Ultrafiltration and sodium removal

There is no high-level clinical evidence that ultrafiltration is improved overall with APD compared with CAPD, but general clinical opinion and theoretical considerations dictate that better fluid removal is achieved in high transporters (Kumano et al 1993, Mujais et al 2000, Twardowski 1990). However, the only RCT of APD versus CAPD in high and high-average transporters actually demonstrated lower (but not statistically significant) net ultrafiltration volumes in patients treated with APD (1092±442 vs CAPD 1190±343 mL/day, respectively) (Bro et al 1999).

A prospective, multicentre, sequential study of CAPD, CCPD, TPD (50% exchange volume) and TPD (25% exchange volume) in 45 patients revealed that net daily ultrafiltration was actually slightly but not significantly higher with CAPD (1066 ± 626 mL/day) than with the other three APD techniques (939 ± 713, 700 ± 718 and 790 ± 637 mL/day, respectively) (Rodriguez et al 1998). The patients studied comprised the full spectrum of peritoneal membrane transport types, so it is possible that significantly better ultrafiltration may have been found if subgroup analyses were performed. Similarly, a case control study (Hufnagel et al 1998) found that median daily ultrafiltration volumes were slightly higher in patients receiving CAPD compared with APD (0.6 versus 0.53 L/day, p = ns), despite the prescription of significantly larger volumes of hypertonic dialysate in the latter. However, although patients were matched at baseline for demographic characteristics and RRF, they were not matched for peritoneal membrane transport characteristics, which were not reported.

Rodriguez-Carmona and Perez Fontan (2002) measured sodium removal and net ultrafiltration in 32 patients before and after changing from CAPD to APD therapy. Sodium removal decreased from 192 to 92 mmol/day (p = 0.02), while ultrafiltration volumes fell from 1310 to 1067 mL/day (not significant) despite the prescription of greater dialysate volumes (20 vs 11.9 L/day), more hypertonic glucose exchanges and more frequent icodextrin use. Subsequent multivariate analysis in the APD group demonstrated that the use of icodextrin, supplementary diurnal exchanges and longer nocturnal dwell times resulted in enhanced sodium removal. Ortega et al (2001) reported that sodium removal is lower in patients receiving APD compared with those receiving CAPD, leading to a tendency to poorer blood pressure control.

Struijk and Krediet (2000) have suggested that the short dwells used in APD impair sodium removal because of enhanced sodium sieving. Nevertheless, the International Society of Peritoneal Dialysis ad hoc Committee on Ultrafiltration Management in Peritoneal Dialysis (Mujais et al 2000) recommends APD for patients with a high transport profile and a net ultrafiltration less than 400 mL/4h following a 4.25% glucose dialysate exchange, although evidence supporting this guideline is lacking. Even if ultrafiltration in high transporters is enhanced by APD, a longitudinal study of 50 APD patients observed that high transporters still experienced a survival disadvantage relative to other transport categories (Hung et al 1999). Thus, the evidence justifying the prescription of APD to treat high transporters is weak.

Small solute clearances

There is some evidence to suggest that, for most patients (except possibly low and low-average transporters), better small solute clearances are achievable on certain APD regimens compared with CAPD (Blake et al 1996, Schaefer et al 1994). Rodriguez et al (1998) demonstrated in their prospective sequential study that all three APD regimens (i.e. CCPD, TPD 50% and TPD 25%) resulted in significantly

better peritoneal Kt/V (up to 34%) and C_{Cr} (up to 24%) values than CAPD, even in low transporters. These were only achieved with greater total daily dialysate volumes (approx. 16 L versus 9 L) and the inclusion of a daytime exchange. CAPD patients were limited to 2 L exchanges and there are no controlled studies that directly compare clearances achieved with APD versus CAPD using higher fill volumes (i.e. 2.5 or 3 L). On the other hand, the 1996 peritoneal dialysis core indicators study showed that in a large, randomly selected sample of prevalent patients, the differences between CAPD and APD with respect to median weekly C_{Cr} (58.9 versus 60.8 L/1.73 m^2) and Kt/V_{urea} (1.9 versus 2.0) were very modest (Rocco et al 1997). Some of the apparent disparity in findings may be explained by the fact that the delivered clearance depends strongly on membrane transporter type. Care should be exercised with prescription of APD in low and low-average transporters, particularly if they are anuric, because delivered clearance may actually be reduced by increasing effective dialysate flow (Durand et al 1996). Nevertheless, APD produced superior creatinine clearances compared with CAPD in low transporters in the Spanish multicentre study (Rodriguez et al 1998).

Quality of life

APD (in the form of NIPD) has been suggested to offer a number of unproven psychosocial benefits over CAPD, which relate directly to fewer connections, the more frequent use of reduced fill volumes, and patient independence from dialysis during the daytime, particularly for workers, school pupils or carers of elderly or debilitated patients (McComb et al 1997, Wrenger et al 1996). De Wit and co-workers (2001) examined health-related quality of life in 37 APD and 59 CAPD patients from 16 different Dutch dialysis centres and found that APD patients enjoyed better mental health and tended to be less depressed and anxious than CAPD patients. However, these differences may have been explained by the fact that APD patients were treated at only 3 of the centres, while CAPD patients were selected from 13 other centres where APD was less available. Additional benefits attributed to APD include being empty of fluid during the day (possibly reducing back pain and body image difficulties) (Wrenger et al 1996) and performing APD at night in the supine position thereby resulting in reduced intra-abdominal pressures compared with the upright position in CAPD (Twardowski et al 1983). These potential benefits are partly negated by the necessity of most patients (except for high transporters) to perform at least one daytime exchange to meet small solute clearance targets (Blake et al 1996).

Residual renal function

Several early observational cohort studies have suggested that APD is associated with a more rapid acceleration of RRF decline compared with CAPD (Hiroshige et al 1996, Hufnagel et al 1999). In a 6-month prospective, non-randomised comparison study, the mean change in renal C_{Cr} measurements for NIPD (n = 8), CCPD (n = 5) and CAPD (n = 5) were -0.29, -0.34 and 0.01 mL/minute/1.73 m^2/month, respectively (p value not quoted)(Hiroshige et al 1996). The study was limited by small numbers and selection bias.

A subsequent prospective, case-controlled study demonstrated that the monthly rate of residual renal C_{Cr} decline was significantly higher in the APD group (CCPD n = 12, NIPD n = 6) compared with the CAPD group (n = 18) at 6 months (-0.28 versus –0.1 mL/minute/1.73 m^2, P = 0.04) and 12 months (-0.26 versus -0.13 mL/minute/1.73 m^2, P = 0.0005) (Hiroshige et al 1996). RRF decreased at the same rate in the NIPD and

CCPD patient subgroups. However, more recent articles have not been able to confirm a differential rate of decline in RRF between CAPD and APD (de Fijter et al 1994, Fischbach et al 2001, Gallar et al 2000, Hamada et al 2000, Holley et al 2001, Johnson et al 2003, Moist et al 2000, Mujais et al 1998, Rodriguez et al 1998, Singhal et al 2000).

Cost
Most costing studies report that APD is 8%–36% more expensive than CAPD (Bro et al 1999, Rodriguez et al 1998). These additional costs include those of the machine, the greater volumes of dialysate employed, and the special tubing and connection sets used.

Summary of the evidence

Two small RCTs of APD versus CAPD have been performed to date (collectively containing 29 patients who completed the studies on APD versus 24 patients on CAPD). Firm conclusions cannot be drawn, but one trial of questionable quality has demonstrated that APD treatment is associated with a significant reduction in peritonitis rates, overall hospital admissions and hospital admissions for dialysis-related problems. No other differences between APD and CAPD were demonstrated. The second trial involved high and high-average transporters followed for 6 months, was of better quality, and observed that APD patients reported significantly more time for work, family and social activities. However, this benefit came at a significantly (22%) increased financial cost. CAPD and APD patients did not differ with respect to other quality of life measures, net ultrafiltration, small solute clearances, residual renal clearance, peritonitis rates or mechanical complications.

What do the other guidelines say?

Kidney Disease Outcomes Quality Initiative: No recommendation.

British Renal Association: APD should be available as clinically indicated (high transporter status of the peritoneum, impaired filtration and psychosocial reasons forming 20–25% of the total CAPD population) and not constrained by financial considerations.

Canadian Society of Nephrology: Patients who are high transporters and who are having fluid overload problems on CAPD should be considered for transfer to APD. (Opinion)

European Best Practice Guidelines: No recommendation.

International Guidelines:

ISPD Ad Hoc Committee on Ultrafiltration Management in Peritoneal Dialysis: For patients with net UF less than 400 mL/4 hours and a high transport profile of small solute clearance, APD and icodextrin for the long dwell are the recommended therapeutic approaches.

Implementation and audit

ANZDATA should report outcome data such as patient survival, peritonitis rates and renal and peritoneal small solute clearances, by dialysis modality.

Suggestions for future research

1. A large, well-conducted, multicentre, RCT of APD versus CAPD is warranted to definitively determine the impact of APD on peritonitis rates, quality of life, RRF, fluid overload, technique survival and overall survival in PD patients.

2. A similar trial should also be performed to assess the role of APD in ameliorating fluid overload and extending technique and patient survivals in high transporters with ultrafiltration failure.

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Appendices

Table 1 Characteristics of included studies

Study ID (author, year)	N	Study Design	Setting	Participants	Intervention (experimental group)	Intervention (control group)	Follow up (months)	Comments
Bro et al, 1999	34	Randomised open-label prospective controlled trial	3 Danish CAPD units	Adult patients receiving CAPD with high or high-average peritoneal transport characteristics	APD treatment	CAPD treatment	6	
de Fijter et al, 1994	97	Randomised prospective controlled trial	University hospital	New patients with end stage renal failure needing PD	CAPD with a Y-connector	Cyclic peritoneal dialysis	24	

Table 2 Quality of randomised trials

Study ID (author, year)	Method of allocation concealment	Blinding			Intention-to-treat analysis	Loss to follow up (%)
		(participants)	(investigators)	(outcome assessors)		
Bro et a, 1999	Sealed envelopes	No	No	No	No	26.5 (9/34)
de Fijter et al, 1994	Third party	No	No	No	Unclear	15.5 (82/97)

Table 3 Results for dichotomous outcomes

Study ID (author, year)	Outcomes	Intervention group (number of patients with events/number of patients exposed)	Control group (number of patients with events/number of patients not exposed)	Relative risk (RR) [95% CI]	Risk difference (RD) [95% CI]
Bro et al, 1999	Hospitalisation	3/13	5/12	0.55 (95%CI: 0.17, 1.83)	-0.19 (95%CI: -0.55, 0.18)
	Peritonitis (1 or more episodes)	2/13	1/12	1.85 (95%CI: 0.19, 17.84)	0.07 (95%CI: -0.18, -0.32)
	Exit-site infection (1 or more episodes)	1/13	1/12	0.92 (95%CI: 0.06, 13.18)	-0.01 (95%CI: -0.22, -0.21)
	Tunnel infection (1 or more episodes)	0/13	1/12	0.31 (95%CI: 0.01, 6.94)	-0.08 (95%CI: -0.28, -0.12)
	Hernia	0/13	1/12	0.31 (95%CI: 0.01, 6.94)	-0.08 (95%CI: -0.28, -0.12)
	Over-hydration	0/13	2/12	0.19 (95%CI: 0.10, 3.52)	-0.17 (95%CI: -0.40, 0.07)
de Fijter et al, 1994	Mortality	2/41	4/41	0.50 (95%CI: 0.10, 2.58)	-0.05 (95%CI: -0.16. 0.06)
	Peritonitis (1 or more episodes)	6/41	2/41	3.00 (95%CI: 0.64, 14.00)	0.10 (95%CI: -0.03, 0.22)