



## Comparison of open and laparoscopic secure placement of peritoneal dialysis catheters

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### Abstract

**Background:** A major and frustrating complication of peritoneal dialysis catheter placement is mechanical outflow obstruction, which may be caused by catheter tip migration. Therefore, a secure and correct positioning of the catheter is important to minimize this risk. This technique is easily accomplished by a laparoscopic approach.

**Methods:** The outcomes of 50 patients in whom peritoneal dialysis catheters were inserted laparoscopically with a secure catheter placement technique were compared with those of 52 patients who underwent an open surgical technique using a stiff wire as guidance for the catheter. The data were prospectively collected but not randomized. All the patients had virgin abdomens, and all the procedures were undertaken or supervised by one surgeon.

**Results:** Catheter migration occurred in six patients (12%) in the open group, as compared with none in the laparoscopic group ( $p = 0.027$ ). There were no significant differences in catheter survival between the two groups.

**Conclusions:** The laparoscopic technique with secure placement of the catheter lowered the incidence of catheter migration, but did not increase the catheter survival.

**Key words:** Peritoneal dialysis — Continuous ambulatory peritoneal dialysis — Peritoneal catheter — Laparoscopy — Secure placement

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A successful peritoneal dialysis program is quite dependent on the proper placement of a permanent peritoneal dialysis catheter. Such a catheter can be placed successfully by a variety of techniques including open surgical, percutaneous, peritoneoscopic, and lap-

aroscopic placements. In recent years, laparoscopic surgery has found a wider use in peritoneal catheter placement with various techniques.

Several studies have demonstrated laparoscopic peritoneal dialysis catheter placements with satisfactory success rates and acceptable morbidity [1, 3, 5, 10]. This technique offers the advantage of entrance to abdominal cavity under direct visualization. Although some authors have found catheter survival to be better with the catheter placed via a laparoscope, the benefit of laparoscopic techniques still is debated. Wright et al. [15] compared laparoscopic and open placement of the catheter prospectively and found no difference in complication rates, catheter survival, pain scores, or length of stay.

A major and frustrating complication of peritoneal dialysis catheter placement is mechanical outflow obstruction, which may be caused by catheter tip migration. Catheter outflow failure has been found after open surgical techniques in 4% to 34.5% of placements, whereas laparoscopic placement techniques have been complicated by flow dysfunction in 4.5 to 13% of patients [2–4]. Outflow failure may be attributable to spontaneous catheter tip migration (10–30%), omental wrap, or adhesion (15%), which can be difficult to correct.

Various techniques have been adapted to solve the problem such as the use of a curled catheter [9], partial omentectomy or stapling of the omentum, and secure placement of the catheters. The secure placement technique is effective in the prevention of catheter tip migration. The procedure has low morbidity, and most catheters function well postoperatively [8, 12, 13]. However, catheter survival has been examined in only a few studies. Therefore, we hypothesized that fixation of the peritoneal dialysis catheter into the pelvis to prevent tip migration may achieve better catheter function.

### Patients and methods

From May 1999 to May 2001, straight double-cuffed Tenckhoff catheters were placed in 102 consecutive patients with end-stage renal disease in our university hospital. All the patients had virgin abdomens

and were commencing peritoneal dialysis. The outcomes of 50 patients in whom the peritoneal dialysis catheters were placed laparoscopically using a secure placement technique were compared with those of 52 patients who underwent catheter placement with the open surgical technique. Local anesthesia was preferred for catheter placement in the open surgical technique. Patient selection was not randomized. All the procedures were undertaken or supervised by one surgeon.

Perioperative and follow-up data were collected prospectively including patient demographics, operating time, early and late complications, catheter survival, and catheter outcomes. Catheter migration was determined by abdominal radiography used to demonstrate deviation of the catheter tip outside the pelvis.

### *Laparoscopic technique with secure placement of the catheter*

The procedures were performed with the patients under general anesthesia. The patient was placed in the Trendelenburg position. A three-puncture approach was used. A 5-mm trocar was placed at the periumbilical site using the open Hasson method for insufflation of carbon dioxide. A pneumoperitoneum was created via this trocar and inflated to a pressure of 10 mmHg. A 30° 5- or 10-mm video laparoscope was inserted through the trocar, and the abdominal cavity was examined. Under direct vision, two 5-mm trocars were placed at the lateral aspects of both abdominal rectus muscles. These trocars were used for the passage of instruments. A dissector or retractor passage through one port helped in small bowel and omentum retraction during suturing of the catheter tip. This port was used to help in the proper placement of the catheter tip deep into the pelvic cavity.

The catheter port was placed in a paramedian location, tunneled in a caudal direction through the rectus sheath. The paramedian incision was made at the medial aspect of the rectus sheath to avoid injury to the inferior epigastric vessels. The entrance site was created with a trocar system. Under laparoscopic control, the stylet was advanced through the trocar. The trocar was withdrawn as the stylet was inserted. The peritoneal dialysis catheter was passed over the stylet, after which the stylet was removed.

The tip of the catheter was sutured to the pelvic peritoneum at the rectovesical pouch in males and behind the uterus in females with a 3/0 Prolene suture using a technique of intracorporeal knot tying. The knot was made as a small loop to allow minimal movement of the catheter tip. The inner cuff of the catheter was adjusted to locate it in a layer of the rectus muscle, not in the peritoneal cavity. All port sites were left to close on their own. The subcutaneous tunnel was created in a curved fashion using a Faller stylet. Dialysis usually was instituted 2 weeks after peritoneal dialysis placement.

### *Open placement of the peritoneal dialysis catheter*

In out center, open operation is the standard procedure for most patients, and local anesthesia is the preferred option. A right or left paramedian incision was made approximately halfway along a line from the anterior superior iliac spine to the umbilicus. A small opening was made in the peritoneum. Using a stiff wire as guidance, the tip of the catheter was passed in to the first Dacron cuff until it closed tightly around the catheter. Free flow of saline into and out of the peritoneum was checked at this stage. The catheter was brought through a subcutaneous tunnel to the previously chosen exit site. Heparin was instilled into the catheter. Finally, the rectus sheath was closed with Vicryl, and the skin was sutured with interrupted nylon.

### *Statistical analysis*

Chi-square analysis and, when indicated, Fisher's exact tests were used for analysis of categorical variables. The *t*-test was used for continuous variables. Product-limit Kaplan-Meier estimation of survival was computed for both groups. Catheter survival was calculated from the day of insertion to the day of revision or removal. Only catheter removals related to mechanical and infectious complications were included in the survival analysis. Removals for other reasons including

**Table 1.** Demographics and clinical outcomes of peritoneal dialysis catheter placement

	Laparoscopic ( <i>n</i> = 50)	Open ( <i>n</i> = 52)	<i>p</i> -Value
Age (years)	55 ± 11	60 ± 11	.046
Male	33	35	NS
Mean follow-up period (months)	26 ± 15	19 ± 13	NS
Duration of operation (min)	65 ± 17	29 ± 3	<.001
<b>Outcomes</b>			
Still on CAPD	32	33	NS
Death	3	6	NS
Transplantation	1	0	NS
Transfer to HD	14	11	NS

NS, not significant; CAPD, continuous ambulatory peritoneal dialysis; HD, hemodialysis

**Table 2.** Complications in the two study groups

	Laparoscopic ( <i>n</i> = 50) <i>n</i> (%)	Open ( <i>n</i> = 52) <i>n</i> (%)	<i>p</i> Value
<b>Mechanical complications</b>			
Catheter obstruction	3(6)	2(4)	NS
Catheter migration	0(0)	6(12)	.027
<b>Infectious complications</b>			
Peritonitis	16(32)	13(25)	NS
Exit-site infection	3(6)	5(9.6)	NS
<b>Other complications</b>			
Bleeding	1(2)	0(0)	NS
Fluid leak	1(2)	1(1.9)	NS
Incisional hernia	3(6)	1(1.9)	NS
Groin hernia	1(2)	2(3.8)	NS

NS, not significant

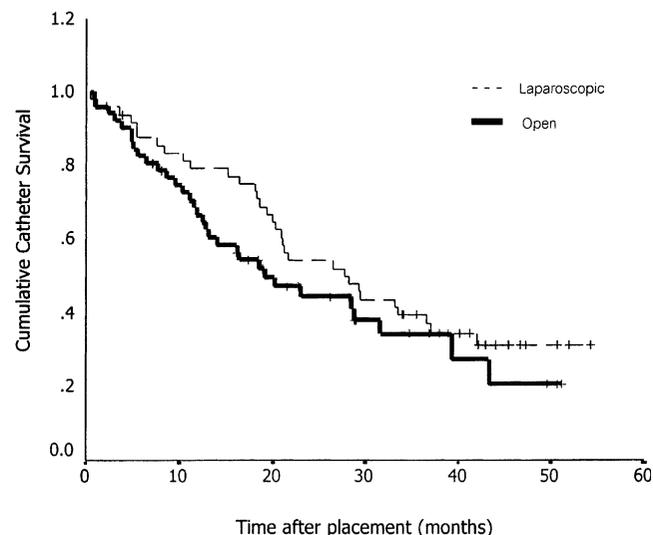
transplantation, patient decision, or death of concurrent disease with a functioning catheter, were excluded. Comparison of probability curves was performed with the log-rank test. All results were considered significant at a *p* value less than 0.05.

## **Results**

Patient characteristics and clinical outcomes are summarized in Table 1. Patients in the laparoscopic group were significantly younger, and their follow-up evaluation was longer. All catheters were placed successfully without perioperative mortality. The open surgical procedure was significantly faster than the laparoscopic procedure. The complications of both procedures are shown in Table 2. No perioperative mortality was found in either group.

Surgical complications in the laparoscopic group included incidental injury to inferior epigastric vessels in one patient, which required immediate reexploration to control bleeding; three periumbilical port-site hernias and one groin hernia, which required herniorrhaphy; and fluid leak resulting in scrotal edema in one patient, which resolved spontaneously after the break-in period.

Catheter migration as a cause of catheter malfunction occurred in six patients (12%) in the open group, as compared with none in the laparoscopic group. Catheter



**Fig. 1.** Catheter survivals for laparoscopic and open groups were not significantly different (chi-square = 1.22, log-rank test;  $df = 1$ ;  $p = 0.27$ )

survivals for the laparoscopic and the open groups are shown in Fig. 1. There were no significant differences in catheter survival between the two groups. The survival probability at 1, 2, and 3 years for the laparoscopic group was 79%, 53%, and 37%, respectively, as compared with 65%, 43%, and 29% for the open group.

## Discussion

Mechanical obstruction of a peritoneal dialysis catheter usually results from malplacement at the operation, omental wrapping, adhesions, or catheter migration out of the pelvis. The peritoneal dialysis catheter may spontaneously undergo repositioning from a dependent to a nondependent position in the abdomen, reducing dialysate return at the end of the dwell period. These problems may occur immediately or several months after insertion [2, 9].

Several studies have demonstrated that securing of the catheter tip in the pelvis reduces the incidence of catheter obstruction. This is easily accomplished by a laparoscopic approach using techniques which vary from suturing [8, 13, 14] to stapling the suture loop to the pelvic peritoneum [7]. We believe that the proper placement of the catheter by suturing the tip deeply to the pelvic peritoneum (a technique similar to that described by Watson et al. [8, 14]) will provide better dialysate outflow than other methods. This requires placing another port for lifting the uterus in females and retracting the bowel and omentum. In addition, the catheter tip can be observed directly during insertion.

Our study is similar to that of Tsimoyiannis et al. [12], but the outcomes were different. They described a prospective, randomized, controlled study comparing laparoscopic catheter fixation with an open technique in 50 patients. Their findings showed that laparoscopic placement provided better catheter survival than the open procedure. The advantages of our study were a

larger number of patients, recruitment of new patients only, and long-term follow-up evaluation. However, the patients were not randomized because only patients able to tolerate general anesthesia were selected to undergo the laparoscopic procedure.

The early and late complication rates in our study compare favorably with those of published series involving both open and laparoscopic insertions [6, 8, 11, 15].

In summary, the laparoscopic technique with secure placement of the catheter lowered the incidence of catheter migration and outflow dysfunction in both the early and long-term periods, as compared with the open surgical technique, although the catheter survivals were not statistically different.

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