Changes in Fluid Transport Components during Prolonged 8-hour Peritoneal Dialysis Dwell with Different Glucose Concentrations in Dialysis Fluid

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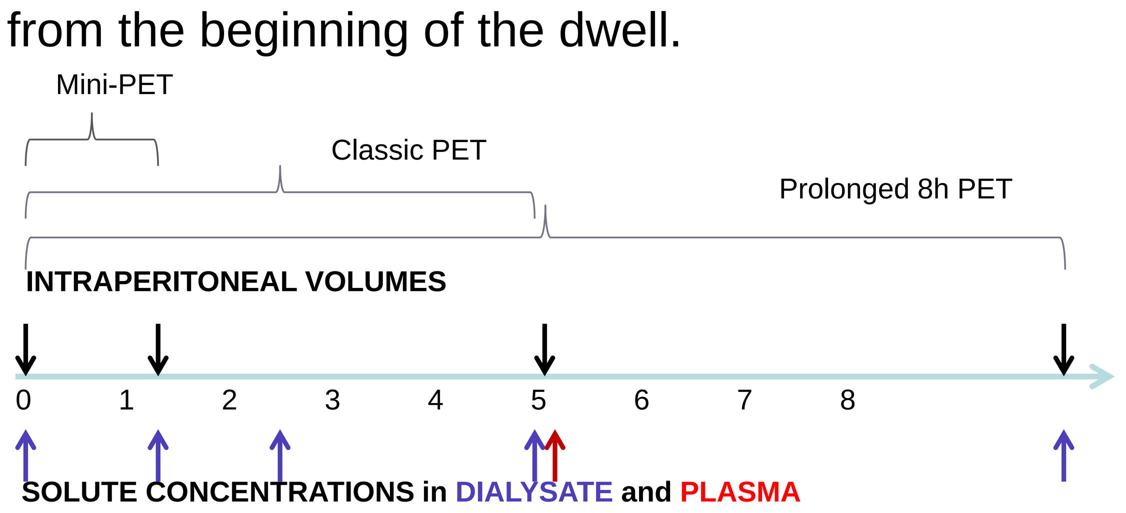
Objectives

- In peritoneal dialysis, fluid transport is strongly related with the individual patient transport characteristics of the peritoneal membrane as well as dialysate content.
- Previous studies showed that
  - some fluid transport components such as free water transport are changing during the dwell time (due to disappearance of osmotic gradient),
  - the others such as peritoneal absorption rate remains relatively constant during the dwell time (being proportional to the intraperitoneal pressure gradient).
- The aim of the study was to further analyze the impact of dwell time and glucose concentration in dialysis fluid on fluid transport components in individual patients.

Methods

Clinical data:

- The study enrolled 32 stable peritoneal dialysis patients
- Each patient underwent three prolonged 8-hour PETs using 1.36%, 2.27%, and 3.86% glucose solution .
- The prolonged 8-hour PET was carried out with temporary drainage at 1 and 4 hour from the beginning of the dwell.



- Dialysate and blood samples were taken to measure concentration of glucose, urea, creatinine, sodium, and phosphate.
- For each dwell the residual volume was calculated based on the initial dilution of urea and creatinine.

Mathematical model:

- The three-pore model was applied for the estimation of transport parameters for each patient and for each dialysis fluid separately.
- The vasodilation effect of glucose and changes of effective surface area caused by the changes of intraperitoneal volume, were taken into account.
- The following fluid transport components were calculated for three consecutive dwell time intervals: 0-1 h, 1-4 h, and 4-8 h:
  - net ultrafiltration, net UF: net intraperitoneal volume change during dwell time of the specified time interval (mL),
  - transcapillary ultrafiltration, TCUF: net volume ultrafiltered from the blood circulation through the pores into the peritoneal cavity (mL),
  - peritoneal absorption, PA: estimated as the difference between net UF and TCUF (mL), or for corresponding dwell time as peritoneal absorption rate, PAR (mL/min),
  - free water transport, FWT: volume ultrafiltered from the blood circulation through the ultrasmall pores into the peritoneal cavity (mL),
  - small pore water transport, SPWT: volume ultrafiltered from the blood circulation through the small pores into the peritoneal cavity (mL).
- The two-way repeated measurement ANOVA, Scheffe post-hoc test, and analysis of contrasts were used when appropriated with statistical significance level set at p=0.05.

Table 1. Mean ± SD values of the peritoneal absorption rate, PAR, estimated for three consecutive dwell time intervals and for three glucose concentrations

PAR, mL/min	0-1 h	1-4h	4-8h
Glucose 1.36%	0.99 ± 0.41	0.98 ± 0.40	0.95 ± 0.39
Glucose 2.27%	1.12 ±0.42	1.10 ±0.41	1.07 ± 0.40
Glucose 3.86%	1.43 ± 0.47	1.40 ± 0.45	1.34 ± 0.43

Results

- The net UF, TCUF, PA, FWT and PAR:
  - ↑ increased with glucose concentration, and
  - ↓ decreased during consecutive dwell time intervals,

  compare Figures 1 and 2, and Table 1.
- The impact of glucose concentration on the fluid transport components was much more pronounced than the dwell time intervals, Figures 1-2, Table 1.
- The positive transcapillary ultrafiltration flow was observed for the final time interval (after 4 hour) in the case of fluid with higher glucose concentration (2.27% and 3.86%), Figure 1.
- Besides higher glucose concentration, the lowest net UF was found for the time interval 4 – 8 h for glucose 3.86%, Figure 1.
- The negative TCUF of 18 mL during final time interval for glucose 1.36%, Figure 1, correspond to the reversed flow (absorption) that occurs through the small pores, Figure 2.
- The positive TCUF of 28 and 65 mL was found for glucose 2.27% and 3.86%, respectively, besides appearance of the reversed flow through the small pores for glucose 2.27% solution, Figure 2.

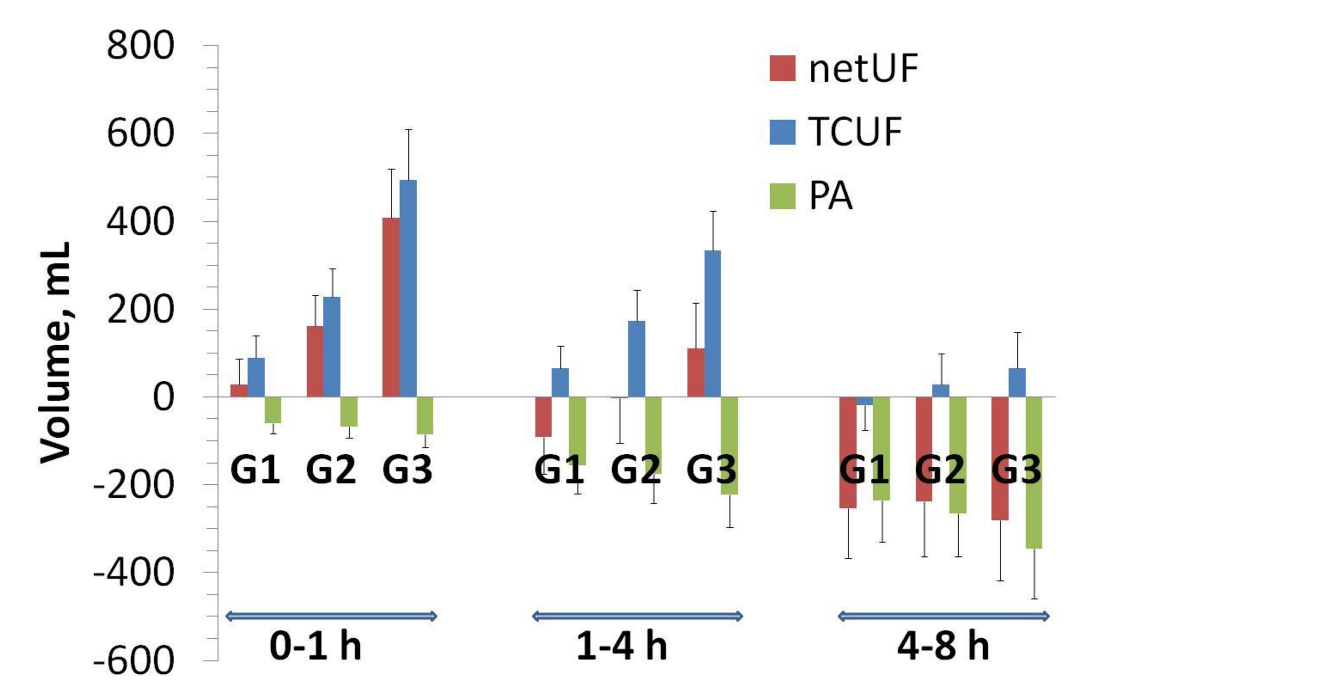


Figure 1. The mean values of fluid transport components: ultrafiltration (net UF), transcapillary ultrafiltration (TCUF), and peritoneal absorption (PA) for three consecutive dwell time intervals and for three glucose concentrations: glucose 1.36% (G1), glucose 2.27% (G2), and glucose 3.86% (G3).

- However, the fractional contribution of each pore type to the ultrafiltration flow remained constant between consecutive time intervals and glucose concentrations in dialysate – data not shown.

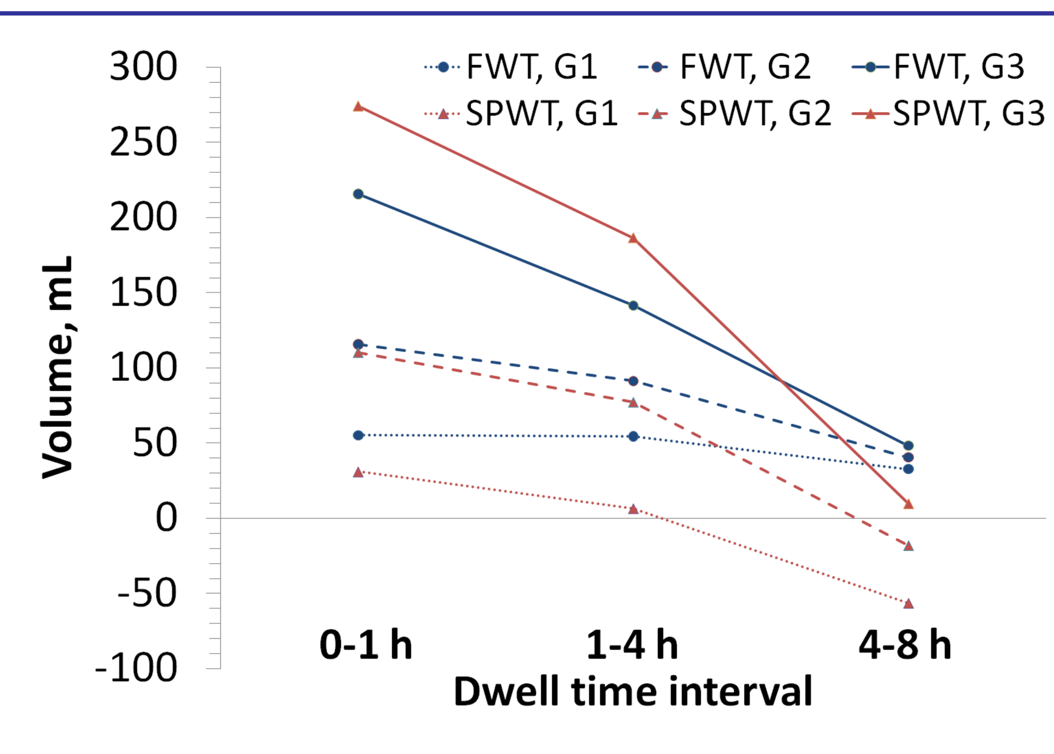


Figure 2. The mean values free water transport (FWT) and small pore water transport (SPWT) for three consecutive dwell time intervals and for three glucose concentrations: glucose 1.36% (G1), glucose 2.27% (G2), and glucose 3.86% (G3).

- The analysis of the peritoneal absorption rate (Table 1) shows considerable increase of PAR with glucose concentration in dialysis fluid and much smaller but significant with dwell time. The only not significant change for PA and PAR was between glucose 1.36% and 2.27%.

Conclusions

The net UF, transcapillary ultrafiltration (TCUF), peritoneal absorption (PA), free water transport (FWT), and peritoneal absorption rate (PAR) increase with glucose concentration in dialysis fluid and decrease with dwell time for each dialysis fluid.

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