**Technique of insertion of peritoneal dialysis catheter**

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**GUIDELINES**

a. The laparoscopic insertion of peritoneal dialysis catheters has been shown to have similar complication rates to laparotomy. (Level I evidence)

b. The peritoneoscopic insertion of peritoneal dialysis catheters may be superior to dissective insertion in the prevention of peritonitis, leaking of peritoneal dialysis fluid around the cuff and technique failure. (Level II evidence)

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**SUGGESTIONS FOR CLINICAL CARE**  
(Suggestions are based on level III and IV evidence)

Peritoneal dialysis (PD) catheters inserted by experienced operators working as part of a multidisciplinary team are associated with low reported infectious complication rates.

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**IMPLEMENTATION AND AUDIT**

1. All PD units should collect data on all peritoneal dialysis (PD) patients including infectious complications (exit site infections [ESIs], tunnel infections and peritonitis), mechanical complications, PD technique survival and patient survival. Data should be submitted to the Australia and New Zealand Dialysis and Transplant (ANZDATA) Registry.

2. Units using peritoneoscopic catheter insertion (for example Y-TEC® system) should also collect data and present this through the Australia and New Zealand Society of Interventional Nephrology (ANZSIN).

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**BACKGROUND**

Infectious and mechanical complications continue to be a major problem in the management of patients on PD. A number of different methods of insertion of the PD catheter have been proposed in an attempt to reduce these complications. These techniques include surgical placement by open dissection, laparoscopy, blind percutaneous placement using a Tenckhoff trocar, blind percutaneous placement with radiological guidance using a guidewire (Seldinger technique), peritoneoscopic (Y-TEC®) insertion under local anaesthetic and direct vision, the Moncrief-Popovich technique (the segment of the catheter that is usually brought out through the skin is buried subcutaneously and the entire wound is closed for 4-6 weeks before the distal segment of the catheter is brought out through the skin via a small incision 2 cm distal to the subcutaneous cuff) and the presternal catheter (a modified Swan neck Missouri coil catheter which is composed of 2 silicone rubber tubes that are connected at the time of insertion) which has a much longer subcutaneous section and an exit site on the chest wall.

The aim of this guideline was to assess whether any particular surgical technique for the insertion of a PD catheter is associated with a lower incidence of peritonitis.
SEARCH STRATEGY

**Databases searched:** MeSH terms and text words for peritoneal dialysis were combined with MeSH terms and text words for peritonitis, catheter and surgery. These were then combined with the filters for randomised controlled trials, meta analyses and cohort studies. The search was carried out in Medline (1950–September Week 4, 2010) and restricted to the years 2003-2010. The Cochrane Renal Group Trials Register was also searched for trials not indexed in Medline.

**Date of searches:** October 2010; update search August 2012.

WHAT IS THE EVIDENCE?

**Systematic reviews**

Strippoli et al performed a Cochrane systematic review of catheter-related interventions for the prevention of peritonitis in PD, consisting mainly of different surgical strategies for PD catheter insertion [1]. The review included 17 trials of a total of 1089 patients, although the methodological quality was “generally suboptimal”. The types of interventions examined included technique of surgical catheter insertion (laparotomy, laparoscopy with or without catheter fixation and/or omentopexy or omentectomy, subcutaneous burying of catheter tip until commencement of dialysis), duration of resting of catheter until usage, midline or lateral insertion and the use of immobilisation techniques. Outcome measures consisted of peritonitis episodes and rate, peritonitis relapse, infectious complications including death, catheter removal or replacement, technique failure and time to first episode of peritonitis. The authors’ conclusions were that no catheter-related interventions have any impact on the risk of peritonitis, exit-site and tunnel infections in PD. The only significant (although considered spurious) finding was of a lower all-cause mortality for straight catheters compared with coiled catheters (RR 0.26, 95% CI: 0.07-0.99). This was considered spurious on the basis of no difference in infectious outcomes between the two catheter types.

With regard to the surgical insertion of PD catheters, the Cochrane review addressed the issue of laparoscopy versus laparotomy and found no difference for the following outcomes: all-cause mortality (2 trials, 193 patients), peritonitis (3 trials, 238 patients), exit-site or tunnel infections (1 trial, 148 patients), catheter removal or replacement (2 trials, 90 patients) or technique failure (3 trials, 206 patients).

Of note is that this systematic review was performed before the increasing use of the peritoneoscopic method of insertion of PD catheters in Australia and New Zealand. Although one trial using this technique was compared prospectively to surgical insertion in a randomised, prospective trial, it was included in the meta-analysis as a trial of laparoscopy vs laparotomy, whereas in fact there are significant differences between surgical laparoscopy and peritoneoscopy, which could undermine the validity of any analysis which groups the two techniques together for the purposes of a comparison of outcomes [2]. These include operator, environmental, technique and infectious prophylaxis differences. For example, laparoscopy requires general anaesthetic, an operating theatre, several incisions for insertion of ports for instrumental access, and insufflation with CO₂. In contrast, peritoneoscopy uses a much smaller instrument (2 mm) which is used with only local anaesthetic, a single incision, and can be done in a procedure room with insufflation of a small amount of room air. This point of differentiation between laparoscopy and peritoneoscopy is an important one, as several other non-randomised and retrospective studies have also shown lower complication rates when PD catheters are inserted by nephrologists rather than surgeons [3-5].
Randomised prospective studies

While the Cochrane review suggested no differences between the different surgical approaches of laparotomy and laparoscopy, there is one important trial of peritoneoscopic versus laparoscopic insertion of Tenckhoff catheters which is worthy of discussion [2]. This is a prospective, randomised controlled trial conducted from October 1992 through October 1995. The investigators randomised 148 patients to receive double-cuffed, swan-neck, coiled-tip Tenckhoff catheters to be either surgically inserted under general anaesthesia or inserted by nephrologists with a peritoneoscope (Y-TEC®) and local anaesthesia in a sterile procedure room. The same three surgeons and same three nephrologists were used to perform the procedures and randomisation was by alternate months for the different procedures. Patients in both groups received vancomycin prophylaxis prior to surgery, and the same post-operative care with daily irrigation of the catheters and dialysis was not commenced for one week. A total of 76 patients who had catheters inserted with the peritoneoscope were compared with 72 who had surgical insertions. For patients who had more than one catheter insertion in the study period, only the first insertion was included in the analysis. The baseline characteristics of the two groups were not significantly different from each other and were representative of the US dialysis population (approx. 50% African-American, approx. 35% diabetic and almost half having had prior abdominal surgery in both groups).

In terms of complication rates, early peritonitis was seen in 9 of 72 patients in the surgical group versus 2 of 76 in the peritoneoscopic insertion group (P = 0.02) and leaks were seen in 8 of 72 surgical versus 1 of 76 peritoneoscopy patients (P = 0.002). There were no differences in catheter malfunction (6 in each group) or visceral perforation (1 in each group). Late complications were similar in both groups and overall catheter failure rates were 55.2% in the surgical group versus 32.8% in the peritoneoscopy group (P = 0.003), after excluding death, transplantation or patient choice to stop PD (similar rates in both groups).

The authors concluded that the peritoneoscopic technique has a lower incidence of early peritonitis and leaks compared with the surgical technique, and the former technique provides better long-term catheter survival. Limitations of the study are that randomisation was by alternate months rather than a more robust randomisation strategy, and that the study was in a single centre rather than multiple centres, raising questions as to the external validity of the results. The results concurred with the previous prospective but non-randomised study by Pastan et al, which compared surgically-inserted catheters to peritoneoscopically-inserted catheters in 88 patients and found a significant difference in catheter survival in favour of the peritoneoscopic (89% at 623 days, median follow-up 251 days) compared with surgical (57% at 682 days, median follow-up 102 days, P = 0.02) [3]. However, no significant difference in peritonitis was found, probably due to the small number of events (7 versus 1 in favour of the surgical group, P = NS).

With regard to the issue of burying the catheter tip at the time of catheter insertion to attempt to reduce infection rates, Moncrief and Popovich randomised 113 patients to either the subcutaneously buried technique (MP) or to the regular catheter insertion and found no difference in peritonitis rates (0.47 vs 0.41 episodes/year/patient) [6]. However, the ESI rate was significantly lower in the subcutaneously buried group (0.109 vs 0.284 episodes/year/patient, P = 0.04).

Subsequently, Danielsson et al randomised 60 patients to either the subcutaneous buried technique or standard insertion with a Moncrief-Popovich catheter and these were compared with a non-randomised group of 65 patients given a standard Tenckhoff catheter [7]. There was no difference in the number of episodes of peritonitis (MP buried 11, MP not buried 12, Tenckhoff 26) but the cumulative probability of peritonitis at 18 months was greater in the MP not buried group than the MP buried group (MP not buried 1/26, MP buried 1/40, Tenckhoff 1/33 treatment months). There were fewer ESIIs in the standard Moncrief-Popovich group.
compared with the standard Tenckhoff group, but no difference in the subcutaneously-buried group.

**Non-randomised studies**

Contemporary series like that of Maio et al from Portugal with the laparoscopic technique show that very low complication rates and excellent catheter survival can be achieved [8]. In this series of 100 patients, there were no infectious complications at all, and catheter survival rates were 97%, 95% and 91% at 1, 2, and 3 years, respectively. A series from Chile of 125 catheters inserted with the open surgical technique had remarkably similar catheter survival rates (92.2% at 5 years) [9]. Series such as these should be the yardstick to which other results are compared.

In terms of comparative studies, there are many non-randomised studies comparing surgical and other techniques (such as peritoneoscopic) with the endpoint of infectious and mechanical complications.

One retrospective cohort series from the US compared PD catheters inserted percutaneously by interventional radiologists under fluoroscopy with those inserted surgically [10]. The authors found that the only difference was in late peritonitis rates (20% in the percutaneous group vs 42% in the surgical group, \( P = 0.018 \), \( N = 101 \) patients).

Swartz et al compared 213 curled catheters that were placed percutaneously (\( P, N = 134 \)) or surgically (\( S, N = 79 \)) between January 1985 and December 1998 and found no difference in the incidence of peritonitis (\( P = 0.91 \pm 0.13 \) vs \( S = 1.05 \pm 0.19 \) episodes per patient-year) [11]. There was no difference in catheter survival between the two groups at 1, 2 or 3 yrs (88%, 71% and 61%, respectively). There were more early dialysate leaks with the percutaneous group (21.6% vs 10.1%, \( P < 0.05 \)).

Ozener et al reported on 133 percutaneous catheters that were inserted by the nephrology staff using the Seldinger technique, and compared the outcomes with 82 surgical controls [5]. They found that there was less peritonitis in the percutaneous group (1/25 vs 1/17 patient months, \( P = 0.01 \)) and a longer time between catheter placement and first episode of peritonitis (22.7 vs 12.6 months, \( P = 0.02 \)). There was no difference in the catheter infection-free period. The one- and two-year catheter survival was significantly better in the percutaneous group than surgical group (90% and 82% vs 73% and 60%, respectively; \( P = 0.0032 \)).

Over a 3-year period, Roueff et al compared 57 patients who underwent percutaneous placement of the PD catheter with a trocar Seldinger technique (from April 1996 to March 1999) with 47 historical controls who had surgically-inserted catheters (from April 1993 to March 1996) [12]. In the period between April 1996 and March 1999, there were 28 patients who could not have a percutaneous procedure due to obesity, previous laparotomy, polycystic kidney disease or hernia. There was no difference in the peritonitis rate at 60 days but late peritonitis after 60 days was lower in the percutaneous group (1/16.4 vs 1/11.7 patient-months). The one-year catheter survival was higher in the percutaneous group (75% vs 71%).

In his series of patients given percutaneous insertion of PD catheters, Savader et al reported catheter survival rates at 6, 12 and 24 months of 89%, 81%, and 81%, respectively [13]. Surgically-implanted catheter survival rates were reported to be 50% to 88% at 12 months and 41% to 60% at 24 months. Peritonitis rates were not specifically reported.

In Australia and New Zealand, there is one retrospective series report on the technique of peritoneoscopic catheter insertion, by Kelly et al [14]. This report from Tamworth, NSW, details 3 years of experience with the Y-TEC® method of insertion of 40 catheters, focussing on complications in the first 6 weeks. There were six complications, including two
malpositions which were attributed to the “learning curve” of the technique, but there was only one ESI and one catheter leak.

With regard to the level of experience of the operator performing the procedure of insertion of the PD catheter, there are several single-centre studies, which report that the approach of having a multidisciplinary team involved in the insertion of catheters and experienced operators (in this case two surgical teams performing surgical catheter insertions with good nursing care prior, and the administration of prophylactic antibiotics) is associated with low rates of infectious complications [15]. In this series from Malaysia, 384 catheters were inserted into 319 patients by either general surgeons or urologists over a 3-year period between January 2004 and November 2007. Complications included catheter tip migration: 29 cases (7.6%), catheter obstruction: 22 cases (5.7%), ESI: 24 cases (6.3%), leaks from incision: 12 cases (3.1%), culture-proven wound infection: 14 cases (3.6%), peritonitis: 11 cases (2.9%), and hemoperitoneum: 1 case (0.3%). No deaths were attributed to surgical mishap. These complications were comparable to other centres reporting low complication rates, such as Tiong et al in Singapore [16]. We did not find any published series of complication rates from centres which do not use this approach, for example those who outsource their PD catheter insertion procedures. It therefore remains uncertain whether this multidisciplinary team approach leads to the lowest possible complication rates. Peritoneal dialysis units that use alternative approaches for PD access should be encouraged to report their complication rates.

SUMMARY OF THE EVIDENCE

In summary, there has been one systematic review of catheter insertion technique for the endpoint of infectious complications, which did not show a benefit of any particular type of procedure over any other [1]. However, this systematic review did not separate the trial of peritoneoscopic insertion compared with surgical insertion using laparoscopy. Although this trial did have some methodological concerns as far as the randomisation was concerned, the study was otherwise of reasonable quality. This RCT, as well as a prospective, non-randomised comparison and several retrospective comparisons all suggest that the peritoneoscopic insertion of PD catheters is associated with lower or equivalent complication rates to surgical insertion (laparoscopy or mini-laparotomy). To date, there have been no further such RCTs of this method. The same Cochrane review noted the interesting finding of higher all-cause mortality with coiled-tipped catheters as opposed to straight catheters (4 trials, 209 patients) although the authors thought these results should be interpreted with caution due to the confidence limits approaching 1 and the relatively small number of patients, as well as there being no obvious biologically plausible explanation for this finding.

Most data from both RCTs and single-centre reports also show the lowest rates of infectious complications in units where there is a multidisciplinary team involved in the perioperative care of PD catheters and the procedure of insertion is performed by experienced operators, be they surgeons, radiologists or nephrologists. However, this approach cannot be mandated as there is no comparator. There is wide variation across the world between individual centres, with similar outcomes being reported with each of the different techniques according to local experience.

WHAT DO THE OTHER GUIDELINES SAY?

Kidney Disease Outcomes Quality Initiative: No recommendation.
UK Renal Association: (2009) [17] Peritoneal Access: Guideline 4.1. We recommend that local expertise at individual centres should govern the choice of method of Peritoneal Dialysis (PD) catheter insertion. (Evidence grade 1B)

Canadian Society of Nephrology: No recommendation.

European Renal Best Practice Guidelines: (2005) [18] A. Each centre should have a dedicated team involved in implantation and care of catheters (Evidence level A). D. Catheters should preferably be implanted operatively or by laparoscopy, but the Seldinger technique in selected cases can achieve comparable outcomes. (Evidence level A/B)

International Guidelines: (ISPD 2010) [19] Guideline 1.1. We recommend that each centre should have a dedicated team involved in the implantation and care of peritoneal catheters. (1C, modified GRADE system)

SUGGESTIONS FOR FUTURE RESEARCH

1. A multicentre RCT of peritoneoscopic versus surgical insertion of Tenckhoff catheters could be facilitated through the AKTN in Australia and New Zealand.
2. A comparison of complication rates in Australia and New Zealand related to operator experience could be conducted.

CONFLICT OF INTEREST

David Mudge has a Level IIb conflict of interest according to the conflict of interest statement set down by CARI.
REFERENCES


Table 1 – Characteristics of included studies

<table>
<thead>
<tr>
<th>Study ID (author, year)</th>
<th>N</th>
<th>Study Design</th>
<th>Setting</th>
<th>Participants</th>
<th>Intervention (experimental group)</th>
<th>Intervention (control group)</th>
<th>Follow up (months)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danielsson et al 2002 [7]</td>
<td>60</td>
<td>Randomised controlled clinical trial</td>
<td>2 centres, Sweden</td>
<td>Patients to receive peritoneal dialysis</td>
<td>Subcutaneous rest period</td>
<td>Not having the distal part buried subcutaneously</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Study ID (author, year)</td>
<td>Method of allocation concealment *</td>
<td>Blinding (participants)</td>
<td>Blinding (investigators)</td>
<td>Blinding (outcome assessors)</td>
<td>Intention-to-treat analysis †</td>
<td>Loss to follow up (%)</td>
<td>Quality score ‡</td>
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<tr>
<td>Danielsson et al 2002 [7]</td>
<td>Not specified</td>
<td>No</td>
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<td>6.7</td>
<td>(−)</td>
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<tr>
<td>Gadallah et al 1999 [2]</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0</td>
<td>(−)</td>
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</table>

* Choose between: central; third party (e.g. pharmacy); sequentially labelled opaque sealed envelopes; alternation; not specified.
† Choose between: yes; no; unclear.
‡ Quality score – “How successfully do you think the study minimised bias?” Choose between: very well (+); okay (Ø); poorly (−).
## Table 3 – Results for dichotomous outcomes

<table>
<thead>
<tr>
<th>Study ID (author, year)</th>
<th>Outcomes</th>
<th>Intervention group (no. of patients with events/no. of patients exposed)</th>
<th>Control group (no. of patients with events/no. of patients exposed)</th>
<th>Relative risk (RR) [95% CI]</th>
<th>Risk difference (RD) [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gadallah et al 1999 [2]</td>
<td>Early complication (overall)</td>
<td>10/76</td>
<td>24/72</td>
<td>0.39 (0.20, 0.77)</td>
<td>-0.20 (-0.33, -0.07)</td>
</tr>
<tr>
<td>Gadallah et al 1999 [2]</td>
<td>Peritonitis</td>
<td>2/76</td>
<td>9/72</td>
<td>0.21 (0.05, 0.94)</td>
<td>-0.10 (-0.18, -0.01)</td>
</tr>
<tr>
<td>Danielsson et al 2002 [7]</td>
<td>Peritonitis</td>
<td>11/30</td>
<td>12/30</td>
<td>0.92 (0.48, 1.74)</td>
<td>-0.03 (-0.28, 0.21)</td>
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<td>Gadallah et al 1999 [2]</td>
<td>Malfunction</td>
<td>6/76</td>
<td>6/72</td>
<td>0.95 (0.32, 2.80)</td>
<td>-0.00 (-0.09, 0.08)</td>
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<tr>
<td>Gadallah et al 1999 [2]</td>
<td>Leak</td>
<td>1/76</td>
<td>8/72</td>
<td>0.12 (0.02, 0.92)</td>
<td>-0.10 (-0.17, -0.02)</td>
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<td>Gadallah et al 1999 [2]</td>
<td>Late complication (Overall)</td>
<td>44/76</td>
<td>44/72</td>
<td>0.95 (0.73, 1.24)</td>
<td>-0.03 (-0.19, 0.13)</td>
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<td>Gadallah et al 1999 [2]</td>
<td>Overall catheter failure</td>
<td>18/58</td>
<td>32/58</td>
<td>0.56 (0.36, 0.88)</td>
<td>-0.24 (-0.42, -0.07)</td>
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<td>Gadallah et al 1999 [2]</td>
<td>Death</td>
<td>9/76</td>
<td>9/72</td>
<td>0.95 (0.40, 2.25)</td>
<td>-0.01 (-0.11, 0.10)</td>
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<td>Danielsson et al 2002 [7]</td>
<td>Death</td>
<td>6/30</td>
<td>5/30</td>
<td>1.20 (0.41, 3.51)</td>
<td>0.03 (-0.16, 0.23)</td>
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<tr>
<td>Danielsson et al 2002 [7]</td>
<td>Exit site infection</td>
<td>5/30</td>
<td>0/30</td>
<td>11.00 (0.64, 190.53)</td>
<td>0.17 (0.03, 0.31)</td>
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