
) = peritoneal dialysis; HR =
confidence interval.

Outerelo et al PDI 2014

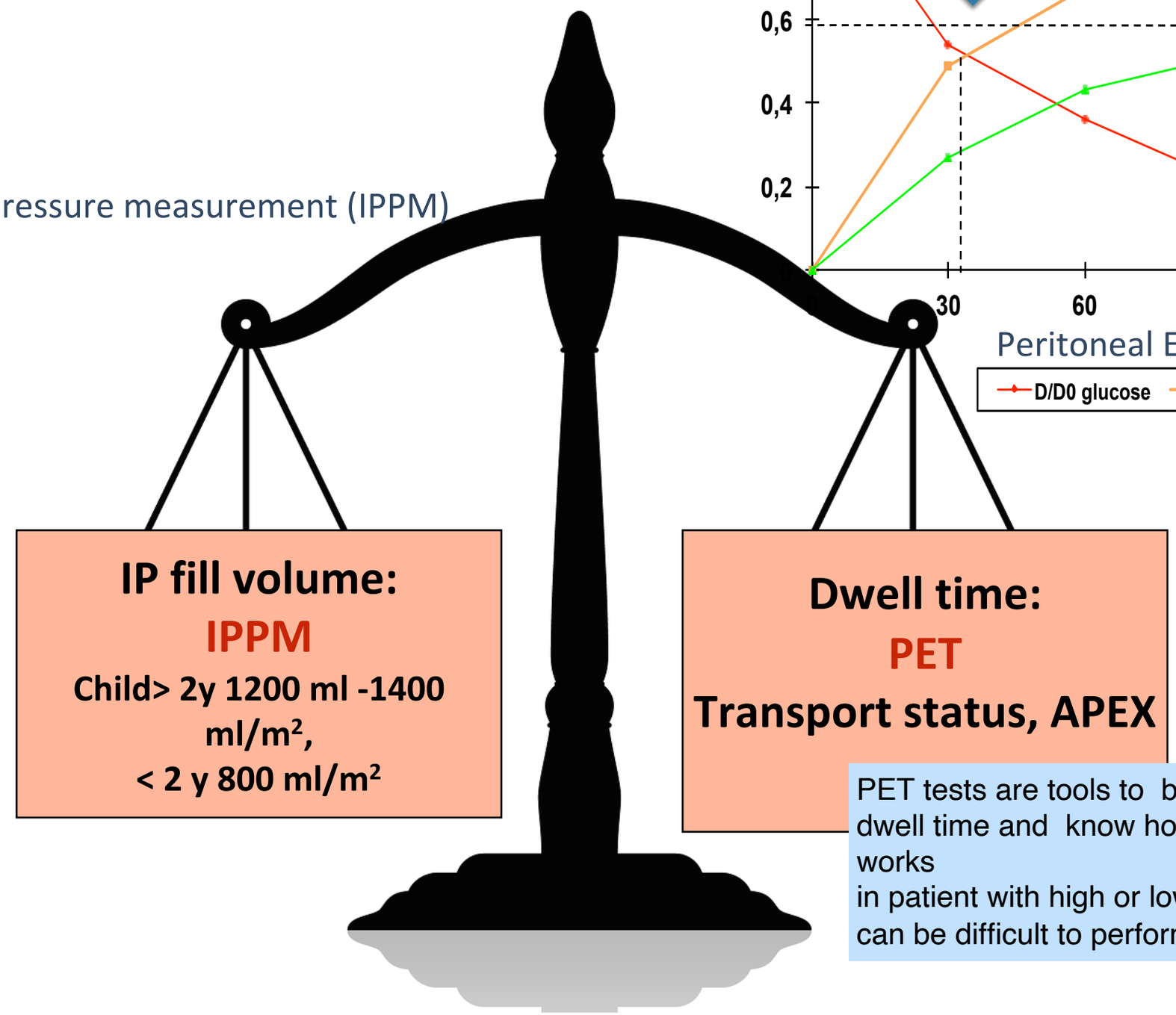
Mortality and switch to HD

IPP > 13 (Outerelo et al. PD 2014)

PERITONEAL DIALYSIS PRESCRIPTION AND TOOLS



Intraperitoneal pressure measurement (IPPM)



IP fill volume:

IPPM

Child> 2y 1200 ml -1400 ml/m²,

< 2 y 800 ml/m²

Dwell time:

PET

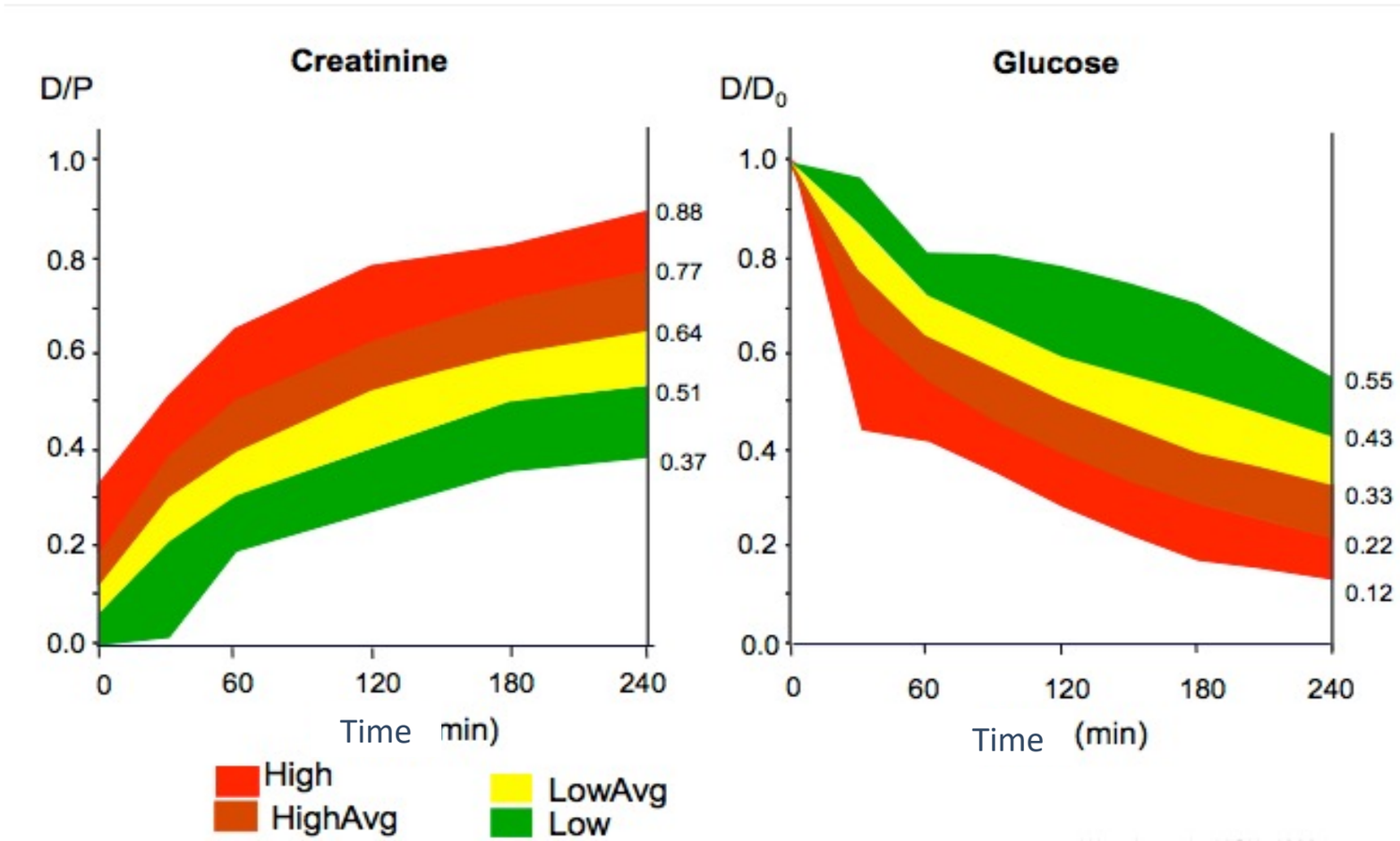
Transport status, APEX

PET tests are tools to better prescribed an optimal dwell time and know how well the membrane works

in patient with high or low transport status, dialysis can be difficult to perform

PERITONEAL EQUILRATION TEST

- Peritoneal equilibration time: 1100 ml/m2, hypertonic solution (2.27 or 3.86), dialysat sample (0, 30, 60, 120, 180, 240 min), blood sample (0, 120, 240 min) at the beginning, every year or if problem
- For urea and creatinine this is calculated as the dialysate to plasma ratio
- For glucose dividing glucose at each time point by the 0-hour dialysate glucose concentration



Warady et al., JASN, 1996

PERITONEAL EQUILRATION TEST

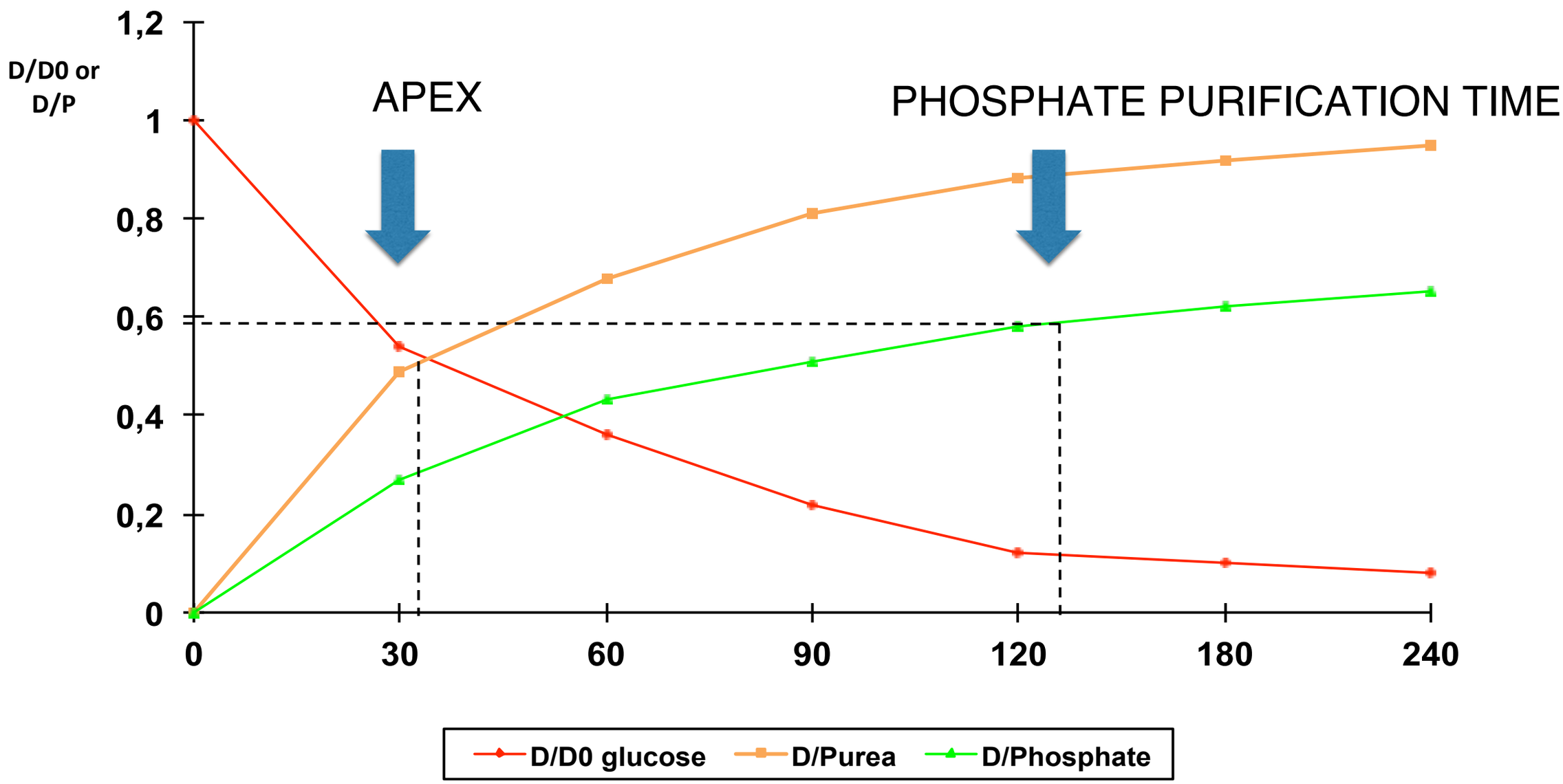
Patients (%)	Type	4-hours D/P creatinine	Characteristics
10%	High	> 0.78	Rapid solute transport Absorption of glucose: reduced UF? Loss of proteins? Serum albumin ?
53%	High Average	0.65 - 0.77	Good solute transport Good UF
31%	Low Average	0.52 - 0.64	Solute transport relatively slow High UF
6%	Low	< 0.51	Slow solute transport Clearance targets difficult to achieve Excellent UF

Short dwell

Long dwell

APEX AND DWELL TIME

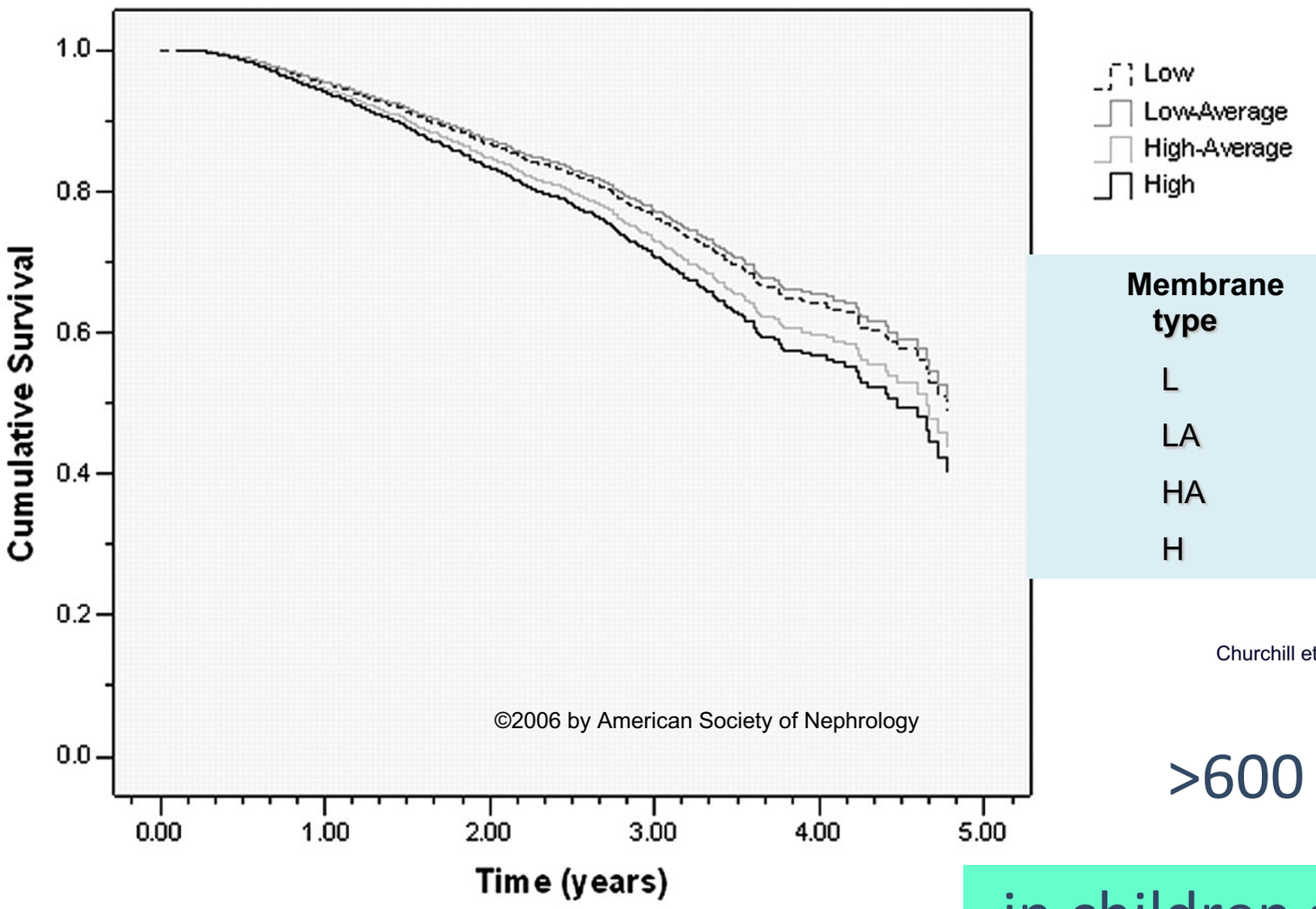
- APEX = the point at which the over time dialysate urea saturation and glucose desaturation curves cross
- Phosphate purification > APEX time



PERITONEAL EQUILRATION TEST AND CLINICAL OUTCOMES

> 3700 patients New Zealand and Australia

Multivariate Cox-adjusted survival curves for each of the four peritoneal transport classes.



Membrane type	Death	Transfer to HD
L	1.00	1.00
LA	1.60	3.26
HA	2.30	4.04
H	1.94	5.82

Churchill et al, JASN, 1998

Markus Rumpsfeld et al. JASN 2006;17:271-278

>600 patients CANUSA study

in children adverse risk factor for longitudinal growth in children

Schaefer et al. JASN 1999

PD FOLLOW UP: STRASBOURG STYLE

- Adequacy: BP, OH, growth, blood sample, ca Ph balance, clearance, KT/V..
- IPP, PET

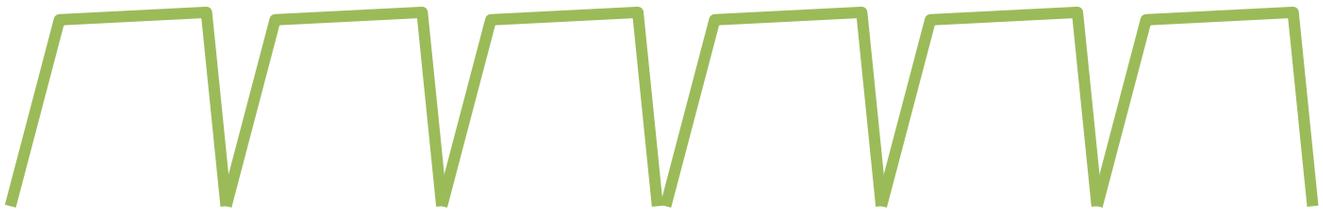
HOPITAUX UNIVERSITAIRES DE STRASBOURG HAUTEPIERRE
Service de Pédiatrie 1
Hôpital de jour : 03.88.12.77.46

Name:
Surname:
Date of birth:

MONTHLY PD FOLLOW UP

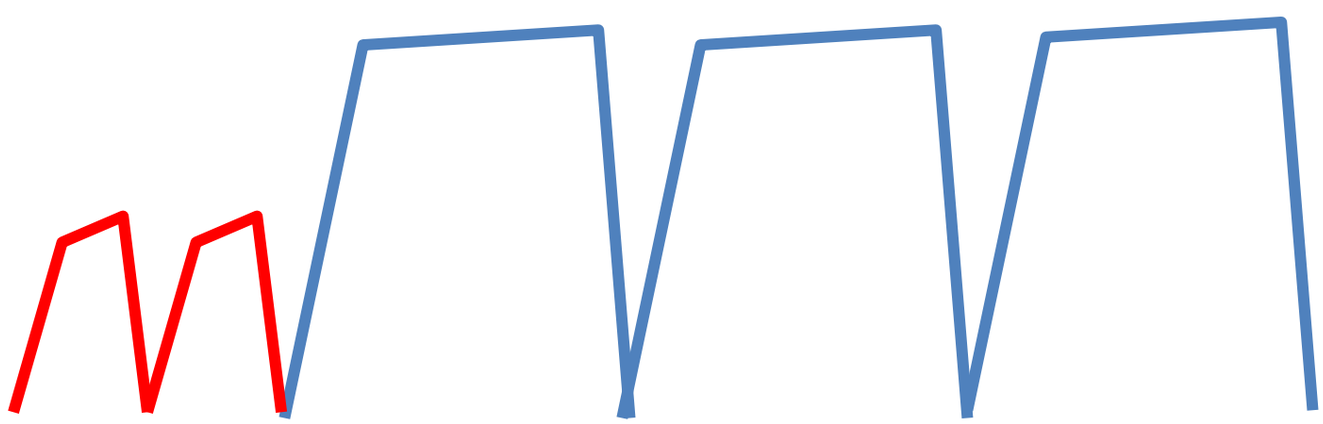
Date :								
height :								
Night UF								
DP plus UF								
Urine 24 h volume								
Dialysat 24 h volume								
IPP (volume)								
Volume drainage first minute (ml/min) :								
Total volume draines /time								
Weight (empti cavity):								
Fibrine? Dialysat aspect?								
Imedancemetry (embty cavity)								
Voume infusion/time								
IPP with maximal night prescribed volur								
Exit score								
Bandage :								
Nasal smears:								
Exit score								
Change of line								
Signature :								

A-APD



Standard **APD:**
repetition of identical cycles with the same dwell time and the same fill volume

Same total amount of dialysate and total duration



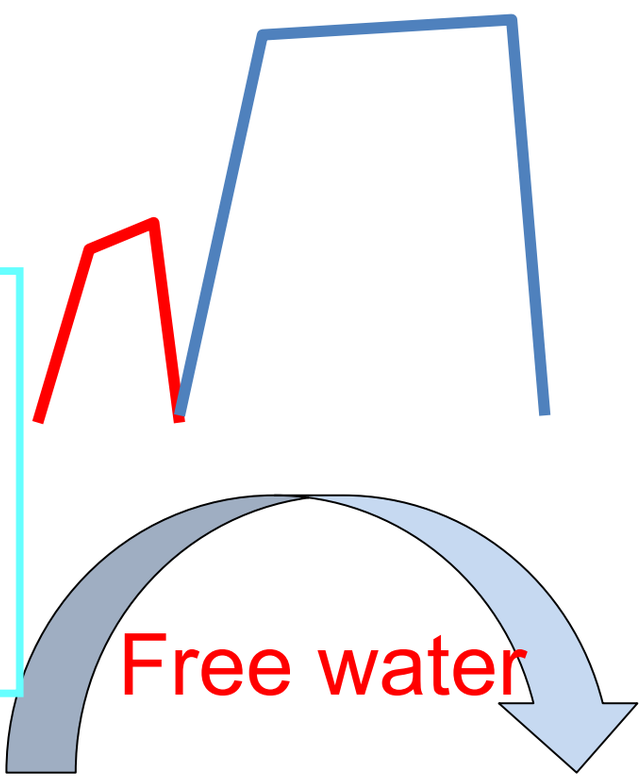
Adapted-APD:
Sequence of short cycles with low fill volume followed by long cycles with high fill volume

HOW DOES IT WORK?

Ultrafiltration exchange
Short/small cycle
Free water transfer via AQ1
-Hemoconcentration
-Incomplete drainage (low IPP)
-Low NaD

Purification exchange
Long/large cycle
(Small pores recruitement)
-Na coupled water
-Long diffusion time
-High diffusion gradient (NaP/NaD)

Impact from a first exchange on the second
Take into account different mechanisms
=> hypothesis

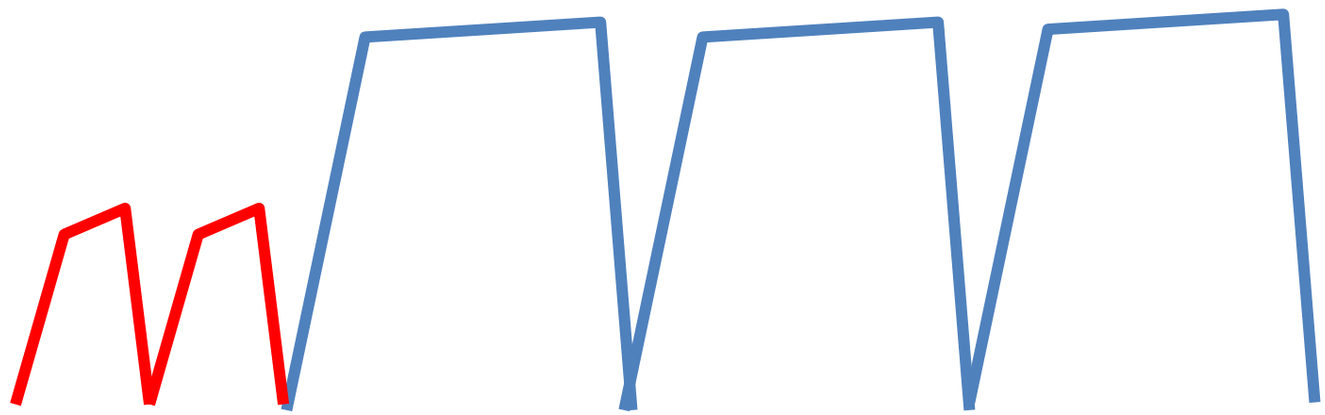


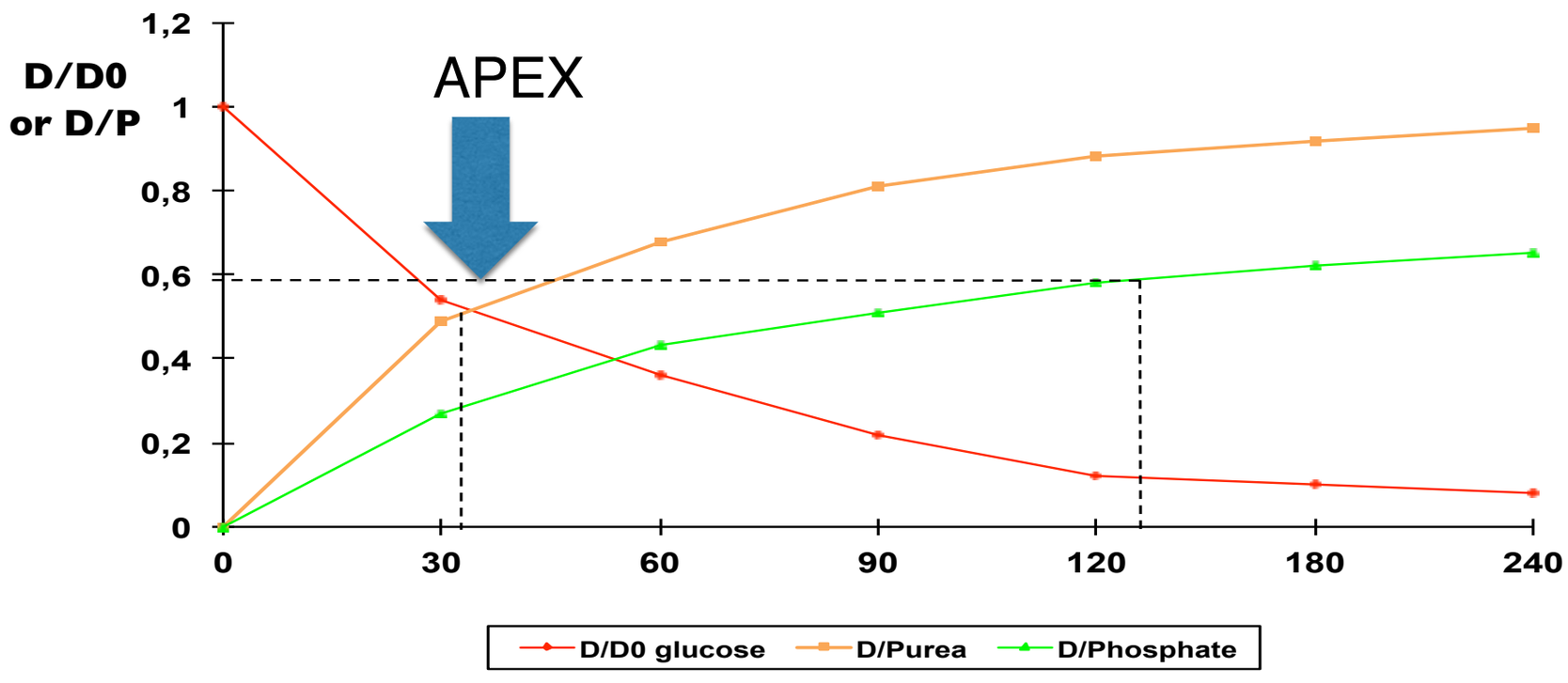
Fischbach et al. KI 2016
Fischbach et al. APD 2014
Fischbach et al. PN 2013

A-APD PRESCRIPTION

Short dwell / small volume
APEX time
Volume : 50% of large dwells

Long dwell / large volume:
Time: 3X short dwell
Volume 1400 to 1500 ml/m^2
IPP 14-15 cm H_2O
(max 18 cm H_2O)





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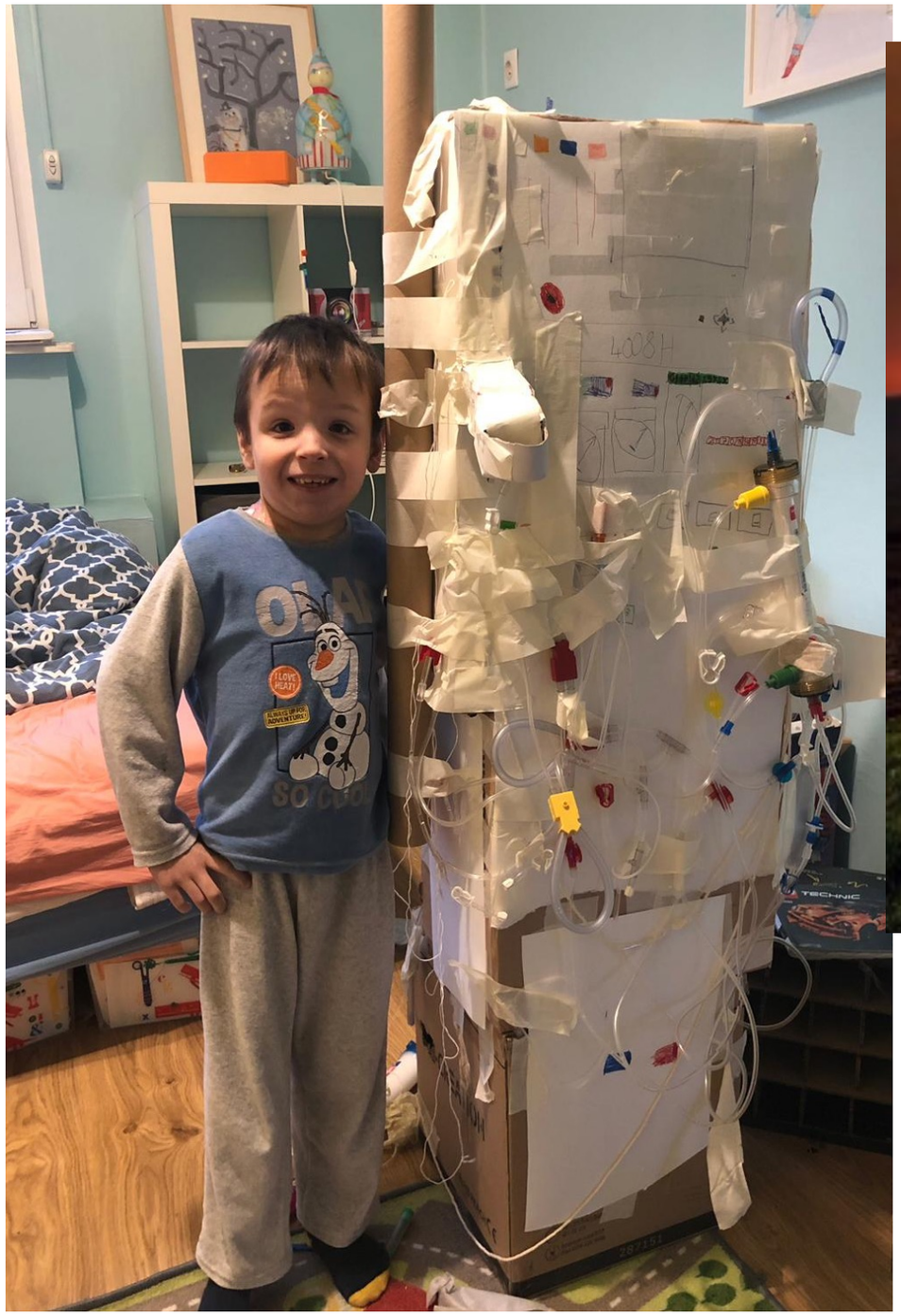

Thank you