‘New’ Technologies in Peritoneal Dialysis

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Progress in PD Technology
What lies ahead for PD?

- Low Sodium PD Solution
  - Phase III clinical trial

- Adapted APD
  - Recent introduction to market
LOW SODIUM PD SOLUTION
Volume Homeostasis is an IMPORTANT Predictor of Outcome

- Dietary Salt Intake
- Urinary Salt Excretion
- Peritoneal Salt Removal

Salt Balance
Purpose of Low Sodium PD Solution

• To increase absolute sodium removal for a given glucose load

• To reduce the ‘gap’ between sodium and water removal – a consequence of sodium sieving via the aquaporin pathway
Increase in Peritoneal Na Removal – Single Exchange Kinetic Study

**Fig. 1.** Net fluid removed, calculated as drained volume minus instilled volume for a commercial dialysate with the same osmolality (CD1.5) and a commercial dialysate with the same glucose concentration (CD2.5) as a low sodium dialysate (LNaD). Net ultrafiltration volume was higher using CD2.5 (*P < 0.05) and LNaD (**P < 0.01) than using CD1.5.

**CD1.5** – 1.5% glucose (Na 132; Osmol 348mOsm/L)
**CD2.5** – 2.5% glucose (Na 132; Osmol 403mOsm/L)
**LNaD** – 2.5% glucose (Na 105; Osmol 348mOsm/L)

**Fig. 4.** Sodium loss, calculated as total mass of sodium instilled minus that drained, for a commercial dialysate with the same osmolality (CD1.5) and a commercial dialysate with the same glucose concentration (CD2.5) as a low sodium dialysate (LNaD). Sodium loss was higher using CD2.5 (*P < 0.05) and LNaD (**P < 0.01) than using CD1.5.
The effects of low-sodium peritoneal dialysis fluids on blood pressure, thirst and volume status

Simon Davies¹, Ola Carlsson², Ole Simonsen³, Ann-Cathrine Johansson⁴, Daniele Venturoli³, Ingrid Ledebo², Anders Wieslander², Cian Chan¹ and Bengt Rippe³

- Open-label, prospective interventional study (n=25)
- Study duration: 2 months
- Prevalent – median time on PD 28.5 months
- APD/CAPD 6/19
- Avg no. of 2.5% glucose exchanges per day: 1.3 vs. 2.21
- Replaced 1 exchange/day with Low-sodium solution

<table>
<thead>
<tr>
<th>Table 1. The composition with respect to Na and glucose concentrations, respectively, for Deltasol and Gambrosol® trio</th>
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<tr>
<td><strong>Solution</strong></td>
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<tr>
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</tr>
<tr>
<td>Sodium (mmol/l)</td>
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<tr>
<td>Gambrosol® trio</td>
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<tr>
<td>Deltasol</td>
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<tr>
<td>Glucose (%)</td>
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- **Compensated Group (A):**
  - Maintain UF
  - Drop in nocturnal BP
  - More marked decrease in thirst
  - Improvement in fluid status

Fig. 4. Mean arterial pressure (MAP) during nighttime during baseline (0 months) and during Deltasol treatment (1 and 2 months) for groups A (●) and B (▼) (*P < 0.05).
Current Status – Phase III Trial in Progress

- PI – Simon Davies

- Single-blind, parallel design RCT comparing low Na PDS vs. standard PDS (single-exchange; n=140)

- **Follow-up**: 8 months (6 months intervention/control; 2 months post-study observation)

- **Primary outcome measure:**
  - 24-hr mean SBP

- **Secondary outcome measures:**
  - RRF
  - Frequency of hyponatraemia
  - Assessment of changes in sodium removal
  - Assessment of decrease in total body water
  - Measurement of 24 hours peritoneal clearance
  - Office BP readings
ADAPTED APD
Optimize UF & Clearance

UF

- Short Dwell
  (maintain osmotic pressure gradient)
- Low Volume
  (Reduce IPP)

Solute Clearance

- Long Dwell Time
  (creatinine, phosphate, middle molecules)
- Increased filling volume
  (enhanced surface area)
Adapted APD Concept

Conventional APD night-time

- Same inflow
- Same dwell time

Adapted APD night-time

- Higher volumes
- Longer dwell time

- Lower volumes
- Shorter dwells

- Same total volume
- Same treatment time
- Same glucose concentration

Individualised modeling of single cycles
THE BENEFICIAL INFLUENCE ON THE EFFECTIVENESS OF AUTOMATED PERITONEAL DIALYSIS OF VARYING THE DWELL TIME (SHORT/LONG) AND FILL VOLUME (SMALL/LARGE): A RANDOMIZED CONTROLLED TRIAL

Michel Fischbach, Belkacem Issad, Vincent Dubois, and Redouane Taamma

Group A

\[ 12 \text{ L} = 6 \times 2 \text{ L} \]
\[ 9 \text{ h} = 540 \text{ min} = 6 \times 90 \text{ min} \]

1.5% glucose concentration (balance)

\[ 12 \text{ L} = (2 \times 1.5 \text{ L}) + (3 \times 3 \text{ L}) \]
\[ 9 \text{ h} = 540 \text{ min} = (2 \times 45 \text{ min}) + (3 \times 150 \text{ min}) \]

1.5% glucose concentration (balance)

\[ \text{C-APD} \]

\[ \text{aAPD named APD-A} \]

45 days

Group B

\[ \text{aAPD named APD-A} \]

\[ \text{C-APD} \]

45 days
Statistically (but clinically) significant higher clearance of solutes with A-APD

- **Urea**
  - $p < 0.01$

- **Creatinine**
  - $p < 0.05$

- **Phosphate**
  - $p < 0.05$

Higher ultrafiltration and higher sodium removal with A-APD

Ultrafiltration

Sodium removal

* Significant p<0.05

p < 0.05

* Significant p<0.01

p < 0.01

Lower Blood Pressure with A-APD

Systolic BP

\[ p < 0.05 \]

Diastolic BP

\[ p < 0.05 \]

Mean BP

\[ MAP = PAd + PP/3 \]

\[ p < 0.01 \]

* Significant \( p < 0.05 \)

* Significant \( p < 0.01 \)

Role of Adapted APD

- Alternative way of delivering APD

- Statistically significant but clinically significant benefit
  - Risk of carry-over effect

- No obvious ‘harm’
  - Cost of ‘machine’

- Also, be mindful of the studied population in the trial:
  - Relatively ‘new’ PD patients (<12 months)
  - Good RRF (mean GFR ~6, 24-hr UV 1.5L/day).

- Would be useful to know whether the response to therapy differed based on peritoneal membrane transporter status.
Summary

• Low Na PDS
  • Biologically plausible and may help to improve BP control in PD patients.
  • But, need to consider implication on:
    • Overall exposure to glucose (from correcting the osmolarity reduction)

• Adapted APD
  • Unlikely to revolutionize care of PD patients.
  • More data on outcome in patients in whom clearance/UF is suboptimal would be useful.
The END