A systematic review and meta-analysis of the influence of peritoneal dialysis catheter type on complication rate and catheter survival

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Peritoneal dialysis (PD) is an effective treatment for end-stage renal disease. There are several configurations of PD catheter design that may impact catheter function, such as the shape of the intraperitoneal segment, the number of cuffs, and the subcutaneous configuration. This review and meta-analysis was carried out to determine whether there is a clinical advantage for one of the catheter types or configurations. Comprehensive searches were conducted in MEDLINE, Embase, and CENTRAL (the Cochrane Library 2012, issue 10). The methodology was in accordance with the Cochrane Handbook for Interventional Systematic Reviews and written based on the PRISMA statement. The initial search yielded 682 hits from which 13 randomized controlled trials were identified. Outcomes of interest were as follows: catheter survival, drainage dysfunction, migration, leakage, exit-site infections, peritonitis, and catheter removal. Comparing straight vs. swan neck and single vs. double-cuffed catheters, no differences were found when results were pooled. Comparison of straight vs. coiled-tip catheters demonstrated that survival was significantly different in favor of straight catheters (hazard ratio 2.05; confidence interval 1.10–3.79, $P = 0.02$). For surgically inserted catheters, the removal rate and survival at 1 year after insertion were significantly in favor of straight catheters. Our meta-analysis clearly demonstrates benefits for catheters with a straight intraperitoneal segment.

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KEYWORDS: catheter configuration; catheter survival; meta-analysis; outcome; peritoneal dialysis; systematic review

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The incidence of end-stage renal disease is increasing worldwide.[1] Although the preferred therapeutic option is kidney transplantation, peritoneal dialysis (PD) still has an important role in the treatment of end-stage renal disease.[2,3] The preservation of residual renal function may be the greatest benefit of PD compared with hemodialysis, which equates to improved survival during the first several years of therapy.[4–6] However, a well-functioning catheter is required to enable successful PD. As recently published, the laparoscopic PD catheter insertion technique tends to be superior over open insertion.[7] Another potentially important aspect regarding outcome of PD is the type of catheter. Several types of catheters are available for use: catheters with different intraperitoneal parts (straight or coiled), different subcutaneous segments (prefabricated bend (swan neck) or straight (Tenckhoff)), and number of cuffs on the catheters (single or double cuff).[8,9] In the existing literature, there is no consensus about the type of catheter that is to be preferred for successful PD. In 2011, Xie *et al.*[10] described that coiled-end catheters have a higher migration rate, but they demonstrate no statistically significant differences between Tenckhoff or swan neck and single- or double-cuff catheters. Our systematic review includes randomized controlled trials (RCTs) up to October 2012, describing multiple outcomes of studies comparing different types of catheters. This meta-analysis comprehends three comparisons: straight vs. coiled catheters, straight vs. swan neck, and single vs. double cuff. By conducting this review and meta-analysis, we tried to obtain a definite answer whether one specific type of catheter is superior regarding outcome and, thus, successful PD.

RESULTS

Out of 682 papers identified in the initial search, 13 RCTs[10–22] fell within the scope of the search protocol. No additional studies were included after manually scrutinizing reference lists. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[23] flow diagram for systematic reviews is presented in Figure 1. The assessment of the quality of the included studies is presented in Figure 2. A meta-analysis was performed using a total of 13 studies, compiling three comparisons: straight vs. swan neck, coiled vs. straight, and single cuff vs. double cuff. The reported insertion

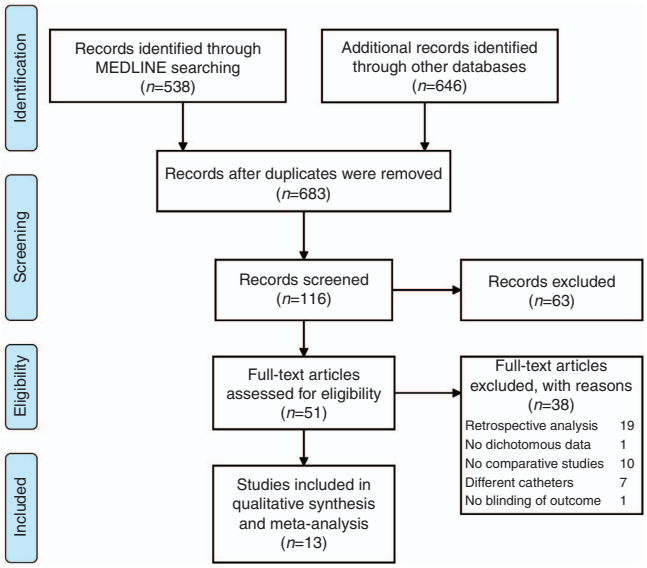

Figure 1 | PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram of the systematic literature search.

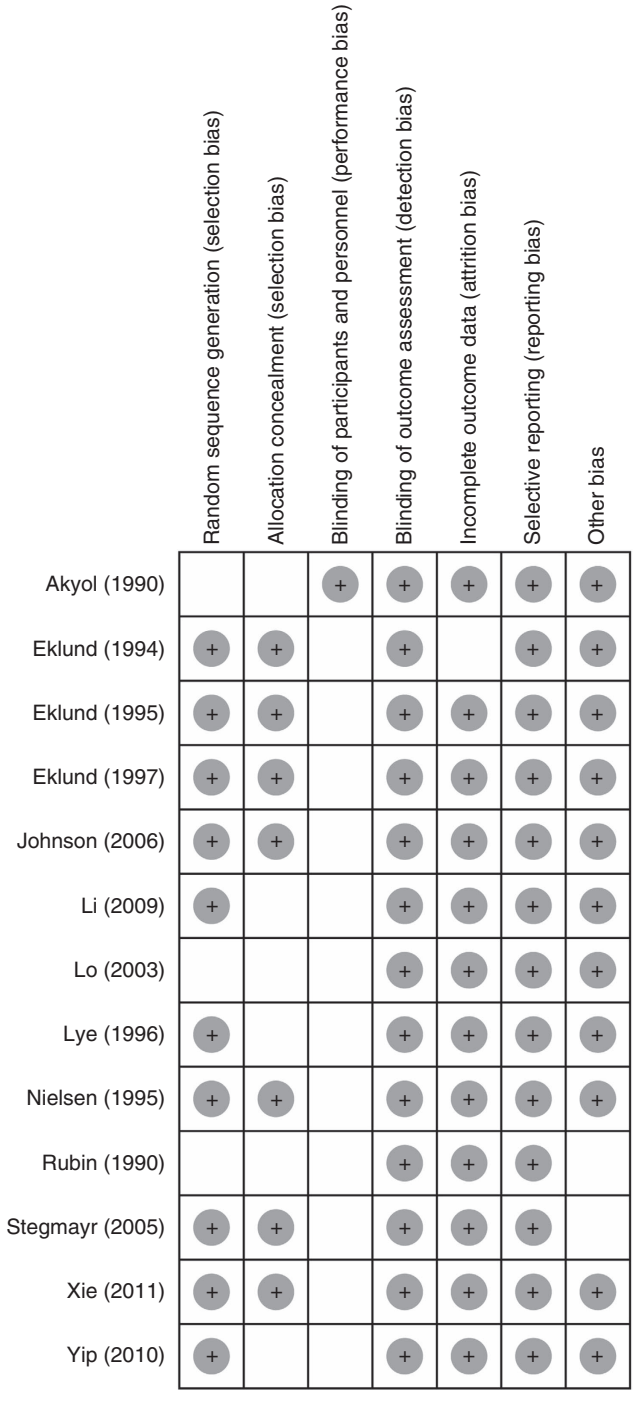

Figure 2 | Risk of bias summary graph of the included studies. +: no risk of bias. No filling: unclear of risk of bias.

techniques were the open technique[10–13,15–22] and the percutaneous technique.[14] The characteristics of these studies are presented in Table 1. Definitions of the analyzed outcome measures are presented in Table 2. A summary of perioperative variables is presented in Table 3.

Intraperitoneal segment: coiled vs. straight

With a total of 454 patients, six studies analyzed the exit-site infection rate between coiled vs. straight catheters. There was no statistically significant difference between these groups (risk difference (RD) 0.04, 95% confidence interval (CI) −0.02 to 0.11; $P=0.22$). Xie *et al.* provided a hazard ratio (HR) for exit-site infections (HR 1.98, 95% CI 0.86–4.58; $P=0.1$). Six studies investigated the incidence of peritonitis in a total of 454 patients and revealed no significant difference (RD 0.01, 95% CI −0.05 to 0.06; $P=0.83$). In addition, the incidence of migration, leakage, and removal did not differ between catheter groups (RD 0.05, 95% CI −0.14 to 0.24; $P=0.60$, RD −0.01, 95% CI −0.06 to 0.03; $P=0.56$, and RD 0.05, 95% CI −0.08 to 0.17; $P=0.46$, respectively). With regard to wound/tunnel infection, drainage dysfunction, and requirement for intervention, no differences were seen (RD −0.00, 95% CI −0.04 to 0.04, $P=0.81$, RD −0.03, 95% CI −0.25 to 0.19, $P=0.81$, and RD 0.06, 95% CI −0.08 to 0.21, $P=0.40$; Figure 3). To conclude, the survival of the catheters at 1 year post insertion was not significantly different (RD −0.01, 95% CI −0.20 to 0.18, $P=0.92$), but, remarkably, the survival at 2 years after insertion was significantly different in favor of straight catheters (RD −0.22, 95% CI −0.35 to −0.08, $P=0.001$; Figure 4). Johnson *et al.*[12] and Xie *et al.*[10] reported HRs of the survival between the groups, showing a significant difference in favor of straight catheters when meta-analyzed (HR 2.05, 95% CI 1.10–3.79; $P=0.02$; Figure 5).

Subcutaneous segment: straight vs. swan neck

Five studies investigated the incidence of exit-site infections with a total of 313 patients. There was no statistically significant difference in the risk of developing an exit-site/tunnel infection between the straight or swan neck catheters