Peritoneal Dialysis International, Vol. 20, pp. 757–765
Printed in Canada.

0896-8608/00 $3.00 + .00

A LAPAROSCOPIC APPROACH UNDER LOCAL ANESTHESIA FOR PERITONEAL DIALYSIS ACCESS

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♦ ***Objective:*** **Presented herein is a technical description of a time-proven laparoscopic approach to establishing successful long-term peritoneal dialysis access.**

♦ ***Design:*** **Using a two-port technique, the peritoneal catheter is inserted through a paramedian port site while continuously monitoring the implant procedure with a laparoscope from a second port location. A long rectus sheath tunnel created with a nontrocar port device keeps the dialysis catheter oriented toward the pelvis. Helium abdominal insufflation enables full surgical laparoscopy under local anesthesia. Validation of the effectiveness of the technique is made by comparison to previous implantation experience using an open dissection method.**

♦ ***Patients:*** **Laparoscopic implantation of peritoneal catheters was performed in 150 patients, and placement by open dissection was accomplished in 63 patients.**

♦ ***Main Outcome Measure:*** **The incidence of complications and revision-free catheter survival between implantation methods were compared.**

♦ ***Results:*** **Catheters implanted laparoscopically had a significantly lower incidence of flow dysfunction ($p < 0.05$) and better survival ($p < 0.001$) than those placed by open dissection.**

♦ ***Conclusions:*** **Compared to implantation by open dissection, the laparoscopic approach provides the patient reduced perioperative discomfort. The procedure can be performed safely with the patient under local anesthesia on an ambulatory basis. Laparoscopic implantation significantly reduces the incidence of catheter flow dysfunction and permits simultaneous identification and correction of other problems that could complicate dialysis therapy.**

KEY WORDS: Laparoscopy; peritoneoscopy; peritoneal dialysis catheter; helium insufflation; anesthetic technique; radially expanding devices.

Laparoscopy, synonymous with the term peritoneoscopy, is not new to peritoneal dialysis (PD) as a means of performing catheter implantation. Ash and colleagues have championed its use as an implantation technique since 1981 (1). Most clinical reports have confirmed that laparoscopic-assisted placement is associated with a lower incidence of catheter complications than that of other methods (2–4). During the past decade, surgeons have become increasingly involved in developing an expanded role for videoscopic surgery in the implantation of PD catheters (5–23). The procedure has evolved into more than just sliding a dialysis catheter through a laparoscopic port into the peritoneal cavity.

Since our initial report (16), continued experience with laparoscopic dialysis catheter implantation has led to slight modifications in our technique and has permitted identification of other aspects of the procedure that need greater emphasis. One of the major innovations is the use of helium for abdominal insufflation. Because helium is painless, it has enabled routine performance of laparoscopic procedures in PD patients under local anesthesia (24). Presented here is a laparoscopic approach that takes greater advantage of the merits of this modality to establish successful long-term peritoneal access. For purposes of perspective, the outcome of our laparoscopic implants is contrasted to our previous experience with catheters placed by open dissection.

MATERIALS AND METHODS

PREOPERATIVE PREPARATION

Patients are fasted 8 hours prior to the implant procedure; however, essential medications are permitted with a sip of water. It is not our practice to perform preoperative bowel preparation unless there is a previous history of constipation. Patients are advised to shower before the procedure with a chlorhexidine soap abdominal wash. Removal of body hair is performed in the preoperative holding area. Patients are instructed to empty the bladder before going to the operating room. A prophylactic antibiotic, cefazolin, or vancomycin in the event of cephalosporin allergy, is administered prior to the procedure.

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Received 13 June 2000; accepted 22 August 2000.

ANESTHESIA AND MONITORING

All implantation procedures are performed in the operating room with anesthesia personnel in attendance. Electrocardiogram and pulse oximetry are continuously monitored along with periodic determinations of blood pressure. When required, intravenous sedation for patient comfort is obtained with midazolam-HCl (1 – 3 mg) and fentanyl citrate (50 – 100 µg). On occasion, propofol (10 – 20 mg) titrated intravenously may be appropriate to cover the period of local anesthetic infiltration. All patients should remain sufficiently alert to control their respiratory pattern and to cooperate with requests to push out and tense the abdominal wall to facilitate Veress needle and port-cannulas insertion.

Local infiltration anesthesia consisting of lidocaine-HCl 1.0% and bupivacaine-HCl 0.5% mixed in equal volumes is favored for rapid onset and prolonged duration. Local infiltration of the peritoneum is essential for complete pain control, and is assisted by laparoscopic monitoring of the local anesthetic injection of other planned port sites after insertion of the camera port.

HELIUM INSUFFLATION

Helium insufflation can be performed with most commercially available laparoscopic gas insufflators as long as the high pressure of the helium tank is appropriately reduced. The insufflator is connected to a helium tank with a helium-specific high-pressure yoke assembly (Mercury Medical, Clearwater, FL, U.S.A.) and regulator (Western Enterprises, Avon Lake, OH, U.S.A.) used to reduce the gas pressure to the insufflator to 260 psi. Pressure limits for abdominal gas insufflation are set between 8 and 10 mmHg. Lower insufflation rates (0.5 – 2.0 L/min.) should be expected with spontaneously breathing patients, compared to rates observed with patients that are paralyzed under general anesthesia.

LAPAROSCOPIC PORTS

Nontrocar ports (InnerDyne, Salt Lake City, UT, U.S.A.) are used to gain peritoneal access for the laparoscopic procedure (Figure 1). The system utilizes a radially expandable plastic sleeve that fits snugly over a Veress-type pneumoperitoneum needle. After the needle–sleeve assembly has been advanced through the abdominal wall, the needle is removed, permitting dilatation of the expandable sleeve with insertion of a dilator–port-cannula assembly. The expandable sleeve is single-use and one is provided with each cannula. The Veress needle is reused with each port placement during the course of the procedure. A 5-mm cannula is used for the laparoscope port. Catheter access is obtained with the 7/8-mm cannula, which is accompanied by a 5-mm reducer cap that maintains an airtight seal around the dialysis catheter tubing during insertion. The reducer cap must be modified by incising the rubber membrane at two points 180° apart to permit passage of the 7-mm Dacron cuffs (Figure 1, inset). The incisions in the reducer cap do not defeat the airtight seal around the 5-mm catheter tubing.

IMPLANTATION PROCEDURE

Laparoscopic dialysis catheter implantation is accomplished using a two-port technique. The peritoneal catheter is inserted through a paramedian port site while continuously monitoring the implant procedure with a laparoscope from a second port location (Figure 2). The pneumoperitoneum needle and laparoscopic camera port utilize the same umbilical-level pararectus incision on the side opposite the planned catheter insertion site. If cholecystectomy or appendectomy scars are present, closed peritoneal access with the Veress needle should be performed on the left side. For safe insertion of the initial port by the closed method, the Veress needle and the Veress needle–expandable sleeve assembly should be inserted in two steps as described below. Alternatively, and in the event of midline scars or multiple previous abdominal surgeries, the initial port is placed by opening the peritoneum under direct vision.

After anesthetizing the skin and underlying abdominal wall, including the peritoneum, a small, less than 1-cm, transverse incision is made through the

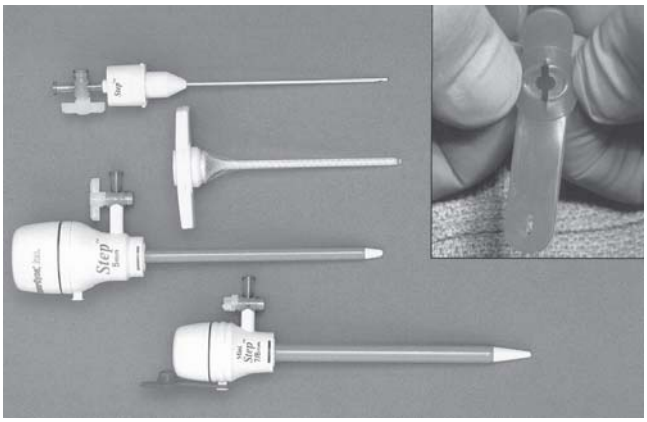

Figure 1 — Laparoscopic nontrocar port system includes, from top to bottom, Veress-type pneumoperitoneum needle; radially expandable plastic sleeve; 5-mm dilator–cannula assembly used as the laparoscope port; 7/8-mm dilator–cannula assembly with attached reducer cap used as the dialysis catheter port. A modified reducer cap (inset) is used to permit passage of Dacron cuffs of the dialysis catheter.

skin only at a point just lateral to the rectus sheath (Figure 2). The underlying subcutaneous tissue is gently separated with a hemostat clamp to the level of the fascia. The Veress needle is then placed through the skin incision down to the surface of the fascia. The patient is requested to push out and tense the abdominal wall. The Veress needle is advanced through the abdominal wall. A discernible "pop" is usually appreciated as the needle passes into the peritoneal cavity. The patient is advised to relax the abdomen and the needle is aspirated and flushed with saline to assure proper placement. Approximately 2 L of helium is insufflated. The Veress needle is removed and placed through the plastic radially expandable sleeve. The needle-sleeve assembly is advanced through the abdominal wall into the peritoneal cavity with the patient pushing out and tensing the abdomen. Intraperitoneal placement is signaled by escape of helium through the needle. The needle is withdrawn and the 5-mm dilator-cannula is advanced through the sleeve. The dilator is removed, the helium hose is attached to the side port of the cannula, and a 5-mm laparoscope is inserted for general exploration. Usually, there will be enough residual helium to permit adequate examination without having to insufflate additional gas. The patient is placed in Trendelenburg position to permit evaluation of the pelvis for adhesions or redundant, thin, filmy omentum that could potentially interfere with proper catheter function. The course of the inferior epigastric vessels is frequently visible and their position should be noted to avoid injury during catheter port placement. Following exploration, the camera is temporarily removed, gas flow is stopped, and attention is directed toward placement of the catheter port.

The catheter port is placed in a paramedian location, tunneled in a caudal direction through the rectus sheath for a distance of at least 4 cm before entry is made into the peritoneal cavity (Figure 3). The skin incision for this port is generally 2 – 3 cm lateral and inferior to the umbilicus. The location of the paramedian incision is kept toward the medial aspect of the rectus sheath to avoid the epigastric vessels (Figure 2). A more accurate determination of proper incision location can be made by laying the catheter on the abdominal wall and noting the position of the deep catheter cuff when the most proximal side holes of the catheter tip are placed at the upper border of the symphysis pubis. The level of the upper border of the cuff is indicated on the skin with a surgical marker as well as a point 4 cm below this mark that will correspond to the site of intraperitoneal entry of the port.

A 2-cm transverse paramedian incision is made at the designated site. The anterior rectus sheath is exposed by blunt spreading dissection with a combination of hemostat clamps and narrow ribbon retractors. The local anesthetic needle is inserted through the anterior rectus sheath to permit dissection of the injectate within the intact sheath. The laparoscope is reinserted and the anesthetic needle is placed perpendicularly through the abdominal wall at the point 4 cm below the paramedian incision [Figure 3(a)]. Assisted by laparoscopic vision, a wheal of anesthetic agent is used to elevate the peritoneum at this location. In addition to providing local anesthesia, the wheal serves as a laparoscopic landmark for the point of intraperitoneal entry of the catheter port. The Veress needle with overlying expandable sheath is placed through the paramedian incision and advanced gently through only the anterior rectus sheath

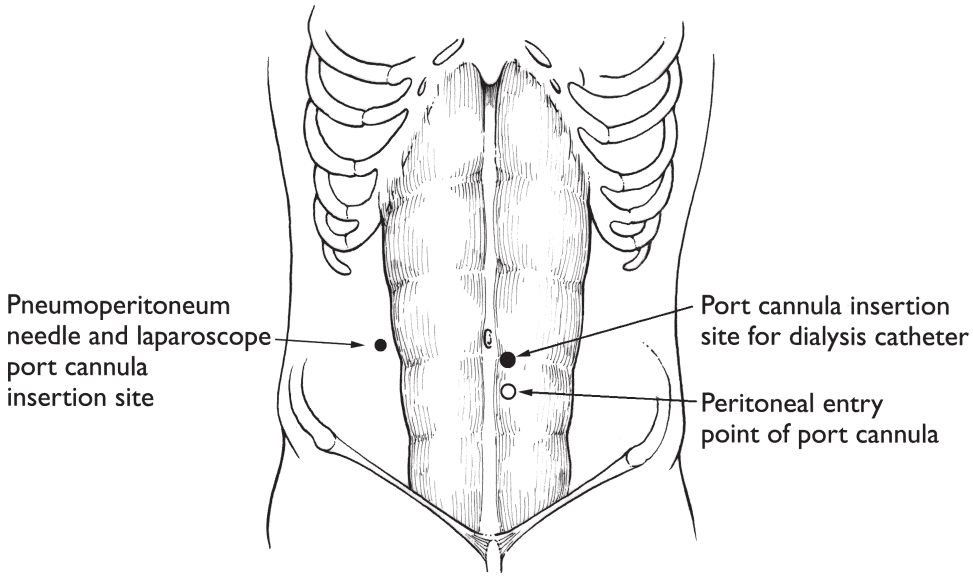

Figure 2 — Primary placement sites of Veress needle, and laparoscope and dialysis catheter port cannulas are shown.

[Figure 3(a)]. Once through the anterior fascia, the spring-loaded obturator covers the sharp edge of the needle. The blunt tip is easily seen through the laparoscope as it tents down the posterior rectus sheath. The needle is then angled toward the pelvis and advanced with the blunt end observed laparoscopically as it is slid down the posterior rectus sheath to the site of the peritoneal anesthetic wheal [Figure 3(b)]. The needle is pushed through the peritoneal membrane into the abdominal cavity. The needle is replaced with the 7/8-mm dilator-cannula to complete the port insertion [Figure 3(c)].

Prior to implantation, the PD catheter is prepared by rinsing the tubing in saline solution and flushing the lumen to remove particulates. The air bubbles are squeezed from the Dacron cuffs before insertion to promote better tissue ingrowth. The catheter is loaded onto a stylet, keeping the alignment of the radiopaque guide stripe straight. Under laparoscopic control, the catheter-stylet assembly is advanced through the catheter port to the desired pelvic location. The stylet is partially withdrawn as the catheter is inserted. The catheter-stylet assembly is advanced so that the deep cuff is visible within the peritoneal cavity [Figure 3(d)]. This maneuver is important to make certain that the deep cuff has been passed through the anterior rectus sheath. The port device is then withdrawn from the abdominal wall up onto the shaft of the catheter-stylet assembly. Under laparoscopic vision, the catheter-stylet assembly is withdrawn so that the Dacron cuff just disappears above the peritoneum. The stylet is removed from the catheter, the pneumoperitoneum is allowed to deflate, and the laparoscope is removed, but the laparoscope port is left in place. Guided by the known distance between the deep and superficial catheter cuffs, the catheter is further withdrawn until the deep cuff is just below the anterior rectus sheath [Figure 3(d)]. Proper deep-cuff positioning is facilitated by the observation that the 7-mm cuff offers resistance as it abuts the tight fascial hole in the anterior rectus sheath.

The subcutaneous tunnel path and catheter exit site are best estimated with the abdomen in normal contour, without the deformity of a pneumoperitoneum. The tunnel tract of an appliance with a preformed tubing bend must follow the precise shape of

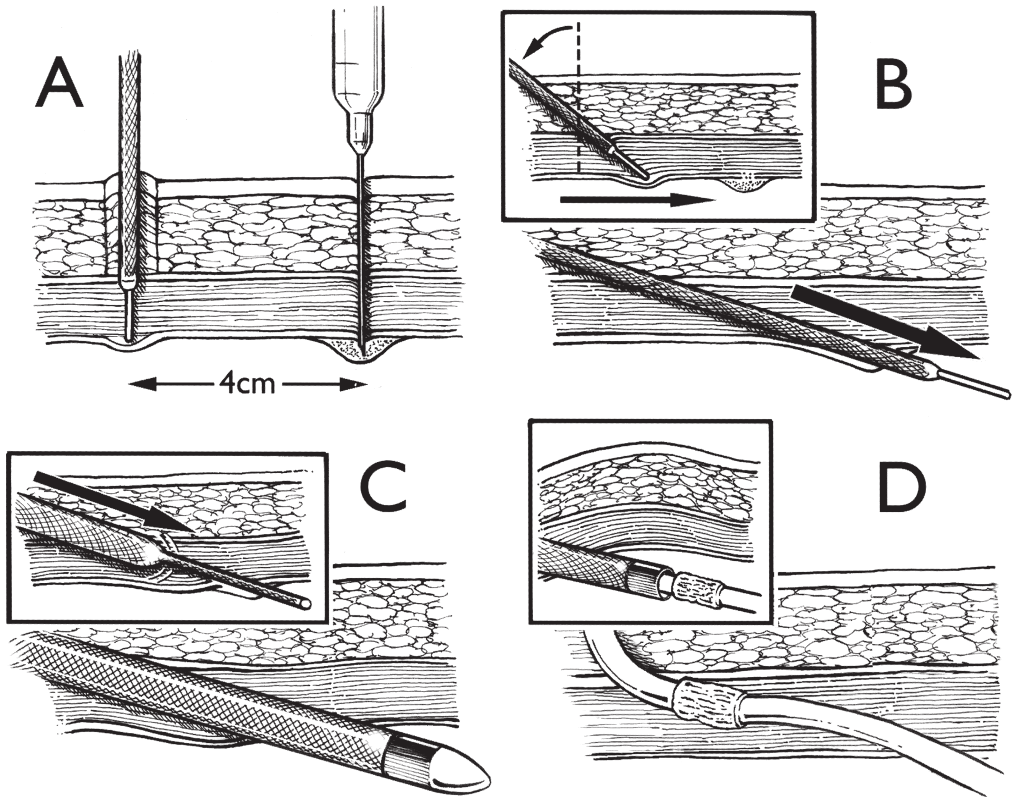

Figure 3 — Steps of abdominal wall implantation of dialysis catheter. (A) An anesthetic wheal is created 4 cm below level of skin incision. Veress needle-expandable sleeve assembly is inserted through skin incision and anterior rectus sheath. (B) The needle-sleeve assembly is angled toward the pelvis, advanced down the rectus sheath, and pushed through into the peritoneal cavity at the anesthetic wheal. (C) The needle is removed and the expandable sleeve serves as a conduit for insertion of the 7/8-mm dilator-cannula. (D) The dialysis catheter over a stylet is advanced into the peritoneal cavity until the deep cuff is visible. The cannula and stylet are withdrawn and the catheter is pulled back until the deep cuff is just below the anterior rectus sheath.

the catheter. The exit site is marked 2 cm beyond the superficial cuff. In catheters without a preformed bend, the external portion of the catheter is laid out over the skin to assist in marking the exit site. The tunnel is shaped in an arcuate configuration so that the catheter makes a gentle bend in the subcutaneous tract and exits the skin below the transverse plane, with the superficial cuff no closer than 2 cm from the skin exit site. The skin incision at the exit site should be the smallest hole possible that leaves the skin snug around the catheter. The catheter is exited through the skin with a tunneling guide that does not exceed the diameter of the tubing and that can be passed in the direction from the paramedian incision to the exit site. The Faller stylet (Faller tunneling stylet, The Kendall Co., Mansfield, MA, U.S.A.) is specifically constructed for this purpose but a resterilized trocar needle saved from a Hemovac set (Hemovac, Zimmer Patient Care Division, Dover, OH, U.S.A.) makes a suitable substitute (Figure 4).

The catheter adapter and transfer set are assembled to the catheter and the implanted device is subjected to a trial irrigation. With the patient in reverse Trendelenburg position, a standard 1-L bag of normal saline for intravenous administration with heparin (1000 U/L) is observed for unimpeded inflow and drainage by gravity. A residual of 250 – 300 mL is left in the abdomen to reduce the likelihood of intraperitoneal structures sucking up against the catheter toward the end of the drainage process. At the conclusion of a successful irrigation, the entire system is flushed with 20 mL of heparin (100 U/mL).

To reduce the risk of infection, no sutures are used at the exit site. The tubing is stabilized near the exit site with tincture of benzoin and sterile adhesive strips. At the conclusion of a successful irrigation, the laparoscope port is removed. The fascial hole is not routinely sutured. Skin wounds are closed with an intracuticular absorbable suture and supported with sterile adhesive strips. Wounds are covered with a combination of gauze and polyurethane adhesive film dressings.

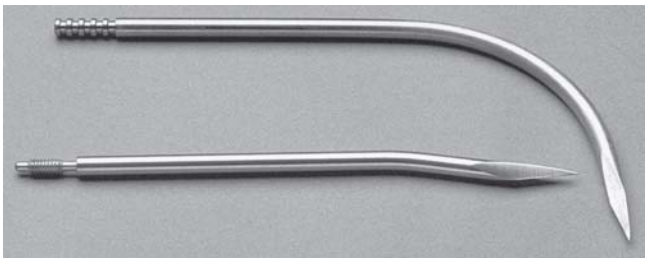

Figure 4 — The Faller stylet (top) and a trocar needle (bottom) saved from a surgical drainage set are suitable instruments to exit the dialysis catheter through the subcutaneous tunnel and skin.

POSTOPERATIVE MANAGEMENT

Postoperatively, the protocol for catheter irrigation consists of a 1-L heparinized saline in-and-out flush performed within 72 hours following surgery and weekly thereafter until PD is instituted. Peritoneal dialysis is generally delayed for a minimum of 2 weeks to permit complete wound healing. Unless excessive drainage is present, dressings are changed weekly for 2 weeks, at which time the patient begins a routine of daily exit-site cleansing with antibacterial soap. The patient is permitted to resume showering after 1 month if wound healing has been uncomplicated. A sterile gauze dressing over the exit site is encouraged.

COMPARISON OF IMPLANT METHODS

Between August 1992 and July 1996, PD catheters were implanted in our institution by open dissection with insertion of the tube in a paramedian location (25). Protocols for trial irrigation and postoperative management were identical to those described for the laparoscopic procedure. The laparoscopic data reported here include all implants performed from July 1996 through March 2000.

Fisher's exact test was used to compare nominal data and the t-test to compare continuous data. Actuarial revision-free catheter survival was estimated using the method of Kaplan and Meier. For survival probability, catheter failure was defined as removal of the catheter for peritonitis, exit-site/tunnel infection, pericannular leak, or tubing break. The occurrence of flow obstruction was regarded as catheter failure although most were salvaged by laparoscopic rescue methods. Comparison of probability curves was performed with the log-rank test. All results were considered significant at p less than 0.05.

RESULTS

There were 150 catheters implanted laparoscopically in 153 consecutive procedures. Early in the experience, 1 patient required conversion to the traditional open implant technique and control of bleeding after recognized trocar injury to the inferior epigastric artery. Two patients with extensive intraperitoneal adhesions could not be implanted. In the open dissection group, 1 patient in 64 consecutive procedures could not be implanted due to adhesions.

Demographic data for dialysis catheters implanted by open dissection and laparoscopy are shown in Table 1. There were no significant differences between the open dissection and laparoscopic groups with respect to gender, previous dialysis experience, history of previous major abdominal surgery, proportion of

procedures performed on an outpatient basis, and incidence of procedures initiated under local anesthesia. Patients in the laparoscopic group were significantly older and their follow-up was shorter. From the standpoint of operative discomfort, the laparoscopic procedure was better tolerated than open dissection, as reflected by the significant difference in the incidence of conversions from local anesthesia to general anesthesia. The incidence of subsequent flow dysfunction was significantly lower in laparoscopically placed catheters.

Our dialysis-related infection data for the two implantation methods have been presented elsewhere and will not be detailed here (26). The risks for first occurrences of infectious events and cumulative infection rates were lower in the laparoscopic group, although the differences were greatly influenced by the manner in which the skin exit sites were constructed in the open dissection group.

Laparoscopic adhesiolysis with the Harmonic Scalpel (Ethicon Endo-Surgery, Inc., Cincinnati, OH, U.S.A.) was performed during nine implant procedures to eliminate intraperitoneal loculations that would have interfered with drainage function. Tacking up or excision of redundant omentum or epiploic appendices was performed during five cases. None of the procedures required a change of the anesthetic method in progress and 11 of the 14 cases were accomplished under local anesthesia.

Catheter survivals for the laparoscopic and open dissection groups are shown in Figure 5. Catheters implanted laparoscopically had a significantly better survival compared to those placed by open dissection. Revision-free survival probability at 1, 2, and 3 years for the laparoscopic group was 87.4%, 81.2%, and 75.5% compared to 74.1%, 57.4%, and 39.2% for the open dissection group.

DISCUSSION

One of the major impediments to acceptance of surgical laparoscopy as a means for PD catheter implantation has been the necessity for a general anes-

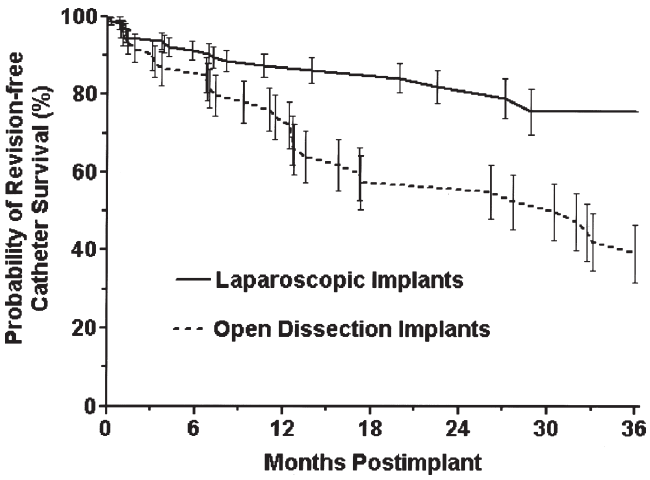

Figure 5—Revision-free catheter survivals for laparoscopic and open dissection implant groups were significantly different (log-rank test, chi-square = 12; df = 1, $p < 0.001$). Error bars represent standard error of mean (SEM).

TABLE 1
Demographics and Clinical Details of Peritoneal Dialysis Catheters Implanted by Open Dissection and Laparoscopic Techniques

Parameter	Open dissection	Laparoscopy
N	63	150
Age (mean ± SD) (years)	49.5±13.7[a]	55±13.4[a]
Male	38 (60.3%)	85 (56.7%)
Previous dialysis experience	12 (19.1%)	31 (20.7%)
Previous major laparotomy	19 (30%)	35 (23.3%)
Postoperative follow-up (mean ± SD) (months)	19.6±12.6[a]	15.2±10.5[a]
Implanted as outpatient	49 (77.8%)	114 (76%)
Initiated under local anesthesia	50 (79.4%)	124 (82.7%)
Converted to general anesthesia because of pain	5 (10%)[a]	0 (0%)[a]
Procedural complications		
Visceral perforation	1 (1.6%)	0 (0%)
Re-operation for hemorrhage	1 (1.6%)	0 (0%)
Postoperative pericannular leak	1 (1.6%)	2 (1.3%)
Catheter flow dysfunction	11 (17.5%)[b]	10 (6.7%)[b]
Perioperative death[c]	1 (1.6%)	0 (0%)

[a] $p < 0.01$.
[b] $p < 0.05$.
[c] Postoperative acute myocardial infarction.

thetic in order to conduct the procedure. Laparoscopy is routinely performed with CO_2 abdominal insufflation to create the operative working space in the peritoneal cavity. Carbon dioxide reacts with the peritoneal membrane to form carbonic acid and produces pain upon contact (27). In addition, CO_2 is rapidly absorbed across the peritoneal membrane and may contribute to significant metabolic acidosis and cardiac arrhythmias (28–30), disturbances that are not well tolerated by high-risk chronic renal failure patients.

Alternatively, helium has been increasingly utilized as a laparoscopic insufflation agent in high-risk patients (31–33). Because of its inertness, helium is devoid of the metabolic consequences associated with CO_2. In addition, helium is painless, thereby allowing the laparoscopic procedure to be performed under local anesthesia (24). Furthermore, the nonflammable property of helium makes it a safe agent for the use of intraperitoneal electrosurgical devices.

Lidocaine and bupivacaine mixed in equal proportions was favored for local anesthetic infiltration because of its rapid onset and long duration. Regardless of the agents used, it is important to achieve good anesthesia of the highly sensitive peritoneal membrane. As the infiltrating needle is advanced through the abdominal wall while injecting, the patient will frequently wince when the anesthetic agent stretches the peritoneal membrane. Once the initial laparoscopic port has been placed, local anesthetic infiltration of all other anticipated port sites is facilitated by laparoscopic visual control.

Intravenous sedation is appropriate to alleviate undue fear and anxiety; however, it should not be substituted for adequate local anesthesia. There is nothing particularly painful about the procedure and many patients have been quite comfortable without sedation. Excessive sedation prevents the patient from being able to cooperate with the operator's request to push out and tense the abdominal wall during Veress needle insertion. More importantly, over-sedation produces an abdominal respiratory pattern that significantly hinders the performance of the procedure. Therefore, it is important to discuss sedation guidelines in advance with anesthesia personnel who are accustomed to performing laparoscopic procedures with the patient narcotized, paralyzed, and under general endotracheal anesthesia.

We use the InnerDyne port system for all laparoscopic surgical procedures on PD patients. A radially expanded tissue tract leaves a smaller hole than that produced by the cutting blades of a standard trocar port device (34), thus reducing the risk of postoperative leak (35). In addition, the InnerDyne system provides greater control and safety when placing the cannula through the rectus muscle sheath. Our single incidence of injury to the inferior epigastric vessels requiring suture control came early in our experience when we were still using trocar ports (16).

To minimize pericatheter leak or hernia, and to reduce the risk of rectus muscle bleeding, the smallest caliber port sleeve that permits passage of the catheter tubing and cuff should be used. The Dacron cuffs of commercially available PD catheters will not pass freely through a port size less than 7 mm. The InnerDyne 7/8-mm port system was used in the present experience.

Implanting the peritoneal catheter so that the intraperitoneal segment remains downward into the pelvis is of critical importance for proper flow function and to reduce the risk of omental entrapment. Recognition of this need was the genesis of various catheter designs that promoted pelvic orientation, for example, preformed tubing bends of the "swan-neck" (36) and "pail-handle" (37) configurations, and the angled flange–bead of the "swan-neck Missouri" catheter (38). Our technique of tunneling the tubing down the rectus sheath for a distance of at least 4 cm before entry into the peritoneal cavity is effective in maintaining pelvic direction of the catheter. This is a mandatory maneuver for catheters with a straight intramural segment and augments those with a "swan-neck" design. While easily implanted by our laparoscopic method, the "pail-handle" configuration requires a perpendicular passage through the rectus sheath. The method we describe for tunneling the catheter through the rectus sheath produces a more favorable downward angle than the flange–bead design, whose large size prevents laparoscopic insertion. The need for laparoscopic suturing of the catheter in the pelvis or within peritoneal folds as advocated by others (9,12,17,21) is eliminated by the use of a long rectus sheath tunnel that effectively maintains the tubing in a downward direction.

Catheter exit-site location should be determined preoperatively with avoidance of the belt line and skin creases. Exit-site direction should be other than upwards and preferentially downwards to prevent pooling of perspiration and cutaneous debris in the exit skin sinus (36). Catheters with a straight intercuff segment should be tunneled subcutaneously with a gentle bend so that the exit site is just below the transverse plane. The superficial Dacron cuff should be positioned so that it will not be any closer than 2 cm to the exit site, even if the catheter were to straighten out in the subcutaneous tract over time. Excessive angulation of a straight catheter in the subcutaneous tunnel may lead to extrusion of the superficial cuff through the exit wound if there has not been proper compensation for tubing resilience (36).

The exit site should consist of the smallest hole possible that permits passage of only the tubing and

leaves the skin snug around the catheter. Tunneling of catheters with clamps or other instruments that greatly exceed the diameter of the catheter tubing should be avoided. Large, loose, pericannular wounds increase the risk of exit-site infection, tunnel tract infection, catheter infection-related peritonitis, and catheter loss (26).

An important advantage of surgical laparoscopy over every other method of catheter implantation is that it allows simultaneous intervention for problems identified during the procedure that could complicate dialysis therapy. Adhesions from previous lower abdominal surgery causing loculation of the peritoneal cavity can result in incomplete dialysate drainage. We have performed adhesiolysis with the Harmonic Scalpel to restore the lower abdominal cavity and pelvis to an open space. The Harmonic Scalpel is an ultrasonically activated device with a shear-shaped end that employs mechanical ultrasonic energy instead of electrical energy to coagulate and divide tissues and blood vessels. Because it produces minimal collateral tissue damage and stimulation, and can be passed through a 5-mm port, it is ideal for laparoscopy under local anesthesia. However, it is neither necessary nor desirable to mobilize every adhesion. Omentum adherent to the abdominal wall above the level of the pelvis that does not interfere with drainage of fluid from the upper abdomen may even protect from omental entrapment of the catheter.

To prevent omental obstruction of the catheter, we will prophylactically tack up redundant, thin, filmy omentum to the upper abdomen if it is found to be filling the pelvis. Care should be exercised to perform the omentopexy high in the abdomen so that it pulls the redundant omentum above the level of the transverse colon. The omentopexy adds 10 minutes to the procedure and requires one additional working port to handle the omentum and a small skin incision for the Endo Close needle (Endo Close Suturing Device, United States Surgical Corp., Norwalk, CT, U.S.A.) at the tacking site. The needle, with an attached 0 polyglycolic suture, is used to skewer multiple folds of the redundant omentum and to secure it to the upper abdominal wall (39).

While clinical success with PD access is said to be as dependent upon operator skill as it is on the implant method used, surgical laparoscopy offers many inarguable advantages. Compared to implantation by open dissection, the laparoscopic approach provides the patient reduced perioperative discomfort and earlier return to full mobility. The procedure can be performed safely, with the patient under local anesthesia, on an ambulatory basis. It significantly reduces the incidence of flow dysfunction and permits simultaneous identification and correction of problems that could complicate dialysis therapy. Laparoscopic PD catheter implantation should become the standard of care for clinical practice.

ACKNOWLEDGMENTS

We thank Steve Beebe and the staff of Audio-Visual Services for their work on the medical illustrations.

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