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Surgical salvage of peritoneal dialysis catheters from chronic exit-site and tunnel infections

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Abstract

Background: Chronic exit-site and tunnel infections of the peritoneal dialysis catheter are significant causes of catheter loss. Surgical salvage procedures that can effectively resolve the infection and preserve dialysis are of major importance.
Methods: Thirteen patients with chronic exit-site and tunnel infections underwent surgical salvage consisting of unroofing the tunnel tract and shaving of the superficial catheter cuff. A control group of 138 patients implanted during the same time span as the study group was used for infection rate and survival comparisons.
Results: The salvage procedure cured the infection in all patients. No dialysate leaks occurred. Peritoneal dialysis was not interrupted. Surgical salvage provided successful long-term peritoneal dialysis that was equivalent to the cohort dialysis population.
Conclusion: Surgical salvage by unroofing/cuff shaving is an effective long-term solution for chronic exit-site and tunnel infection.

Keywords: Peritoneal dialysis; Peritoneal catheter; Catheter infections; Exit-site infections; Tunnel infections; Cuff shaving

Dialysis-related infections continue to be the primary cause for removal of the catheter and loss of peritoneal dialysis as a modality of renal replacement therapy. Chronic exit-site infections can lead to infection of the superficial catheter cuff in 2-cuff devices, tunnel tract infection, and catheter infection-related peritonitis as the infectious process progresses from the skin towards the peritoneum. Recommendations for treatment of chronic exit-site and tunnel infections that are not associated with concurrent peritonitis include catheter removal with simultaneous or delayed catheter replacement [1–3], replacement of the infected external tubing segment by catheter splicing [4–7], or unroofing of the tunnel tract and removal of the superficial catheter cuff [8–13]. The latter method is the least disruptive and least costly of the procedures; however, published results are unfavorable [14–16] or follow-up has been short [8–13]. Reported here is a catheter salvage technique for managing chronic exit-site and tunnel infection and long-term follow-up.

Materials and Methods

From October 1997 through May 2001, 151 consecutive patients underwent implantation of 2-cuff, coiled tip, peritoneal dialysis catheters using a laparoscopic approach previously described in detail [17]. Briefly, the peritoneal catheter was inserted through a paramedian port site through the rectus sheath and muscle while continuously monitoring the implant procedure with a laparoscope from a second port location. The deep catheter cuff was placed in the rectus muscle just below the anterior rectus sheath. Catheters with a swan neck shape were implanted so that the subcutaneous tunnel tract precisely followed the preformed tubing bend with the superficial cuff located 2–3 cm from the downwardly directed exit wound. Tenckhoff-style catheters were bent with an arc in the subcutaneous tissues so that the exit-site was directed laterally. During the time period of this report, the superficial cuff of Tenckhoff catheters was implanted 2–3 cm from the exit-site.

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Between July 1999 and January 2002, 13 patients from the above-described patient group developed chronic exit-site and tunnel infection without concurrent peritonitis. These 13 patients underwent catheter salvage by unroofing the catheter tunnel and shaving of the superficial cuff. The remaining 138 patients served as a control group for infection rate and survival comparisons. All patient data in this report were recorded prospectively as part of a larger database maintained on the dialysis population at our institution.

Exit-site infections were diagnosed if signs of redness and purulent discharge were present [18]. Tunnel infection included induration or redness over the subcutaneous course of the catheter associated with tenderness and pain, with or without abscess formation [18]. Exit-site infection was considered a new event if the episode occurred more than 4 weeks after stopping antibiotic therapy or if the infection was caused by a different organism. Exit-site infections were considered chronic at the time of the second recurrence if the organism was the same and the patient had previously received a 2- to 4-week course of appropriate antibiotic therapy and intensified wound care.

All surgical salvage procedures were performed on an outpatient basis in the clinic or operating room under sterile conditions using local anesthesia. If patients were not currently on antibiotics, they were given a preoperative dose of an agent that covered the known infecting organism. Patients were instructed to drain the peritoneal cavity dry prior to the procedure.

The procedure consisted of making an elliptical incision around the exit-site (Fig. 1A). The incision was extended through the skin and subcutaneous tissues along the course of the catheter until the superficial cuff was identified (Fig. 1B). The cuff was mobilized from the tissues. The exit-site skin and all inflammatory tissue were completely excised to healthy tissue. Inspection was made to determine if the infection extended towards the deep cuff within the rectus sheath. A #15 scalpel blade applied parallel to the cuff surface was used to excise the cuff in repetitive slices until all of the cuff material was removed (Fig. 1C). The scalpel blade was changed frequently to assure ease in performing the shave without applying undue pressure on the tubing. The wound was irrigated with saline.

The catheter and the shaved tubing segment was directed out of the medial aspect of the incision and stabilized in this position by securing it to the adjacent skin surface with tincture of benzoin and sterile adhesive strips (Fig. 1D). In selected cases, in the absence of abscess or cellulitis, the redundant lateral portion of the wound was loosely approximated with absorbable sutures. The remainder of the wound was packed open with saline soaked gauze as a wet to dry application or dressed with silver sulfadiazine-impregnated gauze (Fig. 1E).

Postoperatively, the patients were permitted to resume peritoneal dialysis immediately. Oral antibiotic therapy was continued for 2 to 4 weeks after the surgery until healthy granulation tissue appeared. Patients were permitted to resume showering once the wound was covered with granulation tissue. Dressings were changed daily until the wound was completely healed, after which the patient resumed the routine exit-site protocol of daily antibacterial soap wash, hydrogen peroxide wipe, and a sterile gauze covering dressing (Fig. 1F).

Poisson regression analysis was used to compare exit-site infection rates between the surgical salvage group (study group) and the control group before and after the unroofing/cuff shaving procedure. Catheter survival free of loss from infection was estimated using the method of Kaplan and Meier. All causes for catheter loss except for infection were censored. Comparison of the survival curves for the study and control groups was performed with the log-rank test. All results were considered significant at $P < .05$.

Results

Thirteen patients on peritoneal dialysis an average of 28 ± 12.7 months (range 7.9–52.5 months) underwent surgical unroofing of the tunnel tract and cuff shaving for chronic exit-site and tunnel tract infection without signs of concurrent peritonitis. Infection was present for 3.2 ± 2.1 months (range .2–6.5 months) prior to the procedure. Infecting organisms are shown in Table 1.

No dialysate leaks occurred following the procedure. Peritoneal dialysis was resumed immediately. The procedure cured the infection in all patients. Wound healing was complete in 1.4 ± .4 months (range .9–2.2 months). Follow-up was 18.2 ± 11.6 months (range 6.6–42 months).

Two patients, known *Staphylococcus aureus* nasal carriers, underwent unroofing and cuff shaving for chronic exit-site and tunnel infection from this organism. Despite intranasal and exit-site mupirocin use, both patients developed new infections from *S aureus* involving the deep cuff 8.9 and 33.7 months after the surgical salvage procedure. One patient's deep cuff was not completely within the rectus sheath and partially extruded through the new exit-site. The second patient gained considerable weight causing the new exit-site to invaginate, thereby, making it difficult to clean. Both patients underwent successful insertion of a new catheter and removal of the old catheter at the same procedure.

Three catheters were lost 7.7, 8, and 12 months later from peritonitis without concurrent exit-site infection by an organism different from that producing the original chronic exit-site and tunnel infection. Four patients died from non-infectious causes 6.6, 7.3, 16.5, and 32 months later. Four patients continue on peritoneal dialysis 16.6, 17, 27.6, and 42 months following surgical salvage.

Before undergoing the surgical salvage procedure, the exit-site infection rate of the study group was significantly greater than the control group (Table 2). Following surgical unroofing of the tunnel tract and cuff shaving, the subse-

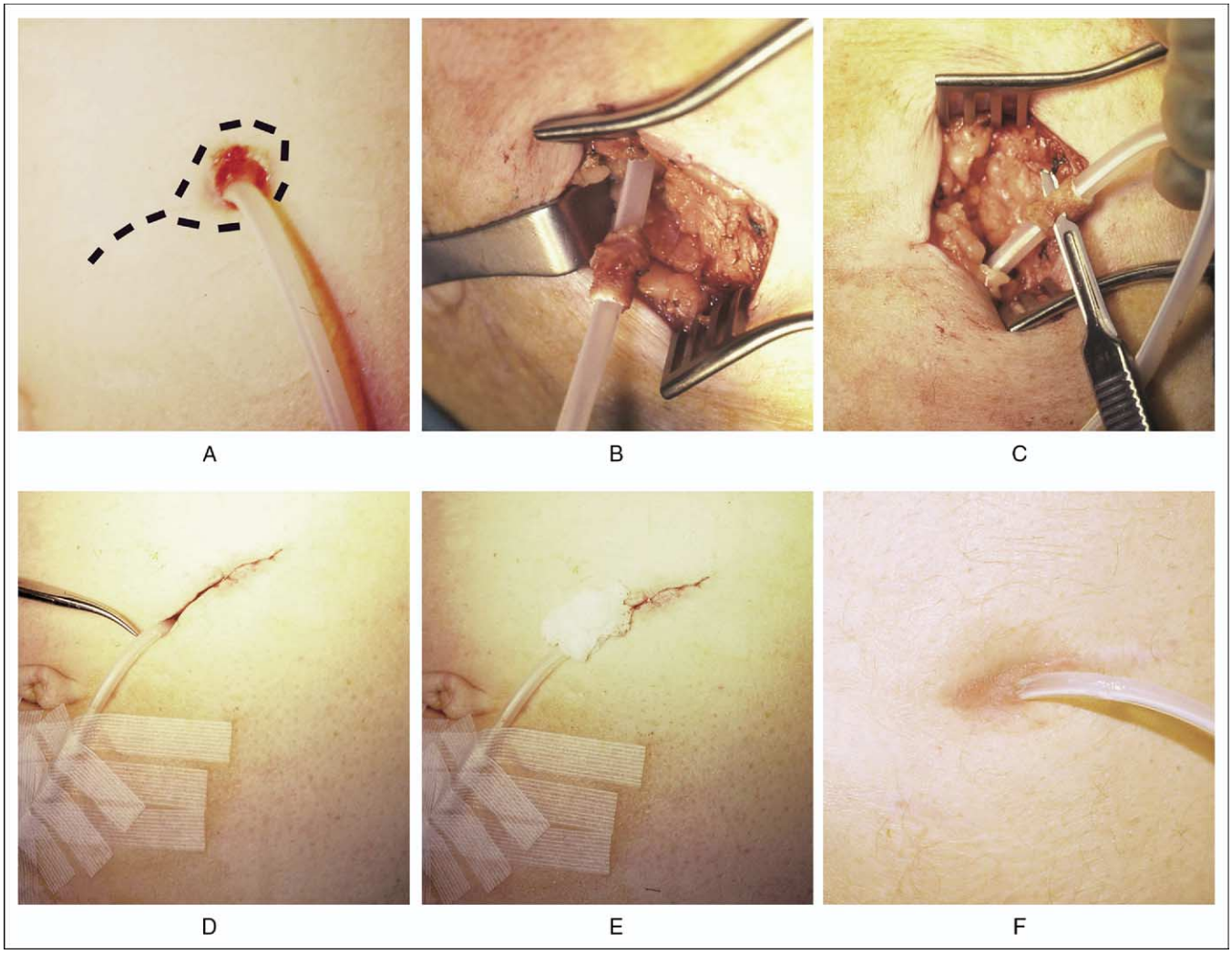

Fig. 1. Unroofing and cuff shaving procedure. (**A**) Chronically infected exit-site with exuberant granulation tissue. Dotted line shows planned incision. (**B**) Superficial cuff is dissected free and infected tissues are excised. (**C**) Cuff is shaved with scalpel blade. (**D**) The catheter is immobilized at the medial aspect of the wound. Hemostat points to shaved cuff. (**E**) Lateral extent of wound is partially sutured and the remainder packed open. (**F**) Healed exit wound.

quent infection rate remained slightly higher but was not significantly different from the control group.

Catheter survival of the study group from loss by infection was not significantly different from the control group (log-rank test: $\chi^2 = .18$; $df = 1$; $P = .7$). Catheter losses from infection in the control group were due to tunnel tract infection with concurrent peritonitis in 2 cases and peritonitis in 29 cases.

Comments

The unroofing/cuff shaving procedure for chronic exit-site and tunnel infection is an effective and economical means of achieving long-term salvage of the peritoneal dialysis catheter. No extra catheter materials are required compared to catheter replacement and splicing procedures. Peritoneal dialysis can continue uninterrupted thereby avoiding the expense and inconvenience of temporary hemodialysis. The patient is not subjected to the risks of mechanical obstruction or leak that accompany new catheter placement. Tunnel infections involving the intercuff catheter segment are amenable to unroofing/cuff shaving proce-

Table 1
Causative organisms for the 13 patients undergoing surgical salvage for chronic exit-site/tunnel infection

Organisms	No. of cases
Staphylococcus epidermidis	1
Staphylococcus aureus	4
Pseudomonas aeruginosa	4
Serratia marcescens	2
P aeruginosa and *S marcescens*	1
Enterobacter cloacae and *Klebsiella pneumoniae*	1
Total	13

Table 2
Comparison of exit-site infection rates between the study group and the control group before and after the unroofing/cuff shaving procedure

Group	Infection rate (episodes per patient-year of dialysis)	Significance of comparison to control group (Poisson analysis)
Control group	.34	—
Study group before unroofing/cuff shaving	1.36	$P < .0001$
Study group after unroofing/cuff shaving	.46	$P = .4$

dures, while catheter-splicing techniques cannot be used under these circumstances.

The unroofing/cuff shaving procedure is not indicated when chronic exit-site and tunnel infection is associated with concurrent peritonitis. The simultaneous occurrence of peritonitis implies deep catheter cuff involvement by the infection. Patients found to have an infected deep cuff at the time of the salvage procedure should be converted to catheter removal. The clinical picture will dictate whether simultaneous insertion of a new catheter can be accomplished after a repeat surgical prep and use of new drapes and instruments, or staged implantation at a later date.

A paramedian approach to peritoneal dialysis catheter implantation that places the deep cuff within the rich blood supply of the rectus muscle assures good tissue ingrowth with firm fixation of the catheter. In this position, the deep cuff will be more resistant to infection, pericannular leaks, and hernias. Midline insertion of catheters may explain immediate pericannular leaks, persistent infections, or subsequent related peritonitis reported by others following unroofing/cuff shaving procedures [10,14,15]. The midline tissues are relatively avascular and provide less fixation of the deep cuff. In addition, failure to recognize the advanced extent of the tunnel tract infection at the outset may have contributed to observed poor results.

Proper planning of the exit-site location and tunnel tract configuration at the time of the original catheter implantation procedure may decrease the risk for development of exit-site and tunnel infection. During the preoperative evaluation, patients should be examined fully dressed in both recumbent and sitting positions. The planned exit-site should be easily visible to the patient and not conflict with the belt line, skin creases, or blindside of skin folds.

Pommer et al [19] demonstrated that a distance of less than 2 cm between the superficial cuff and the skin exit-site promoted exit-site infection. Therefore, consideration must be given in planning the shape of the subcutaneous tunnel tract, especially in Tenckhoff-style catheters, to reduce the risk of superficial cuff migration towards the exit-site that results from the shape memory of a straight tube bent into an arcuate configuration. Presently, we implant the swan neck-style catheters so that the superficial cuff is 2–3 cm from the exit wound. We have modified our technique with Tenckhoff catheters to position the superficial cuff 4 cm from the exit wound. The use of marking stencils that assure accuracy and reproducibility in planning tunnel tract configuration and exit-site location has eliminated the problem of cuffs migrating to less than 2 cm of the catheter exit-site [20].

Early recognition of chronic exit-site and tunnel infection is essentially to providing the best opportunity for catheter salvage. Exit-site infections are considered chronic at the time of the second recurrence if the organism is the same and the patient has previously received a 2- to 4-week course of appropriate antibiotic therapy and intensified wound care. Using these criteria, superficial cuff involvement was confirmed in every case of chronic exit-site infection in the present report. Unroofing/cuff shaving is scheduled electively but urgently in these patients. Immediate surgical intervention is indicated for the presence of an acute tunnel tract infection with abscess and cellulitis.

The success of surgical salvage of peritoneal dialysis catheters by unroofing/cuff shaving is assured by attention to specific details of the procedure. All granulation tissue should be completely excised. Excision of the superficial cuff should be performed as part of the initial operation and not as a staged procedure as recommended by some [11,13]. The continued presence of the cuff serves as an ongoing reservoir of infection. The catheter should be immobilized in its new position. Tubing motion will impair wound healing [21]. However, catheter-anchoring sutures should not be used since stitch abscesses can be a cause of persistent infection. Instead, immobilization is best accomplished with benzoin tincture and sterile adhesive strips stabilizing the catheter to the skin at the medial aspect of the wound. The wound is packed open and allowed to heal secondarily. Although silver sulfadiazine cream impregnated gauze has been used to pack the wound, saline soaked gauze appears just as effective. Dressings are changed daily until the wound is healed.

Proper catheter implantation techniques and prompt appropriate treatment of acute exit-site infections may diminish the problem of chronic exit-site and tunnel infection. Unroofing/cuff shaving for chronic exit-site and tunnel infection is an effective and economical means of salvaging the dialysis catheter. Peritoneal dialysis is not interrupted. Salvage of the catheter from chronic exit-site and tunnel infection by unroofing/cuff shaving provides for successful long-term peritoneal dialysis that is equivalent to the cohort dialysis population.

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