

Original Article

Minimally invasive fluoroscopic percutaneous peritoneal dialysis catheter salvage

Rajeev Narayan¹, Terrance Fried², Gerardo Chica¹, Mathew Schaefer¹ and Daniel Mullins¹

¹Clinical and Interventional Nephrology, San Antonio Kidney Disease Center, San Antonio, TX, USA and ²Clinical Nephrology, San Antonio Kidney Disease Center, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA

Correspondence and offprint requests to: Rajeev Narayan; E-mail: renalraj@gmail.com

Abstract

Background. Peritoneal dialysis catheter (PDC) dysfunction can often be treated fluoroscopically by manipulation with wire, balloon or stiff stylet, saving surgical intervention for refractory cases. We describe an enhanced percutaneous approach to PDC salvage that can lead to a more definitive intervention and salvage for cases refractory to fluoroscopic manipulation.

Methods. In five cases of PD catheter malfunction, the deep cuff was dissected free after a 0.035 hydrophilic wire was passed into the peritoneum through the PDC. Only the intraperitoneal portion of the PDC was explanted. The PDC was cleared of obstruction and omentum. The intraperitoneal portion of the PDC was reimplanted over wire via a peel-away sheath and the deep cuff sutured.

Results. Omental entrapment was present in three of five patients and fibrin occlusion in four of the five cases. All catheters were repaired successfully by the described technique. Post procedure, 3–5 days of lower volume, recumbent PD exchanges were performed prior to full-dose PD. No peri-operative complications or leaks were noted. All PDCs were patent at 6 months. One patient required laparoscopy for recurrent omental wrapping 3 months post intervention.

Conclusions. PDC salvage in this manner is a cost-effective alternative to laparoscopic repair of PDCs failing catheter manipulation. The infection barrier afforded by the original superficial cuff and subcutaneous tunnel is maintained. PD can be resumed immediately. Only refractory cases need laparoscopy. This procedure allows for a more definitive correction of catheter migration and obstruction, avoids placement of a new PDC or temporary hemodialysis, is cost-effective and expands percutaneous options for dysfunctional PD catheters.

Keywords: catheter dysfunction; catheter migration; fluoroscopy; peritoneal dialysis catheter; peritoneal dialysis catheter salvage

Introduction

Peritoneal dialysis catheter (PDC) placement and treatment of catheter dysfunction from fibrin plugging and omental wrapping has typically been accomplished by surgical interventions. Laparotomy for catheter repositioning or replacement or laparoscopic surgical techniques combined with omentopexy and suturing of the catheter to the parietal peritoneum, remain the most common methods for PDC salvage. Surgical interventions involve higher costs than percutaneous approaches, require general anesthesia, operating room scheduling, anesthesia clearance and longer recovery times. This has led to interest in performing PDC insertions and treatment of catheter dysfunction in the outpatient setting, often in an outpatient fluoroscopic laboratory with conscious sedation, in select patients [1–5]. Initial PD catheter placements by fluoroscopic techniques have been shown to be noninferior to laparoscopically placed PDCs [6–8]. Percutaneous catheter salvage via manipulation with a wire, balloon and flexible stylet have been described

and can be done in minutes with minimal patient discomfort and usually without need for sedation [9, 10].

We describe an enhanced percutaneous technique of PDC salvage in a series of five patients who had catheter dysfunction that was resistant to manipulation by wire, flexible stylet and or angioplasty balloon. All patients were seen in the outpatient fluoroscopy laboratory. Under conscious sedation and with perioperative antibiotics the intra-abdominal portion of the PD catheter was explanted then reimplanted under fluoroscopy after being cleared of omental attachments and intraluminal debris. All patients had successful return to PD after catheter salvage at 6 months of follow-up.

Materials and Methods

Five patients who had PDC dysfunction with evidence on fluoroscopy of migration, omental wrapping and/or fibrin plugging, and who declined laparoscopic salvage were offered percutaneous fluoroscopic PDC salvage (Figure 1).

The patients were brought to the outpatient fluoroscopic laboratory after having taken a bowel preparation of ~1 L of Go-Lytley (Braintree Laboratories, Inc., Braintree, MA, USA) the evening before and after ingesting nothing per oral, except for medications, for 4 h prior to the procedure. Insulin and oral hypoglycemic agents for diabetes were withheld the morning of the procedure. Warfarin was withheld for 3–5 days prior to the procedure and an international normalized ratio (INR) was checked as part of the preoperative assessment the day of surgery if it was felt warranted, to ensure an INR of <1.5. Agents such as aspirin or clopidogrel were not withheld. Patients were asked to empty their bladder prior to surgery. A peripheral IV was inserted. Patients received 1 g of cefazolin prior to the procedure. In cases of penicillin or cephalosporin allergy, patients were given 600 mg of clindamycin PO ~1 h prior to surgery. Preoperative vital signs were measured to ensure stability prior to procedure.

Patients were placed in the supine position on the fluoroscopy table and the abdomen and existing PD catheter exposed. The old transfer set was discarded. The abdomen and catheter were sterilely prepared with chlorhexidine 3% and draped. Conscious sedation was achieved with periodic dosing of midazolam and fentanyl via peripheral IV.

Ultrasound was used to locate the deep cuff of the PD catheter; this position was marked on the skin and typically corresponded to the scar from prior PD catheter insertion. Ultrasound with a pulse repetition frequency of <2000 was used to identify blood vessels in the vicinity of the deep cuff and superficial tissues.

The previously marked area of skin overlying the deep cuff was anesthetized with 4–5 cc of 1% lidocaine with epinephrine. A 3–4 cm transverse incision was made using a #15 blade immediately over the previously identified deep cuff of the CAPD catheter. Electrocautery and blunt dissection were used to reach the fascia overlying the deep cuff and the body of the catheter. Tissue was retracted as needed. The external catheter was grasped gently and lifted by hand, taking care not to damage it. The fascia around the base of the catheter where it entered the anterior rectus sheath was further anesthetized with 1% lidocaine with epinephrine. Then, a combination of blunt dissection with hemostats and electrocautery was used to carefully expose the upper half of the deep cuff of the catheter, taking care not to fully free the cuff from surrounding tissue. At this point, a purse string was placed around the fascial defect around the catheter with 1-0 reabsorbable suture and left untied. A 0.035 hydrophilic stiff angle glide

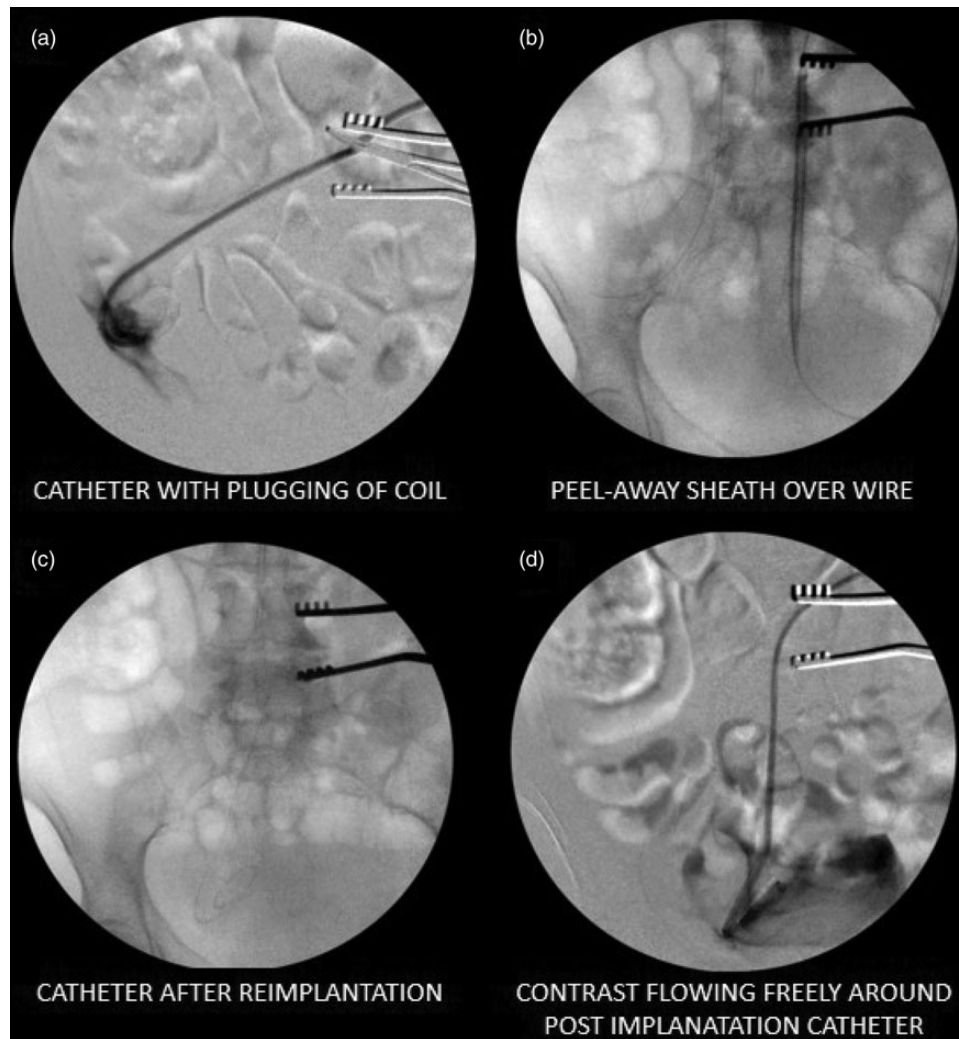


Fig. 1. Fluoroscopic images of dysfunctional PDC before, during and after salvage.

wire was then advanced from the outer portion of the catheter and under fluoroscopy watched as it exited from the intra-abdominal portion of the distal catheter or side hole, into the peritoneum. Once about 20–30 cm of wire was fed into the peritoneum and the wire secured, the rest of the catheter deep cuff was completely freed from the surrounding tissue.

The intra-abdominal portion of the catheter was then gently retracted out of the abdomen using firm traction, taking care to leave 10–20 cm of wire in the peritoneum. Any omental attachments that came out of the fascial defect with the catheter were detached from the catheter and carefully reinserted into the abdomen through the fascial defect. The intra-abdominal portion of the PD catheter was then cleared by hand of intraluminal debris and omental attachments (Figure 2A–C). It was pressure tested with a saline syringe to ensure there were no leaks in the vicinity of the deep cuff where the catheter had been manipulated during removal.

The distal wire was left in the peritoneum and the portion of wire still in the catheter was removed from the catheter. A 7 Fr sheath was placed over wire through the fascial defect into the peritoneum and a peritoneogram was performed to ensure good intraperitoneal location of the catheter sheath tip and to evaluate for free flow of contrast around the bowel and to evaluate for the presence of adhesions in the vicinity of the sheath tip. If adhesions were present, the wire was retracted and manipulated such that it would course inferiorly into the pelvis to avoid the adhesions.

Next, 250–300 cc of warmed normal saline was infused through the sheath either before or after manipulating the wire, to afford easier wire passage and catheter

manipulation into the true pelvis. Care was taken to manipulate the wire such that it looped gently in the vicinity of the symphysis pubis seen on fluoroscopy. Sometimes a 4 Fr straight catheter or 12 Fr dilator was used to help guide the wire into the proper position. Contrast was injected into the abdomen where it would tend to accumulate in a pocket in the most dependent portion of the pelvis, corresponding typically with the recto vesicular recess. A 17 Fr standard hemodialysis catheter peel-away sheath was advanced carefully under fluoroscopy over wire, taking care to position the tip inferiorly aiming it towards the pocket of contrast mentioned above (Figure 1B).

Next, and after the catheter was cleared of any obstructing fibrin, clot or other tissue, and the deep cuff of the catheter was cleared of encapsulating tissue, the internal dilator of the peel-away sheath was removed and the catheter was carefully advanced over wire through the peel-away sheath, taking care to pay attention to the radioopaque stripe such that the catheter did not twist on its way in (Figure 2). The wire was retracted just sufficiently to allow the tip of the catheter to coil on its own with the intention of having the coil land in or close to the aforementioned pool of contrast seen on fluoroscopy. If the position of the catheter was felt suboptimal or the catheter was felt to have twisted, the catheter was retracted then reinserted till the position was felt to be appropriate (Figure 1C). The wire was then removed completely and contrast injected through the catheter to ensure a good flow of contrast around the catheter coil and around loops of bowel (Figure 1D).

A total of ~800 cc of warmed saline with 500 units of heparin per liter was then infused briskly to test inflow,

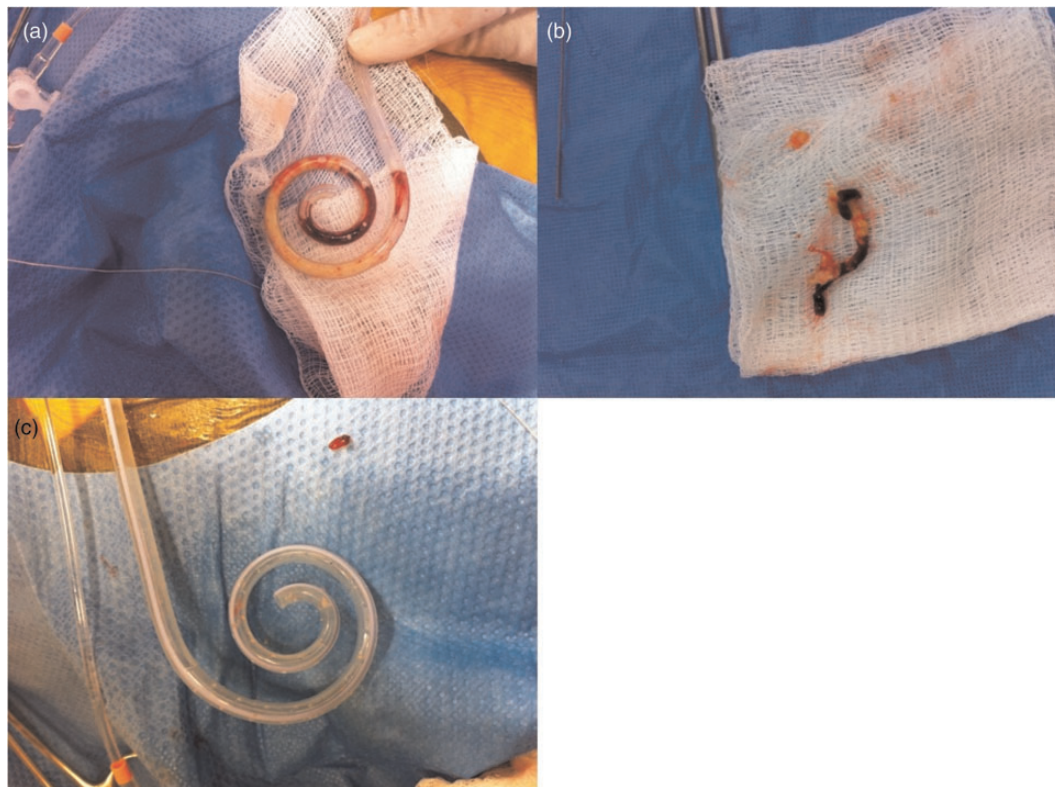


Fig. 2. Obstructed peritoneal dialysis catheter before and after removal of intraluminal debris. (a) Catheter coil completely occluded with fibrin and thrombus. (b) Debris after being manually removed from the catheter. (c) Cleaned and flushed catheter coil ready for reimplantation.

then drained to test outflow. About 200 cc of warmed heparinized saline was left in the abdomen. Subsequently, the deep cuff of the PD catheter was gently inserted under the fascia into the rectus musculature. The previously placed purse-string suture around the fascial defect in the anterior rectus sheath was then tied closed. Gentle tugging and pushing on the catheter confirmed the deep cuff was secured firmly. Additional warmed heparinized saline was sometimes infused to check for pericatheter leak.

The wound was irrigated with gentamicin 1 mg/mL, the deep tissues were closed with 3-0 reabsorbable suture and the skin was closed with interrupted 3-0 nonreabsorbable suture. Cutaneous sutures were removed in 10–14 days.

Patient PD prescriptions were changed to low volume, recumbent exchanges for 3–5 days, and thereafter full peritoneal dialysis was resumed.

Results

All catheters were used immediately or the next day with the lower volume, supine exchanges. No pericatheter leaking was noted. There were no episodes of early (<2 weeks) or later peritonitis or exit-site infections. Patient number #5 had recurrent omental entrapment at 2 months post intervention and was referred for laparoscopic salvage (Table 1).

Discussion

Catheter migration or obstruction due to fibrin or omentum are common causes of PDC dysfunction and require interventions to restore catheter function. PDC dysfunction can be addressed by catheter removal and replacement, or repositioning of the existing catheter by surgical or percutaneous procedures [11, 12]. Percutaneous salvage has been generally considered less effective than surgical approaches with success rates in the literature from 67 to 85%. These varying results are probably operator dependent and may reflect publication bias toward favorable results [13, 14].

In the most comprehensive review to date of percutaneous PDC salvage results, Miller *et al.* described outcomes of fluoroscopic manipulation of 70 consecutive catheters demonstrating mechanical failure [15]. Sixty-two percent of manipulations were successful leading the authors to conclude that fluoroscopic manipulation of dysfunctional catheters should be the first intervention due to the high success rate and low complication rate. The authors further identified several predictors of success with fluoroscopic manipulation. Dysfunctional catheters positioned in the pelvis or lower abdomen had greater success with intervention, and catheters that migrated into the upper abdomen had lower success rates. It is possible that the upper abdominal migrations were due to greater omental encasement retracting the catheter into the upper abdomen. Our procedure would address this by explanting the internal catheter segment from the omentum which would confirm complete extrusion of the catheter from omental pockets, debriding the distal catheter of any omental tissue and re-directing the catheter into the pelvis.

At our facility, all patients had their PD catheter originally placed by percutaneous fluoroscopic techniques, without fixation of the distal pelvic portion to the parietal peritoneum. All catheters were double-cuffed 62 cm adult standard coiled Tenckhoff PD catheters made by Merit/Medigroup (South Jordan, UT, USA). Our results in these five patients demonstrate that percutaneous salvage procedures can be successful. By dissecting out the deep cuff and explanting the internal catheter segment, we had better confirmation of complete catheter debridement and new positioning into the pelvis—an enhancement over wire repositioning alone. Catheter salvage by explantation of just the intra-abdominal portion of the catheter and reimplantation maintains the protection afforded by the original superficial cuff and tunnel as the superficial cuff remains incorporated into the surrounding tissue. This can reduce potential infection as the exit site and tunnel remain intact and can allow for the more rapid resumption of PD compared with new catheter placement. We were initially concerned about how well the deep cuff would reincorporate into surrounding tissues after having been explanted. Fortunately, the deep cuff incorporates rather quickly as demonstrated by the lack of early or late fluid leaks.

Table 1. Patient characteristics

Case	Age	Sex (M/F)	BMI	Catheter insertion site	Comments	°Catheter age	Prior problems	Omental wrap	Fibrin plugging	PDC function at (months)			
										1	2	3	6
1	48	F	35	Left lat. rectus with left side exit	Taken off PD for 4 months	99	No	No	Yes	Good	Good	Good	Good
2	61	F	19	Midline supraumbilical entry with left side exit	Frequent constipation	20	Catheter migration: wire manipulation 1-month post PDC insertion	Yes	Yes	Good	Good	Good	Good
3	49	M	22	Left lat. rectus with left side exit	Frequent constipation	79	No	Yes	No	Good	Good	Good	Good
4	89	M	23	Midline supraumbilical entry with left side exit	Inguinal hernia surgery: off PD for 4 weeks	17	No	No	Yes	Good	Good	Good	Good
5	69	M	35	Right lat. rectus with right side exit	Constipated for 10 days prior to catheter dysfunction	73	No	Yes	Yes	Good	Laparoscopy for recurrent omental entrapment	Good	Good

°Catheter age in weeks at time of salvage.

Catheters subject to omental entrapment are at higher risk of later entrapment [12] regardless of the method of initial placement or salvage. It is not surprising therefore that we had one case with recurrent omental entrapment at 2 months. Usage of more advanced laparoscopic techniques such as those described by Crabtree et al. [16, 17] that include fixation of the PDC in the pelvis and omentoplexy such that repeat omental wrapping is mitigated, might be more appropriate in those cases resistant to salvage either percutaneously or by standard laparoscopy. Our technique is similar to that of Sarafidis et al. [18] except that, in their patient series, the technique was used primarily for catheter migration or kinking and not omental attachments or catheter plugging. In addition, the deep cuff in their patients was in the subcutaneous tissue and not anchored in the lateral rectus musculature or fascia of the linea alba. Also, fluoroscopy was not employed to ensure the catheter coil rested in the pelvis. Moreover, PD exchanges were not started immediately after the procedure.

Our technique is applicable primarily to double-cuffed catheters that have not been anchored to the parietal peritoneum, or have intraperitoneal disks attached to the body of the catheter that would prevent the catheter from being explanted. Catheters such as these are usually placed surgically and will need laparoscopy to treat dysfunction.

Conclusion

Percutaneous management of PDC dysfunction, often in free-standing outpatient centers using fluoroscopy, can be done with lower costs and without the morbidity associated with general anesthesia and laparotomy/laparoscopy. PDC salvage by stilet, angioplasty balloon and stiff hydrophilic wire have variable salvage rates at 6 months. Explanting just the intraperitoneal portion of the PDC and reimplanting after manually removing fibrin occlusion and omental attachments provides a percutaneous option for PDCs resistant to standard fluoroscopic methods and may be a more definitive approach to catheter salvage by percutaneous techniques. Our case series was restricted to five patients due to unclear reimbursement thus far for this procedure. Reimbursement for this procedure was found to vary widely between reimbursement that was below equipment costs to reimbursement that was commensurate to a fresh catheter placement. Hopefully, reimbursement can be clarified by regulatory bodies such that more cases can be treated and a better idea of long-term outcomes can be obtained.

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Conflict of interest statement. No declared. In addition, the results presented in this paper have not been published previously in whole or part, except in abstract format.

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