MINILAPAROTOMY SALVAGE OF MALFUNCTIONING CATHETERS IN PERITONEAL DIALYSIS

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♦ **Background:** Catheter malfunction is a common and significant complication during peritoneal dialysis (PD). We developed a minilaparotomy procedure to rescue malfunctioning catheters and to prevent recurrence of malfunction.

♦ **Methods:** From 2006 to 2011, 11 patients receiving PD had a malfunctioning catheter. In all patients, a 2-cm incision, 5 cm caudally to the previous peritoneal entry site was used to correct the malfunctioning catheter, with concomitant fixation of the catheter to the peritoneum.

♦ **Results:** Catheter tip migration occurred in 7 patients, omental wrapping in 3, and blood clot obstruction in 1. The mean onset time to catheter malfunction was 197.5 days (range: 4 – 1270 days), and the mean operating time was 41 minutes (range: 35 – 56 minutes). There was no recurrence of catheter malfunction and no surgery-related peritonitis.

♦ **Conclusions:** Our minilaparotomy procedure is safe and feasible for the salvage of malfunctioning PD catheters.

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Catheter malfunction, defined as mechanical failure in dialysate inflow or drainage, is not uncommon in peritoneal dialysis (PD) patients. The most common causes of catheter malfunction are catheter tip migration and omental wrapping. Catheter malfunction develops in 3.9% – 13.3% of patients with a Tenckhoff catheter (1,2). Catheter malfunction leads to interruption of PD, and a rescue operation such as fluoroscopy-guided

manipulation using correction instruments, or laparoscopy or minilaparotomy is usually required (1–10). The success and malfunction recurrence rates vary between methods because of differences in the procedures.

We previously introduced a catheter implantation technique using two-point catheter fixation to straighten the intraperitoneal catheter segment (11). In the present study, we extended that idea to the rescue of malfunctioning catheters and the prevention of recurrent catheter migration and omental wrapping.

METHODS

From 2006 to 2011, 275 patients underwent Tenckhoff PD catheter placement in our division. Among those patients, 9 experienced catheter malfunction and underwent re-operation after failure of conservative treatment. Table 1 lists the characteristics of those 9 patients. Another 2 patients with catheter malfunction were referred to our division for salvage surgery and are also included in our analysis.

Our rescue minilaparotomy involves making an incision 2 cm in length 5 cm below the previous wound site of the peritoneal opening. The keyhole incision requires grasping with Kelly clamps to stabilize every incision layer, especially the peritoneum. After the peritoneum is opened, the catheter is pulled out by hand along the catheter insertion site. This procedure also includes blunt dissection of the omental adhesion. A fixation suture at the peritoneum is then made below the catheter using 3-0 nylon. The distal part of the catheter is pushed back into the peritoneal cavity. Because the catheter has been straightened after the peritoneal fixation suture, it is easy to use an index finger to direct the catheter all the way to the pelvic cavity. Finally, we use a 4-0 Vicryl watertight suture (Ethicon 360, Somerville, NJ, USA) to prevent leakage from the peritoneum, and we

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then approximate the abdominal wall layer by layer (Figure 1).

All patients received oral first-generation cephalosporin antibiotics postoperatively for 1 week. Peritoneal dialysis was restarted postoperatively on the same day, with the instilled dialysate decreased

to 1000 mL at each exchange for 2 weeks after the salvage surgery.

RESULTS

Catheters malfunctioned in 4 male and 7 female patients [mean age: 39.3 years (range: 10 – 63 years)]. The initial catheter placement procedure was laparoscopic surgery in 3 patients, and conventional open surgery in the other 8. The mean onset time to catheter malfunction was 197.5 days (range: 4 – 1270 days). Catheter tip migration occurred in 7 patients, omental wrapping in 3, and blood clot obstruction in 1. The development of catheter tip migration varied from 9 days to 1270 days; omental wrapping and blood clot obstruction developed within 4 weeks after the initial placement operation (Table 2).

Primary management of the patients with probable catheter tip migration was laxatives and enemas. Patients received intraperitoneal flushing with heparin solution if omental wrapping was suspected. In 2 patients, local anesthesia was used; the other 9 received general anesthesia. The operation time ranged from 35 minutes to 56 minutes, with an average time of 41 minutes. Additional release of the omental adhesion at the peritoneal catheter entry site was performed for 3 patients with omental wrapping. During follow-up, 3 patients discontinued PD because of kidney transplantation and fungal peritonitis. The mean follow-up time was 19.8 months (range: 6 – 53 months). We observed no recurrence of

TABLE 1
Characteristics of Patients Receiving a Peritoneal
Dialysis Catheter, 2006 – 2011^a

Variable	Procedure type	
	Laparoscopic	Conventional
All patients (n)	233	42
Mean age (years)	51.0	53.0
Mean follow-up (months)	25.1	23.6
Sex [n (%)]		
Men	112 (48.1)	15 (35.7)
Women	121 (51.9)	27 (64.3)
Patients undergoing minilaparotomy [n (%)]		
Men	0	4 (66.7)
Women	3 (100)	2 (33.3)
Cause of catheter malfunction [n (%)]		
Tip migration	0	5 (83.3)
Omental wrap	2 (66.7)	1 (16.7)
Blood clot obstruction	1 (33.3)	0

^a Two patients referred from another hospital for minilaparotomy are excluded.

Figure 1 — Minilaparotomy incision site and fixation of catheter to the ventral abdominal wall.

TABLE 2
Patient Characteristics and Outcomes After Minilaparotomy Salvage Surgery

Pt ID	Age (years)	Sex	Previous PD surgery	Malfunction onset time (days)	Catheter tip position	Primary management procedures	Anesthesia	Operative time (minutes)	Cause of catheter malfunction	Outcome
1	21	Male	Open	175	LUQ	Laxative, enema	Local	51	Tip migration	Shift to HD at 13 months for fungal peritonitis
2	28	Male	Open	21	LUQ	Heparin	Local	45	Omental wrapping	47 Months on CAPD
3	10	Female	Laparoscopic	7	LLQ	Heparin	General ^a	35	Omental wrapping	Kidney transplantation after 10 months
4	63	Female	Open	398	LUQ	Laxative, enema	General ^b	36	Tip migration	53 Months on CAPD
5	47	Female	Open	194	RUQ	Laxative, enema	General ^b	40	Tip migration	35 Months on CAPD
6	31	Female	Open	1270	LUQ	Laxative, enema	General ^b	36	Tip migration	Kidney transplantation after 6 months
7	42	Female	Laparoscopic	4	LLQ	Heparin	General ^b	41	Blood clot obstruction	12 Months on CAPD
8	47	Female	Laparoscopic	27	LLQ	Heparin	General ^b	56	Omental wrapping	15 Months on CAPD
9	58	Male	Open	50	LUQ	Laxative, enema	General ^b	37	Tip migration	14 Months on CAPD
10	32	Male	Open	9	LUQ	Laxative, enema	General ^b	37	Tip migration	7 Months on CAPD
11	53	Female	Open	17	RUQ	Laxative, enema	General ^b	38	Tip migration	6 Months on CAPD

Pt = patient; PD = peritoneal dialysis; LUQ = left upper quadrant abdomen; HD = hemodialysis; CAPD = continuous ambulatory peritoneal dialysis; LLQ = left lower quadrant abdomen; RUQ = right upper quadrant abdomen.

^a With endotracheal tube.

^b With laryngeal mask airway.

malfunctioning catheters and no post-operative peritonitis within 1 month after surgery.

DISCUSSION

To restore catheter function as quickly as possible, a rapid differential diagnosis is the first important step. The most common causes of catheter malfunction are omental wrapping, catheter tip migration, and fibrin or blood clot obstruction (6).

Omental wrapping usually develops early after catheter placement surgery. Clinically, the inflow of dialysate decreases slightly, and drainage is obviously hindered. Wrapping may be a result of an excessively long and wide omentum, especially in children, or of primary omental adhesion with inadequate lysis during the initial catheter placement surgery (Figure 2).

Unlike omental wrapping, catheter tip migration can develop at any time after catheter placement. A slight decrease in dialysate drainage combined with increased body weight makes a diagnosis of catheter tip migration more likely. Plain abdominal radiography confirms the deviation of an intraperitoneal catheter upward away from the pelvic cavity (Figure 3). Patients with catheter tip migration sometimes have a history of constipation, with the consequent sigmoid colon bulging possibly leading to upward migration of the catheter. Thus, laxatives and enemas are the initial management steps while awaiting confirmation of catheter tip migration. If catheter malfunction persists after primary management, manual correction along the intraperitoneal catheter direction may be helpful in repositioning the catheter.

Obstruction by blood clot or fibrin coating usually presents with blood-tinged dialysate drainage. Heparin and urokinase are commonly used to release obstructions. Salvage surgery is required when primary noninvasive

management fails. Ideally, salvage surgery should be safe, with a high success rate, ease of performance, ability to prevent recurrence, and quick recovery time. Manipulation under fluoroscopy guidance has been reported to be beneficial in about half the cases of malfunctioning catheters in the short term. The procedure is relatively noninvasive and easily performed. Owing to limitations of existing catheter designs, the redo rate is up to 64%, sometimes accompanied by episodes of peritonitis (3–5,7).

Figure 2 — Omental wrapping caused by incarceration of the greater omentum.

A laparoscopic approach, with omentectomy or omentopexy, has been reported to be efficient in the treatment of omental wrapping and prevention of recurrence (1,2,8,9). Laparoscopic fixation of the catheter tip to the pelvic cavity is also beneficial in the prevention of catheter migration. However, those procedures involve complicated laparoscopic suturing techniques, and the multiple laparoscopic working ports increase the risk of dialysate leakage. Also, the cost of laparoscopic instruments has markedly increased.

Kim *et al.* (10) introduced a minilaparotomy technique to correct malfunctioning catheters. However, unlike the present report, their report did not mention the exact incision site, and additional catheter fixation procedures were not routinely offered. Our previous laparoscopic experience in PD catheter placement using the peritoneal fixation technique resulted in a catheter tip migration rate of 0% and an omental wrapping rate in the most recent 5 years of 1.6% (3 of 183 patients) (11,12). We think that catheter fixation at the ventral abdominal wall may be beneficial in lowering the rate of catheter tip migration. Extending that idea to minilaparotomy with a catheter fixation procedure may also be useful in treating catheter malfunctions and preventing recurrence.

In the early period of this study, 2 patients received local anesthesia. Although they were ultimately able to tolerate the procedure through the use of a massive

Figure 3 — (a) Pre-adjustment plain abdominal radiograph of patient 5 shows upward migration of the peritoneal dialysis catheter. (b) After adjustment, the catheter is directed toward the pelvic cavity.

amount of anesthesia, we think that the procedure caused unnecessary distress for both the surgeons and patients. Afterward, we routinely used general anesthesia.

During correction of the 3 cases of omental wrapping, we found that the folded, incarcerated omentum originated from the peritoneal entry site of the catheter, along the intraperitoneal portion and toward the side holes of the catheter. The folded omentum may have originated from previous intra-abdominal adhesion. We released the adhesion at the peritoneal entry site and restored the catheter function. We applied that finding in 200 subsequent cases of laparoscopic PD placement with an intraoperative blunt dissection at the peritoneal entry site, and no further cases of omental wrapping developed.

In another 2 patients referred to our hospital for correction of catheter tip migration, we found that the peritoneal entry site of the catheter was about 20 cm to the pubic symphysis. Although the diagnosis of catheter tip migration with malfunctioning catheter was confirmed, we nevertheless performed re-implantation of a new catheter. In these 2 cases, inadequate drainage might have developed even after salvage surgery, and so re-implantation seemed a better choice.

CONCLUSIONS

Here, we introduce a safe and simple procedure for the salvage of malfunctioning PD catheters. The peritoneal fixation technique is useful in preventing malfunction recurrence.

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DISCLOSURES

The authors have no financial conflicts of interest to declare.

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