IS ADAPTED APD MORE EFFICIENT THAN CONVENTIONAL APD? A COMPUTER SIMULATION STUDY

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BACKGROUND

A modified version of automated PD (APD), adapted APD (aAPD), using not only variable dwell times but also variable fill volumes, has been tested against conventional APD (cAPD) with fixed dwell volumes in an open, multicenter, prospective randomized crossover trial with parallel study arms [1]. The results indicated that aAPD can lead to improved small solute clearances, increased ultrafiltration (UF), and, above all, markedly increased sodium removal (NaR). To theoretically test these results we have modeled aAPD vs. cAPD in computer simulations using the three-pore model (TPM).

METHODS

We simulated aAPD vs. cAPD according to the original three pore model, employing the exchange schedules clinically tested by Fischbach et al. [1]. The simulations were performed by either assuming that changes in intraperitoneal hydrostatic pressure (IPP) are translated into proportional alterations in the capillary Starling pressure equilibrium, using a "pressure factor"(P+), or, as predicted from physiology, that IPP changes do not significantly affect the Starling balance (P-). Furthermore, the effective peritoneal surface area (A) was either kept constant (A-) or set variable (A+) as a function of intraperitoneal volume according to Keshaviah et al. [2].

Graphs and tables

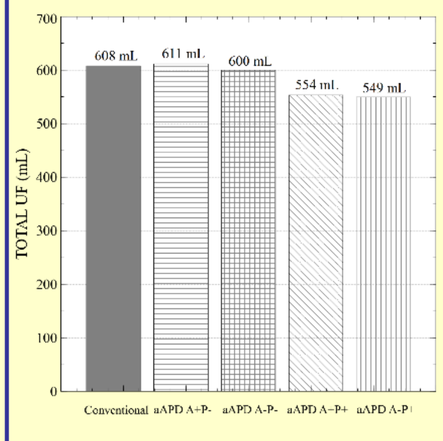

Fig 1. Total UF volume simulated for conventional (2 x 6 L) APD and four different variants of aAPD.

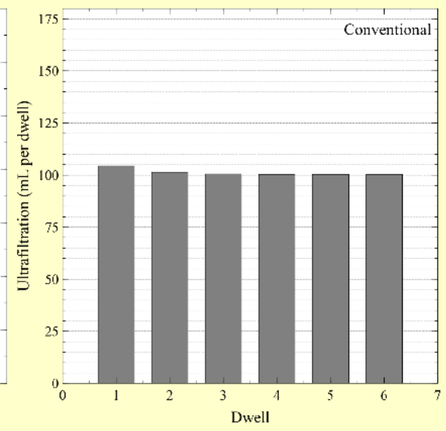

Fig 2. UF in mL/dwell for each individual dwell in conventional APD with 2 x 6 L exchanges.

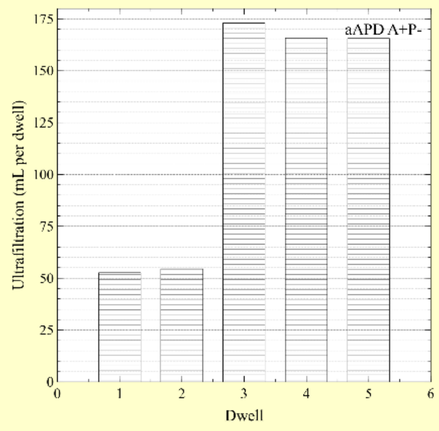

Fig 3. UF in mL/dwell in aAPD in cases where the surface area changes (A factor) but not the P factor affected peritoneal transport.

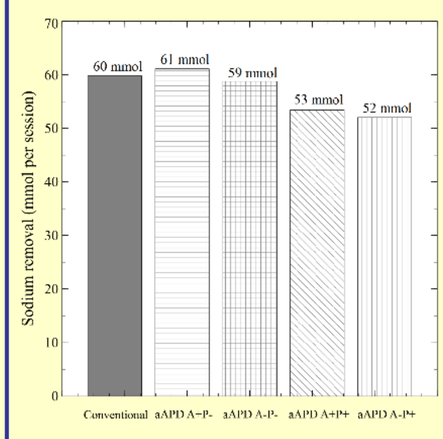

Fig 4. NaR in cAPD and in four different scenarios of aAPD. When the IPP was simulated to make an "unrealistic" contribution to the capillary Starling fluid equilibrium, then NaR and UF volume were reduced.

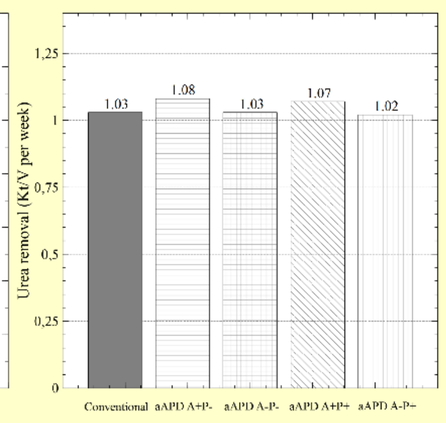

Fig 5. Urea removal in terms of weekly Kt/V_{urea} for conventional APD and in four different scenarios of aAPD.

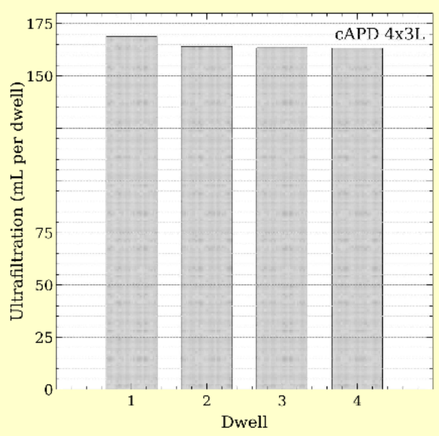

Fig 6. UF in mL/dwell for a 4x3L session (A+P-) giving a total UF of ~660 mL.

RESULTS

- In Fig. 1, scenarios with or without the impact of the area (A) factor or the P factor are denoted by + or -, respectively. If the IPP was simulated to vary with the IPV and these changes in IPV affected the Starling balance, then aAPD seemed to be less efficient in producing UF than cAPD, whether the A factor was allowed to vary with IPV or not.
- In scenarios where the A factor was set variable (A+) and the P factor was set constant (P-), the simulations demonstrated a small improvement of small solute clearances (~+5%; fig. 5+6) and a very small improvement of UF (fig. 1) and NaR (fig. 4) in aAPD compared to cAPD.
- A 4x3 L session (A+P-) was also simulated showing an improved UF (~+9%, Fig. 6) and small solute transport (~+10%, not shown) compared to cAPD.

CONCLUSIONS

Due mainly to the increased fill volumes in three out of five dwells in aAPD, this modality caused a slight increase in small solute clearances, similar to a regimen of 4x3 L, which occurred if the P factor was set constant. However, the effects on UF and NaR were marginal. The computer simulations point to a need for accurate sodium determinations in aAPD, considering all the methodological problems and pitfalls relevant to determining dialysate Na^+ concentrations and peritoneal sodium mass balance.

REFERENCES

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[2] Keshaviah P, Emerson PF, Vonesh EF, Brandes JC. Relationship between body size, fill volume, and mass transfer area coefficient in peritoneal dialysis. J Am Soc Nephrol. 1994; 4:1820-6.

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L2) Dialysis. Peritoneal dialysis.
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