

1. The influence of peritoneal dialysis systems and solutions on the incidence of peritonitis and catheter-related infections

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Guidelines

(Include recommendations based on level I or II evidence)

- a. **Disconnect systems of CAPD result in lower rates of peritonitis than standard systems (“spike” or luer lock) and the standard system should no longer be used. (Level I evidence)**
- b. **Twin bag systems have lower rates of peritonitis than Y-disconnect systems (Level I evidence) and are recommended as the preferred CAPD technique.**
- c. **There is no difference in peritonitis rates in patients using glucose versus Icodextrin for the CAPD long dwell. (Level II evidence)**

Suggestions for clinical care

(Suggestions are based on Level III and IV evidence)

- There is insufficient evidence to determine a difference in the rates of peritonitis or catheter-related infections between patients using APD or CAPD disconnect systems.

Background

Peritonitis is the most common complication of peritoneal dialysis (PD). Peritonitis episodes may lead to technique failure, damage to the peritoneal membrane and mortality. The transfer of bacteria via the PD catheter into the peritoneal cavity is most likely to occur during the exchange process. The PD system used is therefore likely to influence the incidence of peritonitis.

Since the introduction of PD in 1976, three main types of connecting systems have been used. The original “spike” (or luer lock) system required a new connection between the catheter and dialysate bag at each exchange. This system was largely replaced by the disconnect systems. Initially, the Y-set was used, in which a new exchange takes place via a Y-connection, with spent dialysate first drained to an empty bag connected to one Y limb. The new solution attached to the other Y limb is first used to flush the connecting system, (early systems used a disinfectant) into the spent bag before fresh fluid is run into the peritoneal cavity and the Y-connector disconnected from the PD catheter. The Y-set was further modified to produce the

double bag system. This system incorporates a pre-connected fresh dialysate bag, thus eliminating one connection procedure by the patient.

Automated peritoneal dialysis (APD) systems are now being used extensively. These use a single connection each night, consequently reducing the risk of patient-related contamination.

More biocompatible PD solutions are becoming available. These new solutions have low levels of glucose degradation products and a neutral pH and may cause less mesothelial and interstitial damage than do conventional PD solutions. This may translate into a more intact peritoneal membrane with better preserved transport characteristics and beneficial effects on the frequency of peritonitis.

Observational studies suggest a lower rate of peritonitis occurs with disconnect systems compared with the original “spike” systems. It has also been suggested that APD may be associated with a lower peritonitis rate because of the fewer exchanges involved.

The objective of this guideline was to examine the evidence for the effect of PD systems and solutions on rates of peritonitis and determine whether CARI guidelines in this area of clinical practice could be drafted.

Search strategy

Databases searched:

1) MeSH terms and text words for CAPD were combined using “and” with text words for APD (no MeSH terms exist). These were then combined using “and” with MeSH terms and text words for peritonitis. The search was carried out in Medline (1966 – August Week 3 2002). The Cochrane Renal Group Trials Register was also searched for trials not indexed in Medline.

2) MeSH terms and text words for PD were combined with MeSH terms and text words for dialysate and then combined with MeSH terms and text words for peritonitis. The search was carried out in Medline (1966 – August Week 4 2002). The Cochrane Renal Group Trials Register was also searched for trials not indexed in Medline.

Date of searches: 1) 9 September 2002; 2) 16 September 2002.

What is the evidence?

Type of continuous ambulatory peritoneal dialysis (CAPD) system

One systematic review of randomised controlled trials (RCTs) addressed the question of whether the Y-set and double bag system reduced the incidence of CAPD peritonitis compared with standard systems (Daly et al 2001). This review examined 12 trials, with a total of 991 randomised patients (1993-99). Significantly fewer patients (133/363 vs 158/263) experienced peritonitis when using a disconnect

system (Y-set or double bag) compared with a “spike” system (Odds Ratio 0.33; 95% CI, 0.24-0.46). When the Y-set system was compared with the double bag system, fewer patients experienced peritonitis with the newer double bag system (44/154 vs 66/138; Odds Ratio 0.44; 95%CI, 0.27-0.71).

Only three studies in this review reported information about exit site infections (ESIs). There was no significant difference in this parameter when Y-set and double bag systems were compared with the “spike” system (39/131 vs 40/133; Odds Ratio 0.99; 95% CI, 0.57-1.72).

The study did not report any differences between disconnect systems and the “spike” system in relation to technique failure, the need for catheter removal, hospitalisation, quality of life or mortality.

Effect of automated peritoneal dialysis (APD)

There are no adequate systematic reviews or RCTs that address the rate of peritonitis in patients using CAPD versus APD.

Bro et al (1999) compared 17 patients on APD with 17 patients using CAPD for 6 months. However, no conclusions could be drawn about peritonitis rates as there were only two episodes in the CAPD group and one in the APD group.

Type of PD solution:

There is one RCT of peritonitis rates in PD patients using biocompatible PD fluid versus conventional fluid. Gokal et al (1995) reported the results of a prospective, randomised, controlled study (n = 209) comparing the use of Icodextrin versus glucose in CAPD long term. There was no significant difference in peritonitis rates during the 6-month study (0.76 episodes per patient year in the conventional group versus 0.93 per patient year in the Icodextrin group).

Rippe et al (2001) also found in an RCT with 40 patients (randomly allocated) receiving biocompatible PD fluid versus 40 receiving conventional PD fluid, that there was no difference in peritonitis rates (0.47 per year in conventional versus 0.55 per year in the study group).

Posthuma et al (1999) reported an open, prospective, 2-year study of glucose versus Icodextrin dialysate in APD (n = 38) and found no difference in peritonitis rates.

Summary of the evidence

Please refer to the Evidence Tables shown in the Appendices.

Evidence from non-randomised studies: Effect of automated peritoneal dialysis (APD)

Rodriguez-Carmona et al (1999) in a non-randomised prospective study of 213 patients on CAPD and 115 on APD found that the peritonitis rate was increased by 0.20 episodes per patient year in CAPD patients. The ESI rate was similar.

Case control studies have generally found lower rates of peritonitis in patients on APD. Huang et al (2001) reported 1.22 episodes per 100 patient months in 95 APD patients versus 2.28 episodes per 100 patient months in 112 patients on CAPD. There were no differences in the ESI rates.

Gahnnani et al (1995) found peritonitis rates of 1 per 23 patient months in patients on APD (n = 73) versus 1 per 14.4 patient months for those on CAPD (n = 55). ESI rates were also lower in the APD patients.

Holley et al (1990) conducted a study of 244 patients and reported peritonitis rates in APD patients of 0.3 episodes per year versus 0.5 episodes per year in patients on CAPD using the Y-set, and 1.3 episodes per year in patients using the CAPD “spike” system.

Yishak et al (2001) performed a retrospective review of 198 patients over 10 years and found no difference in the peritonitis rates associated with APD and CAPD.

Evidence from non-randomised studies: Type of PD solution

Sprosen et al (2002), however, reported in abstract form, a prospective registry study of 1762 patients treated with biocompatible versus conventional PD solution. A significantly lower rate of peritonitis was found in patients receiving biocompatible solution (n = 276; 1/74 months) versus conventional solution (n = 1486; 1/34 months). Unfortunately, this registry was non-randomised and further analysis will be necessary to eliminate other factors that could explain this difference.

What do the other guidelines say?

Kidney Disease Outcomes Quality Initiative: No recommendation.

British Renal Association: The use of disconnect systems should be standard unless clinically contraindicated.

Canadian Society of Nephrology: No recommendation.

European Best Practice Guidelines: In patients with frequent episodes of peritonitis, the patient, the system, and the handling of the delivery system should all be reviewed.

International Guidelines: International Society for Peritoneal Dialysis Guidelines/Recommendations 2000 update: No recommendation.

Implementation and audit

A national database for the collection of peritonitis rates, which would also incorporate type of PD system and PD solution, should be established. Benchmarking between Australian Renal Units would allow the beneficial practices of Renal Units with lower rates of peritonitis to be communicated to other Units.

Suggestions for future research

1. Conduct a multicentre RCT of APD versus CAPD disconnect systems addressing peritonitis rates.
2. Investigate the effect of biocompatible PD solutions on peritoneal membrane characteristics and peritonitis rates.

References

- Bro S, Bjorner JB, Tofte-Jensen P et al. 1999. A prospective, randomized multicenter study comparing APD and CAPD treatment. *Perit Dial Int* 19: 526-33.
- Daly CD, Campbell MK, MacLeod AM et al. 2001. Do the Y-set and double-bag systems reduce the incidence of CAPD peritonitis? A systematic review of randomized controlled trials. *Nephrol Dial Transplant* 16: 341-47.
- Gahnnani N, Gorban-Brennan N, Kliger AS et al. 1995. Infection rates in end-stage renal disease patients treated with CCPD and CAPD using the UltraBag™ system. *Adv Perit Dial* 11: 164-67.
- Gokal R, Mistry CD, Peers EM and the MIDAS Study Group. 1995. Peritonitis occurrence in a multicenter study of icodextrin and glucose in CAPD. *Perit Dial Int* 15: 226-30.
- Holley JL, Bernardini J, Piraino B. 1990. Continuous cycling peritoneal dialysis is associated with lower rates of catheter infections than continuous ambulatory peritoneal dialysis. *Am J Kidney Dis* 16(2): 133-36.
- Huang J-W, Hung K-Y, Yen C-J et al. 2001. Comparison of infectious complications in peritoneal dialysis patients using either a twin-bag system or automated peritoneal dialysis. *Nephrol Dial Transplant* 16: 694-07.
- Posthuma N, ter Wee PM, Donker AJ et al. 1999. Peritoneal defense using icodextrin or glucose for daytime dwell in CCPD patients. *Perit Dial Int* 19: 334-42.
- Rippe B, Simonson O, Heimburger O et al. 2001. Long-term clinical effects of a peritoneal dialysis fluid with less glucose degradation products. *Kidney Int* 59: 348-57.
- Rodriguez-Carmona A, Perez Fontan M, Garcia Falcon T et al. 1999. A comparative analysis on the incidence of peritonitis and exit-site infection in CAPD and automated peritoneal dialysis. *Perit Dial Int* 19: 253-58.
- Sprosen TS, Miserque D, Story KO et al. 2002. Significant reduction in peritonitis observed in patients prescribed the biocompatible PD solution Physioneal: first data from the European PD Solutions Registry. *Perit Dial Int* 22(1): 148 (abstract).
- Yishak A, Bernardini J, Fried L et al. 2001. The outcome of peritonitis in patients on automated peritoneal dialysis. *Adv Perit Dial* 17: 205-08.

Appendix

Table 1 Characteristics of randomised controlled trial evidence

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 controlled clinical trial	University, multicentre	PD patients with high or high-average peritoneal transport characteristics, 4% diabetic	Y-set CAPD	APD (NIPD or CCPD)	6	None
Gokal et al 1995	209	Randomised controlled clinical trial	Teaching hospitals, multicentre	CAPD patients (>3 months on treatment); 39% in the control group and 64% of the treatment group had experienced previous peritonitis episodes	Icodextrin for long dwell in CAPD	Glucose for long dwell in CAPD	6	None
Posthuma et al 1999	38	Randomised controlled clinical trial	University and teaching hospital	CCPD patients with estimated life expectancy >2 years, 2.6% diabetic	Icodextrin for long dwell in CCPD	Glucose for long dwell in CCPD	24	None
Rippe et al 2001	80	Randomised controlled clinical trial	University, multicentre	CAPD patients, able to use 2 L bags with a calcium concentration of 1.35 mmol/L, 35-43% diabetic	Gambrosol 40 CAPD solution	Conventional CAPD fluid (potentially bioincompatible)	24	None

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 al 1999	Unclear	No	No	No	No	2.9
Gokal et al 1995	Unclear	No	No	No	Yes	0.0
Posthuma et al 1999	Unclear	No	No	No	No	2.6
Rippe et al 2001	Adequate	No	No	No	No	35.0

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	Peritonitis (1 or more episodes)	2/13	1/12	1.85 (0.19 to 17.84)	0.07 (-0.18 to 0.32)
	Exit-site infection (1 or more episodes)	1/13	1/12	0.92 (0.06 to 13.18)	-0.01 (-0.22 to 0.21)
	Tunnel infection (1 or more episodes)	0/13	1/12	0.31 (0.01 to 6.94)	-0.08 (-0.28 to .012)
	Hernia	0/13	1/12	0.31 (0.01 to 6.94)	-0.08 (-0.28 to .012)
	Overhydration	0/13	2/12	0.19 (0.10 to 3.52)	-0.17 (-0.40 to 0.07)
Gokal et al 1995	Peritonitis (1 or more episodes)	22/100	23/103	0.93 (0.55 to 1.56)	-0.06 (-0.14 to 0.01)
Posthuma et al 1999	Peritonitis (1 or more episodes)	3/19	0/19	7.00 (0.39 to 126.92)	0.16 (-0.06 to 0.34)
	Death (all-cause)	0/19	4/19	0.11 (0.01 to 1.93)	-0.21 (-0.41 to -0.02)
Rippe et al 2001	Peritonitis (1 or more episodes)	13/40	14/40	0.93 (0.50 to 1.72)	-0.03 (-0.23 to 0.18)