

A 9-Year Survival Analysis of the Presternal Missouri Swan-Neck Catheter

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Peritoneal dialysis (PD) catheter survival is challenging because of infection and malfunction. The swan-neck presteral catheter has a coiled intra-abdominal segment with a bead and a flanged cuff at the peritoneum; a titanium adapter joins the abdominal segment to the upper segment. The upper segment has two cuffs, one on either side of the presteral swan-neck segment. The present study evaluated the survival of Missouri presteral swan-neck PD catheters implanted at the University of Missouri–Columbia and followed at Dialysis Clinics, Inc., through 2006. Catheter type and insertion date were prospectively recorded. Survival was defined as the interval from insertion date to date of removal, censoring, or analysis. Catheters were censored for transplant, death, or transfer to another unit.

A total of 131 presteral catheters were implanted in 129 patients. Mean patient age was 60.9 ± 16.3 years. No catheters were removed during the first 3 months for either infection or technical problems. One catheter was removed at 6 months for malposition and another at 2 years for an external leak; all other catheter losses were attributable to peritonitis. Cumulative catheter survival was 93.5%, 82.5%, 63.9%, and 60.0% at 1, 2, 3, and 4 years respectively. The mean observation period was 19.7 ± 17.8 months, and the longest catheter survival was 87.5 months. New episodes of peritonitis were 91 in number, a rate of 1 episode per 28 patient-months. Although catheter survival exceeded the recommendation of better than 80% at 1 year, we noted a trend toward lower catheter survival and a higher peritonitis rate than were reported earlier in this series with a smaller number of catheters. That trend

is partly explained by repeated episodes of peritonitis in 11 catheters; 8.5% of the patients experienced 40% of the peritonitis episodes.

Key words

Peritonitis, Missouri swan-neck catheter, presteral catheter

Introduction

Peritoneal dialysis (PD) is an important treatment modality used in the management of patients with end-stage renal disease (ESRD). However, obtaining and maintaining access to the peritoneal cavity can be challenging because of the associated complications. A crucial component of effective PD therapy is therefore selection of a catheter type that is associated not only with longer survival, but also with fewer complications and infectious episodes.

The Missouri swan-neck catheter, originally designed to reduce access-associated complications, has gained considerable favor because of an associated reduction in exit-site and tunnel infections, pericatheter leaks, catheter tip migration, outer cuff extrusion, and peritonitis (1–4). A flange and bead just below the internal cuff of the swan-neck catheter (Figure 1) facilitates the reduction of the above-mentioned complications (4–6). Moreover, Twardowski *et al.* developed a downward exit to reduce exit-site and tunnel infections and prevented leaks by placing the deep cuff in the rectus muscle. Catheter tip migration was reduced by placing the tip in a caudal direction, with a permanent bend between the 5-cm and 3-cm spaced cuffs to reduce outer cuff extrusion. Implantation technique for the catheter has been described in detail previously (3,4,6). Previous prospective and retrospective data comparing the Missouri swan-neck, Tenckhoff, and the Toronto Western Hospital catheters demonstrated improved catheter survival and an overall reduction in complications with the Missouri swan-neck catheter (1,2).

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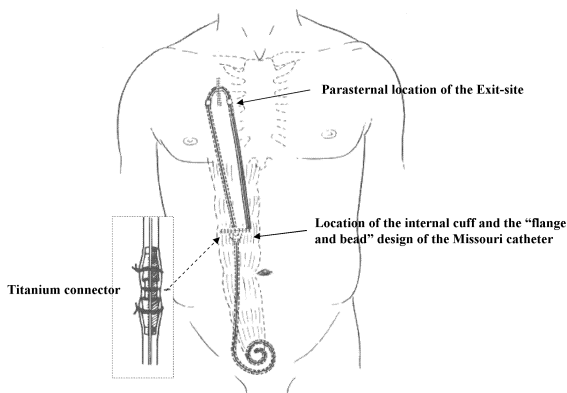


FIGURE 1 Presternal catheter, post implantation, in relation to body structures. Adapted from (2), courtesy of Zbylut J. Twardowski.

Twardowski *et al.* then introduced the presternal catheter, composed of two silicone tubes joined by a titanium connector (Figure 1), to further reduce exit-site infections relative to conventional abdominal catheters (3,4). Being less subject to movement, the exit at the chest wall reduces the risk of trauma and contamination. And by taking advantage of the thinner subcutaneous tissue of the chest relative to the abdomen, this design makes a viable alternative for obese patients, patients with ostomies, and patients who choose to take baths or whirlpool treatments (3,4). Other than a slightly slower solution flow, the possibility of accidental catheter disconnection, and a slightly more challenging implantation technique, presternal catheters are generally accepted as having very few disadvantages (7). Kubota *et al.* reported further reductions in the incidences of peritonitis and dialysate leak with an approach that combined the presternal catheter and the Moncrief implantation technique (8). Previous publications reported that, as compared with the swan-neck abdominal catheter, the swan-neck presternal catheter improved rates of catheter survival and peritonitis (2,5).

We now report a retrospective analysis of catheter survival for the presternal Missouri swan-neck catheter over a 9-year period of clinical use. For the analysis, we compared rates of catheter survival and peritonitis with expected survival derived from other authors and centers (9–11).

Patients and methods

This retrospective analysis includes all patients implanted with a Missouri swan-neck catheter at the University of Missouri Health Sciences Center and followed at Dialysis Clinics, Inc., (DCI) from January 1, 1997, to October 20, 2006. This PD center is the only one for mid-Missouri, and all training and follow-up are performed by staff at a single clinic.

After institutional review board approval, we obtained the patient list from the nurse manager. Data were extracted from the university's electronic medical record and the DCI medical information system, hardcopy charts, and clinical records at DCI. Demographic data included each patient's age, race, sex, and cause of end-stage renal disease.

Catheters were censored at the time of transplant, transfer to another center, or death. Catheter survival was defined as time from the date of catheter insertion to the date of catheter removal or of analysis. Reasons for removal included transplant, modality failure, death, leak, malfunction, and infection. The probability of catheter survival was calculated using the Kaplan–Meier technique.

Data regarding peritonitis episodes were obtained from prospectively collected quality assurance data. Peritonitis was defined as either a dialysate white blood cell count of $100/\text{mm}^3$ or more, with 50% or more segmented cells, or a positive peritoneal fluid culture, with symptoms of turbid effluent or abdominal pain. Recurrent peritonitis was defined as an infection with the same organism recurring within 2 weeks following the cessation of antibiotics. Each episode of recurrent peritonitis was counted as a continuation of the first episode. The number of episodes of peritonitis and the total number of days were tallied. The total days were divided by the number of peritonitis episodes to determine the rate of infection expressed in patient–months between episodes.

Results

A total of 131 presternal catheters was implanted in 129 patients. Mean patient age in the presternal catheter group was 60.9 ± 16.3 years (mean \pm standard deviation), with 57% of the group being men. The causes of end-stage renal disease in the group were diabetes mellitus ($n = 55$), hypertension ($n = 19$), membranoproliferative glomerulonephritis ($n = 4$), focal glomerulosclerosis ($n = 13$), polycystic kidney disease ($n = 7$), membranous glomerulonephritis

($n = 2$), and chronic interstitial nephritis ($n = 3$), with 26 cases being categorized as “other” (Table I).

Catheter survival was 93.5% at 12 months, 82.5% at 24 months, 63.9% at 36 months, and 60% at 48 months (Figure 2). The mean observation period was 19.7 ± 17.8 months, and the longest catheter survival was 87.5 months. No catheters were removed during the first 3 months for either infection or technical problems. One catheter was removed at 6 months for malposition, and another at 2 years for an external leak; all other catheter losses were attributable to peritonitis. Episodes of peritonitis numbered 91, for a peritonitis rate of 1 episode per 28 patient-months. In addition, 8.5% of the patients experienced 40% of the peritonitis episodes.

TABLE I Demographics of patients implanted with Missouri swan-neck presternal catheters

Patients (n)	129
Catheters (n)	131
Patient characteristics	
Age (years)	60.9 ± 16.3
Sex (n , M/F)	73/56
Ethnicity (n)	
African American	14
Caucasian	112
Asian	2
Hispanic	1
Causes of ESRD (n)	
Type 2 diabetes mellitus	55
Hypertension	19
Focal glomerulosclerosis	13
Others	42
Mean observation period (months)	19.7 ± 17.8
Survival at 35 months	63.9%
Total peritonitis episodes (n)	91

M/F = male/female; ESRD = end-stage renal disease.

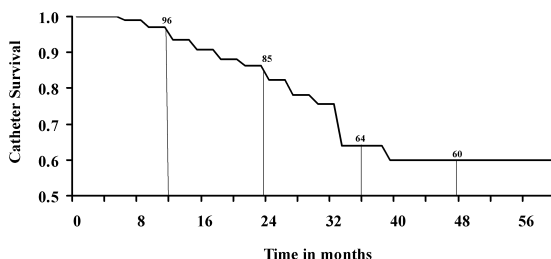


FIGURE 2 Kaplan-Meier analysis of catheter survival for 131 Missouri swan-neck presternal catheters.

Discussion

The overall survival of the Missouri swan-neck catheter at our center was comparable to that reported by Eklund *et al.* (10).

Earlier, we reported a peritonitis rate of 1 episode per 37.4 patient-months for presternal catheters (5); the current study found a slightly worse peritonitis rate of 1 episode per 28 patient-months. Although catheter survival exceeded the recommendation of 80% or better at 1 year, we observed a trend toward lower catheter survival and a higher peritonitis rate than reported earlier in this series with a smaller number of catheters. We attribute the increase in the presternal catheter peritonitis rate to repeated episodes of peritonitis in 11 catheters: 8.5% of the patients experienced 40% of the peritonitis episodes.

Twardowski *et al.* (5) reported a 2-year survival probability of 0.95 for the Missouri swan-neck presternal catheter. In the current analysis, the presternal catheter survival rate at 24 months was 82.5%. Our 1-year catheter survival of 93.5% for the presternal design was nearly equivalent to the 1-year Missouri swan-neck catheter survival of 95% reported by Lye *et al.* (9).

Conclusions

Although a cluster of peritonitis episodes adversely affected the outcome of presternal catheters, survival of the Missouri swan-neck catheter continues to be excellent. The 1-year catheter survival equals or exceeds survival data from other centers (9,10).

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