

A Comparative Study on Using Coiled Versus Straight Swan-Neck Tenckhoff Catheters in Patients Undergoing Peritoneal Dialysis

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Abstract

The key to successful long-term peritoneal dialysis (PD) is permanent and safe access to peritoneal cavity. The two most commonly used Tenckhoff catheters for PD are the straight and coiled catheters. The present study was undertaken to assess the catheter survival, catheter associated infections, and all cause mortality and to compare the straight with coiled catheters in PD. During April 1997-August 2006, 96 patients undergoing peritoneal dialysis in Ghaem Hospital, Mashhad, Iran were enrolled in this study. In 53 patients straight catheter and in 43 patients coiled catheter were used. The catheter survival, and catheter associated infections including peritonitis and exit site infection rate were compared between the two groups. The catheter survival in the two groups was in favor of coiled ones. Catheter associated peritonitis and exit site infection were more prevalent in patients with straight catheters ($P=0.027$ and $P=0.006$ respectively). Overall patient survival rate was not different between the two groups ($P=0.919$). There was no difference regarding tunnel infection between the two groups ($P=0.673$). Straight PD catheters were not associated with more overall patient mortality rate but less catheter survival was noted in this group. In comparison with coiled PD catheters, peritonitis and exit site infection were seen more frequently in patients dialyzed using straight catheters. We found no difference regarding leakage episodes ($P=0.562$) or re-operation due to catheter malposition resulting in catheter salvage ($P=0.26$). Overall re-operation rate was not different between the two groups ($P=0.732$). Straight PD catheters were not associated with more patients' mortality rate but had less catheter survival than coiled PD catheters. Peritonitis and exit site infection were found more frequently in patients dialyzed with straight catheters.

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Keywords • Peritoneal dialysis • survival • peritonitis • catheters

Introduction

The key to successful long-term peritoneal dialysis (PD) is permanent and safe access to peritoneal cavity. Despite improvement in Tenckhoff catheter related survival during the last few years, the catheter related complications such as malfunction and infection continue to be the cause of significant morbidity.^{1,2,3} The two most commonly used Tenckhoff catheters for PD are the straight catheter

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(straight intra-abdominal portion) and coiled (or curled) catheter (coiled intra-abdominal portion).

To date, some small controlled trials that compared straight with coiled catheters yielded conflicting results.⁴⁻¹¹ In one small trial,¹⁰ involving 40 patients no difference in catheters survival or mechanical complications between straight and coiled catheters was found. But a greater rate of exit site infection in the former group was observed. Similarly, Nielsen et al.⁴ reported a benefit of coiled catheters with respect to one-year catheter survival (77% versus 36%; $P < 0.01$), primarily because of a marked decrease in catheter migration. Based on the clinical practice guidelines, such as Caring for Australians with Renal Insufficiency, British Renal Association, and International Society of Peritoneal dialysis, no specific catheter has been proved superior to the other.^{12,13}

The present study was undertaken to assess the catheter survival, catheter associated infections, and all cause mortality and to compare the straight with coiled catheters in PD.

Subjects and Methods

In a retrospective cross sectional study, all adult patients undergoing peritoneal dialysis during April 1997-August 2006 in Ghaem Hospital, Mashhad (northeast Iran) were enrolled in this study. In 53 patients straight catheter and in 43 patients coiled catheter were used. There was no difference between the two groups regarding the demographic characteristics such as age, sex distribution, and history of diabetes mellitus and coronary artery diseases. All catheters were implanted in the operation room and under local anesthesia, using laparoscopic procedure by two surgeons. With the patients in the Trendelenburg position, a right lateral entry site at the lateral border of the rectus muscle was chosen. A 1-2 cm skin incision at this site was made and then dissection using a hemostat was made. After dissection with the Stylet method, the stylet-catheter was pushed through the abdominal wall, aiming 20 degrees off the perpendicular towards the patients' coccyx. Correct placement of the catheter in the abdominal cavity was assessed by observing the easy flow of the serum fluid into abdomen and its escape through the catheter after stylet removal. The catheter over the stylet was pushed into abdominal cavity until the catheter met a firm resistance or until the suture points descend to skin surface. Then the catheter was sutured in its place.

The incidence rate of exit site infection, tunnel infection, and peritonitis extracted from the registered files data. Exit site infection was defined as purulent discharge or two of the three criteria: induration, tenderness, and erythema greater

than 13mm.¹⁴ Peritonitis was defined as an elevated dialysate white blood cell count of more than 100/l, of which at least 50% were polymorphonuclear neutrophils, cloudy dialysate effluent, and abdominal pain and/or fever.¹⁵

Time to death from the beginning of peritoneal dialysis was calculated, deaths associated with catheter related complications such as septicemia were considered as catheter-related death. Transference to hemodialysis due to catheter-related complications such as ultrafiltration failure (4 patients), treatment resistant bacterial peritonitis (11 patients), treatment resistant and recurrent fungal peritonitis (8 patients), non-functioning catheter (4 patients), and catheter leakage (2 patients) were also considered to be catheter-related. However, transference to hemodialysis due to patient's choice and kidney transplantation were not considered as catheter-related.

Comparison of clinical and demographic characteristics between the straight and coiled catheter groups were performed by using Student *t* test, Chi-square test, or Mann-Whitney U test, depending on data distribution. Time to return to hemodialysis hazard curves, and cumulative hazard probabilities, were generated according to Kaplan-Meier method.

Differences in hazard curves between the two groups were evaluated by using log-rank test. Overall patients' survival was also evaluated by Kaplan-Meier method. Data were censored at the time of transplantation, the patients' choice of hemodialysis, or end of the study. Time to catheter removal and catheter-associated complications analyses were also censored at the time of death provided that death was not attributable to catheter malfunction or catheter-associated infection.

Results

These results regarding different aspects of catheter related complications and survival were obtained:

Transference to hemodialysis due to catheter-related complications

Frequency of the complications that were directly related to catheter, culminating in hemodialysis transference in two groups, are shown in table 1.

When evaluating the frequency of re-operation (including catheter manipulation under local anesthesia) due to catheter malposition and mal-function, resulting in catheter salvage, we found no difference between the two groups ($P = 0.24$). There was also no difference in overall re-operation rate between the two groups ($P = 0.732$).

Table1: Catheter-related complications resulted to hemodialysis transference

COMPLICATION	Coiled Catheter	Straight Catheter
Ultrafiltration failure	2	2
Treatment resistant bacterial peritonitis	4	10
Recurrent and treatment-resistant fungal peritonitis	6	1
Catheter non-function	1	3
Catheter leakage	0	2
Peritonitis resulting in severe septicemia and eventually death	3	2
bowel obstruction	0	1

When controlling for all episodes of leakage (10 in straight and 9 in coiled group), we found no significant difference between the two groups ($P = 0.562$).

Peritonitis, exit site infection, and tunnel infection

Twenty three patients, 11 in straight and 12 in coiled group, had no episode of peritonitis. The mean of episodes of peritonitis was 3.51 and 1.95 in straight and coiled catheter groups respectively ($P = 0.027$). In 38 patients with coiled and 35 patients with straight catheters, there was no episode of exit site infection. The mean of the episodes of exit site infection was 0.63 ± 1.456 and 0.1 ± 0.297 for straight and coiled catheters respectively ($P = 0.006$). Eight patients with straight and one patient with coiled catheters, had at least one episode of tunnel infection. The mean of episodes of tunnel infection showed no significant difference between the two groups ($P = 0.673$).

Termination of peritoneal dialysis because of catheter related complications

Termination of peritoneal dialysis because of catheter related complications including infections, recurrent and treatment resistant peritonitis, recurrent and treatment resistant fungal peritonitis, catheter malfunction (ultrafiltration failure, catheter non-function, catheter leakage) and mortality consequent to septicemia was found in 26 patients in straight catheters group and 12 patients in coiled catheters group ($P = 0.028$).

Catheter and patient survival

There was significant difference in overall catheter survival rate between the two type of peritoneal catheters (log-rank score = 4.549 $P = 0.033$), in favor of coiled catheters (table 2, figure 1). When stratified by surgeon, no difference between the two groups was noted. Non-catheter related deaths in straight and coiled catheter groups were 10 and 8 cases respectively.

There was no difference regarding the overall patients survival rate between the two groups (log-rank score = 0.010 $P = 0.919$).

Table2: Comparison of catheter survival rate between the two types of peritoneal catheters

Catheter survival	Straight Catheters	Coiled Catheters
Cumulative proportion surviving 3 months	0.882 ± 0.041	1 ± 0
Cumulative proportion surviving 6 months	0.882 ± 0.045	0.952 ± 0.033
Cumulative proportion surviving 1 year	0.771 ± 0.061	0.918 ± 0.046
Cumulative proportion surviving 3 years	0.322 ± 0.094	0.486 ± 0.134

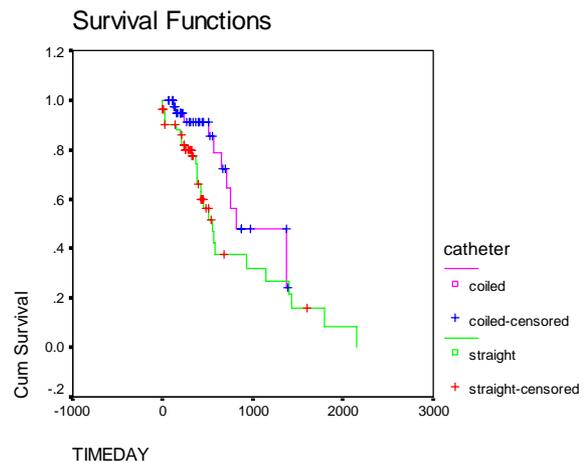


Figure 1: Kaplan-Meier survival curve for straight

Discussion

The results of the present study showed that the risk of catheter-associated infections including peritonitis and exit-site infection were significantly more for straight catheters. Also catheter survival was significantly longer for coiled catheters. These finding is at odds with those recently reported by Johnson et al.¹ In their randomized controlled trial, no difference was observed between the two catheter groups in catheter-associated infections and median catheter survival was significantly worse for coiled catheters.

Another study, originally intended to recruit 50 patients, was terminated prematurely because of a significantly greater rate of catheter malfunction in coiled, versus straight catheters.¹¹ Akyol et al. showed a trend toward worse one-year catheter survival in 10 patients receiving coiled compared with 10 patients receiving straight catheters (70% versus 90%, respectively).⁹ However the small number of the patients involved meant that the study was underpowered for being able to detect a significant difference between the two groups. A recent Cochrane review was also unable to evaluate the impact of catheter type on survival because only one trial of 40 trials was suitable for inclusion in their meta-analysis.¹³

Our study was a 10-year, retrospective, single center, experience. The different results

of our study with others may be due to differences in study design and quality, lack of stratification by surgeon, questionable extrapolation due to excess catheter failure rate, the presence of co-intervention (Moncrief-popovich versus conventional insertion technique, median versus lateral insertion site) and patients' population. In our patients, all catheters were inserted laterally, using conventional technique and under local anesthesia. The patients' population was demographically rather homogenous and when stratified by surgeon, no difference between the two groups was noted. Less infection rate and longer catheter survival in coiled group may be due to the design of coiled catheter that allows for better separation of the parietal and visceral layers of peritoneum and better protection of flow in and out of the tip of the catheter.^{2,3}

We, as the proponents of the coiled catheter, believe that this device allows better flow, less inflow pain, less propensity for catheter migration and omental wrapping, and fewer traumas to the viscera than straight catheters. These advantages may have resulted in fewer catheter related infections, and longer survival of coiled peritoneal catheters in our patients. The overall advantage of the coiled catheters is not so much that can be reflected in a better overall patient survival rate.

Conclusion

Straight PD catheters were not associated with more patient mortality rate but had less catheter survival than coiled PD catheters. Peritonitis and exit site infection were seen more frequently in patients undergoing peritoneal dialysis with straight catheters.

Conflict of Interest: None declared

References

- 1 McDonald SP, Russ GR, Kerr PG, Collins JF. Australia and New Zealand Dialysis and Transplant Registry. ESRD in Australia and New Zealand at the end of the millennium: a report from the ANZDATA registry. *Am J Kidney Dis* 2002; 40: 1122-31.
- 2 Twardowski ZJ, Prowant BF, Nichols WK, et al. Six-year experience with Swan neck presternal peritoneal dialysis catheter. *Perit Dial Int* 1998; 18: 598-602.
- 3 Flanigan M, Gokal R. Peritoneal catheters and exit-site practices toward optimum peritoneal access: A review of current developments. *Perit Dial Int* 2005; 25: 132-9.
- 4 Nielsen PK, Hemmingsen C, Friis SU, et al. Comparison of straight and curled Tenckhoff peritoneal dialysis catheters implanted by percutaneous technique: a prospective randomized study. *Perit Dial Int* 1995; 15: 18-21.
- 5 Eklund BH, Honkanen EO, Kala AR, Kyllönen LE. Peritoneal dialysis access: Prospective randomized comparison of the swan neck and Tenckhoff catheters. *Perit Dial Int* 1995; 15: 353-6.
- 6 Eklund BH, Honkanen EO, Kala AR, Kyllönen LE. Catheter configuration and outcome in patients on continuous ambulatory peritoneal dialysis: a prospective comparison of two catheters. *Perit Dial Int* 1994; 14: 70-4.
- 7 Scott PD, Bakran A, Pearson R, et al. Peritoneal dialysis access. Prospective randomized trial of 3 different peritoneal catheters--preliminary report. *Perit Dial Int* 1994; 14: 289-90.
- 8 Rubin J, Didlake R, Raju S, Hsu H. A prospective randomized evaluation of chronic peritoneal catheters, insertion site and intra peritoneal segment. *ASAIO Trans* 1990; 36: 497-500.
- 9 Akyol AM, Proteous C, Brown MW. A comparison of two types of catheters for continuous ambulatory peritoneal dialysis (CAPD). *Perit Dial Int* 1990; 10: 63-6.
- 10 Lye WC, Kour NW, van der Straaten JC, et al. A prospective randomized comparison of the swan neck. Coiled and straight tenckhoff catheters in patients on CAPD. *Perit Dial Int* 1996; 16: S333-5.
- 11 Stegmayr BG, Wikdahl AM, Bergström M, et al. A randomized clinical trial comparing the function of straight and coiled tenckhoff catheters for peritoneal dialysis. *Perit Dial Int* 2005; 25: 85-8.
- 12 Brown F. The CARI guidelines. Evidence for peritonitis treatment and prophylaxis: type of peritoneal dialysis catheter. *Nephrology* 2004; 9: S59-64.
- 13 Strippoli GF, Tong A, Johnson D, et al. Catheter type, placement and insertion techniques for preventing peritonitis in peritoneal dialysis patient. *Cochrane Database Syst Rev* 2004; 18: CD004680.
- 14 Twardowski ZJ, Prowant BF. Exit-site healing post catheter implantation. *Perit Dial Int* 1996; 16: S51-70
- 15 Gokal R, Ash SR, Helfrich GB, et al. Peritoneal Catheter and exit-site practices toward optimum peritoneal access. *Perit Dial Int* 1993; 13: 29-39.