Incremental Dialysis

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What Got Me Thinking About This My First Incremental PD Patient

- 78 year old man with advanced chronic kidney disease secondary to nephrosclerosis
- GFR 8 ml/min
- He and his wife would do his exchanges
- "*Let's start with 3 exchanges a day instead of 4 for now.*"

My First Incremental PD Patient

- Patient stayed on 3 exchanges/day for 5 years until he died (sudden death at home)
- GFR in year 5: still 8 ml/min!

My First Incremental PD Patient

Comment

- The patient and his wife did 1 less exchange every day compared to conventional PD
- That is 365 fewer exchanges each year, X 5 years

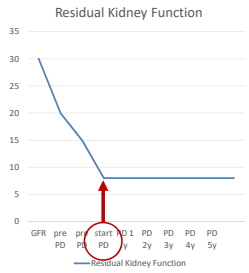
1825 saved exchanges

My First Incremental Patient

Question

If the GFR declined to 8 ml/min, why didn't it continue to decline?

Why did it stabilize?



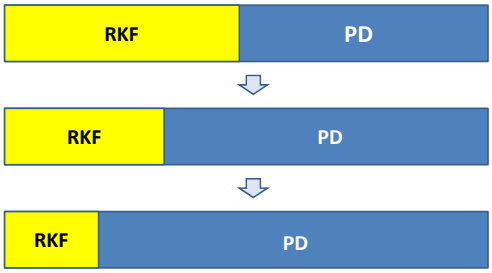
How Could PD Protect the Kidneys?

- Gently reduce hyperfiltration of remaining nephrons?
- Removal of nephrotoxic uremic toxins?
- Correction of hyperphosphatemia?
- Correction of metabolic acidosis?

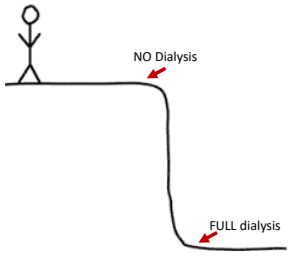
What is Incremental PD?

- Starting with less than the "usual" PD prescription in patients with residual kidney function (RKF)
- Increasing the dose of PD over time as the RKF declines

Incremental PD – A Schema



Does This Make Sense?



Why Incremental PD? (1)

- Most PD is an elective start, with "significant" kidney function (GFR 7 ml/min or more)
- Small amounts of PD tend to result in improvement of symptoms
- It doesn't burden the patient with the same prescription that a patient with no kidney function might need
- It allows time for the patient to become comfortable with the therapy

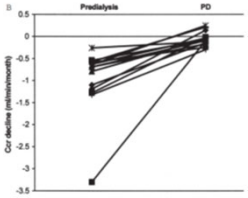
Why Incremental PD? (2)

- Less total glucose exposure
- Fewer exchanges, so less risk of peritonitis
- It saves money

Why Incremental PD?

- PD may slow the rate of decline of GFR compared to the pre-dialysis period and so "stretch out" the duration of RKF
  - Berlanga 2002
  - He 2016

Slope of Decline of RKF Before and with PD



Berlanga Perit Dial Int 2002

RATE OF DECLINE OF RESIDUAL KIDNEY FUNCTION BEFORE AND AFTER THE START OF PERITONEAL DIALYSIS

Lian He,[1,2] Xihui Liu,[1,2] Zi Li,[4,2] Zita Abreu,[2] Tushar Malavade,[2] Charmaine E. Lok,[2] and Joanne M. Bargman[2]

Department of Nephrology,[1] Peking University 3rd Hospital, Beijing, P.R. China; University Health Network,[2] Toronto General Hospital and the University of Toronto, Toronto, ON, Canada; Division of Nephrology,[3] Linyi People's Hospital, Linyi, Shandong, P.R. China; Department of Nephrology,[4] West China Hospital, Chengdu, Sichuan, P.R. China

- 77 incident PD patients
- rate of decline in the predialysis period compared to rate of decline while on peritoneal dialysis
- GFR estimated in predialysis period by MDRD equation
- GFR estimated in PD by averaged 24h urine creatinine and urea clearance

He Perit Dial Int 2016

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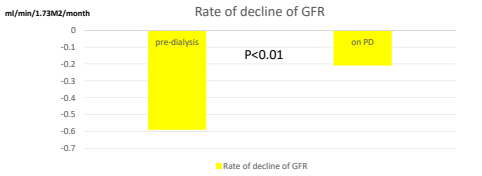

He Perit Dial Int 2016

Original article

Incremental peritoneal dialysis: Clinical outcomes and residual kidney function preservation☆

*Mercè Borràs Sans**, *Andrea Chacón Camacho, Carla Cerdá Vilaplana, Ana Usón Nuño, Elvira Fernández*

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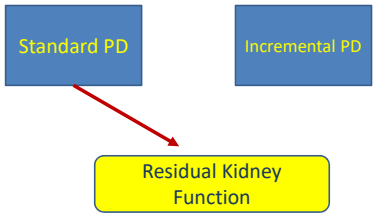
- 46 patients receiving 3 or fewer exchanges/day
- 24 months
- many were transplanted before moving to standard PD
- good outcomes

Barras Sans Nefrologia 2016

Incremental PD Is Also Kidney Protective

Barras Sans Nefrologia 2016

Could Incremental PD be Even More Protective of Kidney Function?



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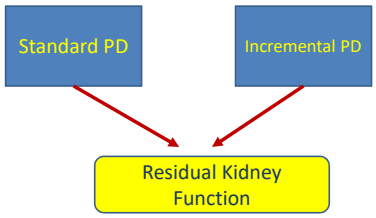

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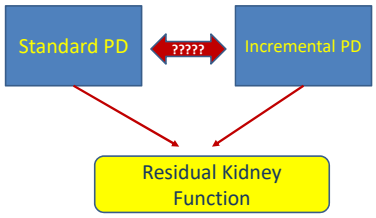


Incremental PD

- Incident PD patients
- Residual GFR 3-10 ml/min
- 29 patients on incremental (iPD) regimen
- 76 patients on standard PD prescription (stPD)
- Median duration of iPD was 17 months

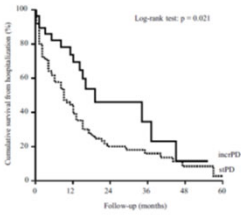
Table 1 Baseline data of the two groups: incrPD and stPD

	incrPD	stPD	*p*
Number of patients	29	76	
Male gender	13 (55%)	50 (66%)	0.611
Age (years)	63 ± 12	59 ± 18	0.200
Weight (Kg)	63.4 ± 10.2	62.8 ± 16.7	0.837
BMI (Kg/m^2)	24.1 ± 3.9	23.5 ± 4.5	0.130
RRF (ml/min/1.73 m^2 BSA)	5.74 ± 1.34	5.42 ± 1.75	0.381
D/P creatinine 4th hour	0.63 ± 0.14	0.62 ± 0.11	0.426

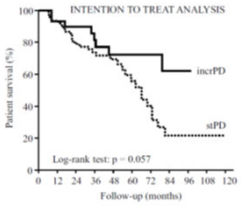
Sandrini J Nephrol 2016

Conventional versus Incremental PD

Hospitalization

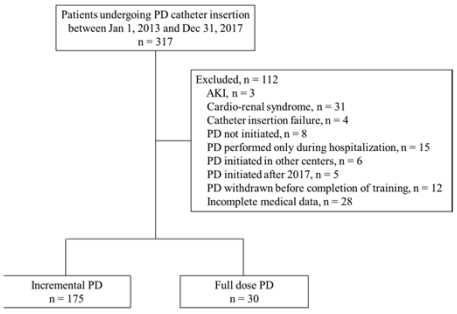


Survival

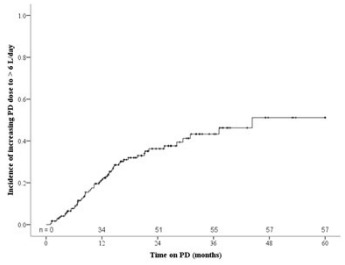


Sandrini J Nephrol 2016

Walking the Walk: The University Health Network Experience



Cumulative Incidence of Increasing the PD Dose to > 6L/Day



Yan and Bargman (unpublished)

Multivariate Regression for Factors Associated with Increased Dose of PD within 1 Year of Start

	OR (95% CI)	p value
Male gender	3.338 (1.240-8.984)	0.017 *
BMI (1 kg/m2)	1.117 (1.039-1.202)	0.003 *
Alb (1g/L)	0.902 (0.829-0.983)	0.018 *
Scr (1 µmol/L)	1.001 (1.000-1.003)	0.146
FPG (1 µmol/L)	1.129 (0.981-1.298)	0.091
Initial PD dose	1.446 (0.914-2.290)	0.115

Yan and Bargman (unpublished)

How To Prescribe Incremental PD

CAPD

- One exchange overnight
  - if using a 1.5% solution, there will likely be absorption, so it depends on the fluid status of the patient
  - can use 2.5% solution or icodextrin
  - the icodextrin will usually result in ultrafiltration

How To Prescribe Incremental PD

CAPD

- 2 exchanges, 4h each during the day, night dry
  - this works well in patients with RKF
  - good incremental regimen for those who don't like fluid in the abdomen overnight

How To Prescribe Incremental PD

CAPD

- 2 exchanges, 12 hours each may not be successful
  - there will likely be fluid absorption that can result in volume overload

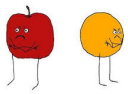
How To Prescribe Incremental PD

APD

- Night cycles, day dry is a great regimen (NIPD)
  - don't have to worry about fluid absorption during the long day dwell
  - Example: 3 X 1.5 L exchanges over 8 hours

You Can't Add Kidney GFR to Dialysis Clearance

- They are two different things
- It's like adding apples and oranges



$$2.3 = \frac{\left(\frac{10080 \times \frac{1-e^{-tKt/V}}{t}}{\frac{1-e^{-tKt/V}}{tKt/V} \times \frac{10080}{Pvt} - 1}\right)}{\left(1 - \frac{0.74}{F} \times \frac{UF_w}{V}\right)} + \left(K_{RU} \times \frac{10080}{V}\right)$$

Chin Kidney Int Rep 2017

Titrating the Dose of Dialysis to Residual Kidney Function *(CAPD)*

10 ml/min — anuric

Declining residual kidney function

- **overnight 2.5%**
- **1 X 4h 1.5% in the evening**
- **3 X 2L daytime**
- **overnight 2L icodextrin**

Titrating the Dose of Dialysis to Residual Kidney Function *(APD)*

10 ml/min → anuric

Declining residual kidney function

- 8 hours
- 2L X 3
- day dry

- 9 hours
- 2.5 L X 4
- last fill 2L icodextrin

Titrating the Dose of Dialysis to Residual Kidney Function *(APD)*

10 ml/min → anuric

Declining residual kidney function

- 8 hours
- 1.5L X 3
- no last fill

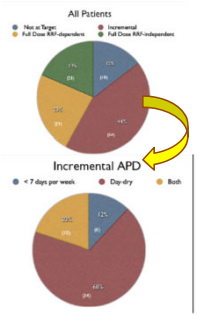
- 9 hours
- 2.2 L X 4
- last fill 1.5L
- "midday" exchange 1.5L

The Volume Can Also be Increased Incrementally

- No need for a full 2 or 2.5L dwell volume at the outset
- Allow time for adjustment to the sensation
- It takes 9 months to grow a baby for a reason

Incremental PD *(London, Ontario)*

- Status report from the University of Western Ontario of 10 years of incremental PD, mostly in APD patients
- Survival rates the same as those in the rest of the Ontario province



Ankawi Can J Kid Health Dis 2016

Randomized Trial of 3 versus 4 Exchanges a Day *(Shanghai)*

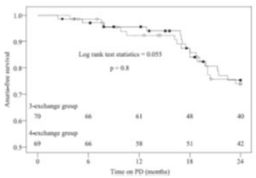
- 70 patients 3 exchanges a day
- 69 patients 4 exchanges a day
- baseline GFR about 6 ml/minute
- lower Kt/V urea and less UF in the 3 X day group
- less glucose exposure in the 3 X day group

	3 Exchanges (n = 70)	4 Exchanges (n = 69)	P
Kt/V			
1 mo	2.33 ± 0.54	2.56 ± 0.54	0.07
6 mo	2.14 ± 0.54	2.41 ± 0.50	0.006
12 mo	2.02 ± 0.36	2.27 ± 0.53	0.005
18 mo	1.97 ± 0.52	2.27 ± 0.56	0.009
24 mo	1.95 ± 0.39	2.19 ± 0.48	0.03
Glucose exposure from PD fluid, g/d			
1 mo	100 (82-111)	120 (109-137)	<0.001
6 mo	100 (82-111)	120 (109-137)	<0.001
12 mo	100 (82-118)	127 (109-145)	<0.001
18 mo	100 (82-118)	127 (109-145)	<0.001
24 mo	100 (82-118)	127 (109-145)	<0.001

Yan Am J Kidney Dis 2017

Randomized Trial of 3 versus 4 Exchanges a Day *(Shanghai)*

- Follow-up up to 2 years
- Trend to fewer episodes of peritonitis in the 3 X day group and longer peritonitis-free survival
- Identical time to anuria and survival in both groups



Anuria-free survival

Yan Am J Kidney Dis 2017

Why *Not* Incremental PD?

- The patient may refuse to increase the dose of PD once the RKF declines
  - I haven't found this to be a problem if the process is explained to the patient
- If the RKF declines rapidly without an increase in PD dose, the patient may become underdialyzed
- The 24h urine needs to monitored for residual GFR (average of 24h creatinine and 24h urea clearance)
  - if the patient "forgets", a stable serum creatinine usually reflects a stable RKF

Incremental Dialysis: Summary

- someone with <u>some</u> kidney function does not need the same dialysis prescription as someone with <u>no</u> kidney function
- Incremental HD and PD may preserve kidney function and therefore allow incremental dialysis to continue
- There are many potential benefits, especially for quality of life