6. Type of peritoneal dialysis catheter

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Guidelines

No peritoneal dialysis catheter has proven to be superior to the two cuff standard Tenckhoff catheter in the prevention of peritonitis. (Level II evidence)

Suggestions for clinical care

(Suggestions are based on level III and IV sources)

- **No recommendation.**

Background

The key to successful chronic peritoneal dialysis (PD) is a reliable and permanent PD catheter. There are a number of variations on the standard single or double Dacron cuff Tenckhoff catheter that are now available which have been developed in an attempt to improve both the infectious complications, such as peritonitis and exit-site infections, and the mechanical complications. These variants include a coiled Tenckhoff, Toronto-Western Hospital catheter with silicone discs perpendicular to the catheter along the intraperitoneal segment, the Lifecath catheter with a disc positioned on the parietal peritoneal surface, the Ash (T-fluted, Advantage) catheter with a T-shaped intraperitoneal segment, the Swan neck, with an inverted U shaped arc, the Moncrief-Popovich which is similar to the Swan neck but has a longer external skin cuff of 2.5 cm, the Pail-handle (Cruz), which has 2 right angle bends and small cuffs for peritoneoscopic insertion, the Swan neck presternal catheter (Missouri), Twardowski (2002) which is composed of 2 silicone rubber tubes that are connected with a titanium connector at implantation with a coil and a longer subcutaneous tunnel, and the Self-locating catheter which is similar to a classic Tenckhoff with a 12 g tungsten weight at the internal tip.

The aim of this guideline was to establish whether there was any PD catheter that has an advantage in reducing the incidence of peritonitis. Other complications such as mechanical problems are not formally addressed.

Search strategy

Databases searched: MeSH terms and text words for PD were combined with MeSH terms and text words for various types of catheters, and then combined with MeSH terms and text words for peritonitis. The search was carried out in Medline (1966 – October Week 3 2002). The Cochrane Renal Group Trials Register was also searched for trials not indexed in Medline.

Date of search/es: 12 November 2002.

What is the evidence?

Prospective randomised controlled trials

Eklund et al (1997) randomised 60 patients to Tenckhoff catheters with either single or double Dacron cuffs and showed there was no difference in the probability of developing the first episode of peritonitis. There was also no difference in exit-site infections (ESI) or catheter survival at 1 or 2 years (single 95.5 vs double 96.7% at 1 year, and single 82.7 vs double 79.9% at 2 years).

Akyol et al (1990) in a prospective, randomised, double-blind comparison of 39 patients showed no difference in peritonitis rates between patients with double cuff curled Tenckhoff (15 in 255 patient months) and double cuff conventional straight catheter (19 in 266 patient months). There was also no difference in exit-site infections, mechanical complications or catheter survival at 78 weeks.

Nielsen et al (1995) randomised 72 patients to either single cuff straight catheter or a single cuff curled catheter which were inserted percutaneously by the nephrologists and found no difference in the number of catheters that were removed for peritonitis (straight 2/38 vs curled 2/34). The straight catheter had a reduced catheter survival at 12 months (36% vs 77%, $p < 0.01$), primarily due to catheter tip migration.

Lye et al (1996) randomised 40 patients to double-cuff Swan neck (SN) coiled or double cuff straight Tenckhoff (T) catheter, implanted by surgical technique and found no significant difference in the incidence of peritonitis (SN 0.96 vs T 0.90 episodes/patient-year). There were fewer exit-site infections in the Swan-neck coiled catheter group (0.29 vs 0.60 episodes/year) but no difference in mechanical complications, technique failure or catheter survival at 12 months (SN 95% vs T 90%).

Eklund et al (1994) randomised 40 patients to either a single-cuff straight Tenckhoff catheter or a permanently bent single-cuff Swan-neck catheter and found no difference in peritonitis episodes at 2 years (T 29 vs SN 27), the number of patients with peritonitis (T 10 vs SN 11), the mean interval between episodes of peritonitis (T 11.2 vs SN 14.1 months), or the calculated probability of first episode of peritonitis at 12 months (T 59.5% vs SN 52.5%). There was no significant difference in exit-site infections or 2-year catheter survival.

Eklund et al (1995) randomised 40 patients to double cuff Swan neck or a double cuff straight Tenckhoff and found no difference in the total number of peritonitis episodes

(SN 13 vs T 15), the mean interval between episodes (SN 26.4 vs T 31.8 months), the risk of developing peritonitis within 12 months (SN 29.2% vs T 27.3%) or peritonitis as a cause of exit from the study (SN 2 vs T 2 patients). There was no significant difference in ESI or catheter survival at 2 years (SN 90% vs T 95%).

Scott PD et al (1994) randomised 89 patients to a straight double-cuff Tenckhoff, Toronto-Western double-disk or a standard coiled catheter and reported that there was no difference in peritonitis at 12 months, mechanical complications or 12-month catheter survival.

Summary of the evidence

There are 7 randomised controlled trials (RCTs) comparing different catheter types – single- or double-cuff, Tenckhoff straight and coiled, Toronto-Western, and Swan neck (permanent bend) straight and coiled – which show no significant difference in the incidence of peritonitis. Despite retrospective evidence suggesting an advantage of the double-cuff over the single-cuff catheter in respect of both peritonitis and catheter survival, there is only one RCT addressing this issue, which shows no significant difference in the incidence of peritonitis. One study compares the single-cuff straight vs curled catheter and another the double-cuff straight vs curled, with no significant difference found in the incidence of peritonitis. There are 3 RCTs comparing the straight Tenckhoff catheter with the permanently bent catheter (Swan neck or permanently bent Tenckhoff) and there was no difference in peritonitis. There was also no difference in peritonitis between the straight double-cuff Tenckhoff, Toronto-Western and standard coiled catheter in an RCT.

Retrospective studies

The United States Renal Data System 1992 Annual Report retrospectively documented less peritonitis with the double-cuff than the single-cuff catheter.

Warady et al (1996) reported on data in the North American paediatric dialysis database which has 1,383 courses of peritoneal dialysis documented in it. The incidence of peritonitis was found to be lower with the double-cuff than the single-cuff catheter (1/15.1 vs 12.6 months, $p < 0.01$).

Honda et al (1996) from the Japanese Registry in Pediatric CAPD patients documented better catheter survival with the double-cuff vs single-cuff catheter (82.2% vs 69.0% at 1 year and 54.2% vs 43.2% at 2 years) but did not comment on the difference in peritonitis between the two groups in a retrospective review of 434 paediatric PD patients.

Hwang and Huang (1994) compared 26 patients with the Swan neck Missouri 2 catheter from 1992-1994 with 166 patients with straight Tenckhoff catheters from 1986-1992. Peritonitis was not reported on but they did find that there was no difference in ESIs (SN 55.7% vs T 55.8%), tunnel infections (SN 7.7% vs T 9.1%) or catheter tip migration (SN 7.7% vs T 5.2%). There were however, fewer cuff extrusions and pericatheter leakages and a better catheter survival at 1, 2 and 3

years with the Swan neck Missouri 2 catheter (SN 90.0%, 80.2%, 67.9% vs T 84.7%, 67.9%, 54.0%).

Gadallah et al (2000) retrospectively analysed 462 patients over a 6-year period and compared the double-cuff, straight catheter with a curled-end (n=219), with the double cuff, 60^{o} Swan neck catheter with a coiled end (n=243). Although they did not assess peritonitis or catheter survival, they did find significantly less catheter tip migration in the Swan neck group (< 1% vs 15%, p = 0.002).

Nebel et al (1991) in a retrospective study over 3 years compared 23 patients with a Swan neck Tenckhoff catheter and 49 controls with a straight Tenckhoff catheter from the commencement of dialysis. There were significantly more episodes of peritonitis in the Swan neck group (24 in 12 patients compared with 9 in 8 patients, 1.1 vs 0.3 episodes of peritonitis/patient-year) but no difference in ESIs, tunnel infections or cumulative catheter survival at 3 years (SN 23.6% vs T 25.0%).

Twardowski et al (1992) reported on a 6-year experience with Swan neck catheters and compared the Swan neck prototype (n=27), Swan neck Missouri 2 with a straight IP segment (n=105) and a coiled IP segment (n=49). They found no significant difference in peritonitis or 3-year catheter survival rates.

Ash et al (2002) inserted 18 Ash Advantage (T-fluted) catheters in 10 new dialysis patients and 8 who had had previous problems, including 2 with peritonitis (1 also with an ESI and outflow failure, 1 also had adhesions and a compartment abdomen). Both of these patients had to have the catheter removed – one due to peritonitis, the other due to adhesions and outflow failure. One patient developed peritonitis that resolved with antibiotics and did not require removal of the catheter. There was 90% catheter survival at 12 months.

Twardowski et al (1990) compared 103 Swan neck Missouri catheters with 148 standard catheters as historical controls (Tenckhoff and Toronto-Western). The Swan neck catheters had either a coiled or straight IP segment. There was no difference in the number of catheter failures due to peritonitis or ESI. The catheter survival was significantly better in the Swan neck group at 3 years (64% vs 29%) than for standard catheters.

Minguela et al (2001) reported on 105 self-locating catheters, 53 straight catheters and 15 coiled catheters that were implanted in 139 patients. There was no significant difference in the annual peritonitis rate (self-locating 0.72 $\pm$ 1.42, straight 0.95 $\pm$ 2.31, coiled 0.65 $\pm$ 0.86 episodes annually). There was better catheter survival in the self-locating group at 1, 2 and 3 years than the coiled or straight groups, respectively (97%, 80%, 75% at 1 year and 96%, 80%, 67% at 3 years).

What do the other guidelines say?

Kidney Disease Outcomes Quality Initiative: No recommendations**.**

British Renal Association 2002: No recommendations for adults apart from supporting the ISPD guidelines 1998 and repeating the statement that overall no

catheter appears to be superior to the standard double-cuff Tenckhoff catheter. In the paediatric section, they comment that there is no best catheter configuration to prevent peritonitis but later suggest that the Swan neck tunnel, two-cuff and downward-pointing exit site may have an advantage, based on data from the North American Registry.

Canadian Society of Nephrology: No recommendations.

European Dialysis and Transplant Association–European Renal Association: Up to now no specific catheter has proved to be superior to the others (Level A).

International Society for Peritoneal Dialysis 1998: Convincing data exist to indicate that the double-cuff catheter is preferable to the single-cuff catheter, therefore a double-cuff configuration is recommended (the data they quote is retrospective data for both peritonitis – USRDS 1992, Warady et al 1996, Honda et al 1996 – and for catheter survival time – Lindblad et al 1988 and Favazza et al 1995). A downward-directed exit may decrease the risk of catheter-related peritonitis. Properly implanted, preformed arcuate or pail-handle catheters will always have a downward-directed exit and are therefore, advantageous in this respect. Overall, no catheter appears to be superior to the original two-cuff, standard Tenckhoff catheter, although experience with Swan neck catheters is promising. There is a need for large, randomised prospective studies and long-term experience.

Implementation and audit

All renal units should maintain data on all PD-related problems including ESIs, tunnel infections, peritonitis, catheter malfunction rates and catheter survival times. This data should be submitted to the ANZDATA registry.

Suggestions for future research

RCTs should be performed when new PD catheters are developed to establish whether there is any clinical benefit.

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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
Akyol et al 1990	40	Randomised controlled clinical trial	University	Patients undergoing placement of peritoneal dialysis catheters; 12% diabetic	Straight Tenckhoff catheter	Curled Tenckhoff catheter	13	None
Eklund et al 1997	60	Randomised controlled clinical trial	Teaching hospital	Patients undergoing placement of peritoneal dialysis catheters for CAPD; 26% diabetic	Single cuff Tenckhoff catheter	Double cuff Tenckhoff catheter	20	None
Eklund et al 1995	40	Randomised controlled clinical trial	University	Patients undergoing placement of peritoneal dialysis catheter for CAPD; 16% diabetic	Tenckhoff (straight, double cuff) catheter	Swan Neck (double cuff, coiled) catheter	12	None
Eklund et al 1994	40	Randomised controlled clinical trial	University	Patients undergoing placement of peritoneal dialysis catheter for CAPD; 13% diabetic	Tenckhoff (straight, single cuff) catheter	One bubble slanted flange Swan Neck (single cuff, coiled) catheter	NA*	None
Lye et al 1996	40	Randomised controlled clinical trial	University	Patients undergoing placement of peritoneal dialysis catheter for CAPD; only patients commencing CAPD for the first time; 35% diabetic	Tenckhoff (straight, double cuff) catheter	Swan-neck (coiled, double cuff) catheter	12	None
Nielsen et al 1995	72	Randomised controlled clinical trial	University	Patients undergoing placement of peritoneal dialysis catheter for CAPD; 18% diabetic	Straight Tenckhoff (single cuff) catheter	Permanently bent Swan Neck (curled, single cuff) catheter	6	None
Scott et al 1994	89	Randomised controlled clinical trial	Teaching hospital	Patients undergoing placement of peritoneal dialysis catheter for CAPD; proportion of diabetic patients not available	Tenckhoff (straight, double cuff) catheter	Toronto Western (curled) double disk catheter or Oreopoulos standard (coiled) catheter	12	None

*NA = not available

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)		
Akyol et al 1990	Unclear	Yes	Yes	No	Unclear	5.0
Eklund et al 1997	Unclear	No	No	No	No	Unclear
Eklund et al 1995	Unclear	No	No	No	Unclear	0.0
Eklund et al 1994	Unclear	No	No	No	Yes	0.0
Lye et al 1996	Unclear	No	No	No	Unclear	Unclear
Nielsen et al 1995	Unclear	No	No	No	No	0.0
Scott et al 1994	Unclear	No	No	No	Unclear	Unclear

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]
Akyol et al 1990	Peritonitis rate*	14/266	17/255	0.79 (0.40 to 1.57)	-0.01 (-0.05 to 0.03)
	Exit-site/tunnel infection	3/20	3/20	1.00 (0.23 to 4.37)	0.00 (-0.22 to 0.22)
	Catheter removal/replacement	1/20	6/20	0.17 (0.02 to 1.26)	-0.25 (-0.47 to -0.03)
Eklund et al 1997	Peritonitis	14/30	17/30	0.82 (0.50 to 1.53)	-0.10 (-0.35 to 0.15)
	Exit-site/tunnel infection	11/30	14/30	0.79 (0.43 to 1.44)	-0.10 (-0.35 to 0.15)
	Catheter removal or replacement	6/30	3/30	2.00 (0.55 to 7.27)	0.10 (-0.08 to 0.28)
	All-cause mortality	2/30	5/30	0.40 (0.08 to 1.90)	-0.10 (-0.26 to 0.06)
Eklund et al 1995	Peritonitis	9/20	8/20	1.13 (0.55 to 2.32)	0.05 (-0.26 to 0.36)
	Peritonitis rate*	15/476	13/342	0.83 (0.40 to 1.72)	-0.01 (-0.03 to 0.02)
	Exit-site/tunnel infection	12/20	10/20	1.20 (0.68 to 2.11)	0.10 (-0.21 to 0.41)
	Exit-site/tunnel infection rate*	23/476	20/342	0.83 (0.46 to 1.48)	-0.01 (-0.04 to 0.02)
	Catheter removal/replacement	2/20	2/20	1.00 (0.16 to 6.42)	0.00 (-0.19 to 0.19)
	All-cause mortality	1/20	3/20	0.33 (0.04 to 2.94)	-0.10 (-0.28 to 0.08)
Eklund et al 1994	Peritonitis	3/20	4/20	0.75 (0.19 to 2.93)	-0.05 (-0.28 to 0.18)
	Peritonitis rate*	10/327	11/381	1.06 (0.46 to 2.46)	0.00 (-0.02 to 0.03)
	Exit-site/tunnel infection	11/20	9/20	1.22 (0.65 to 2.29)	0.10 (-0.21 to 0.41)
	Exit-site/tunnel infection rate*	21/327	19/327	1.11 (0.61 to 2.02)	0.01 (-0.03 to 0.04)
	Catheter removal/replacement	3/20	4/20	0.75 (0.19 to 2.93)	-0.05 (-0.28 to 0.18)
	All-cause mortality	0/20	4/20	0.33 (0.04 to 2.94)	-0.20 (-0.39 to -0.01)
Lye et al 1996	Peritonitis rate*	20/267	22/275	0.94 (0.52 to 1.68)	-0.01 (-0.05 to 0.04)
	Exit-site/tunnel infection	14/20	9/20	1.56 (0.89 to 2.73)	0.25 (-0.05 to 0.55)
Nielsen et al 1995	Peritonitis	2/38	2/34	0.89 (0.13 to 6.01)	-0.01 (-0.11 to 0.10)
	Catheter removal/replacement	24/38	8/34	2.68 (1.40 to 5.16)	0.40 (0.19 to 0.61)
Scott et al 1994	Peritonitis	3/30	6/59	0.98 (0.26 to 3.66)	0.00 (-0.13 to 0.13)
	Exit-site/tunnel infection	1/30	1/59	1.97 (0.13 to 30.36)	0.02 (-0.06 to 0.09)
	All-cause mortality	1/30	6/59	0.33 (0.04 to 2.60)	-0.07 (-0.17 to 0.03)

* Given as episodes/total patient months on PD