ASDIN Core Curriculum for Peritoneal Dialysis Catheter Procedures

American Society of Diagnostic and Interventional Nephrology
Table of Contents

Chapter 1 .................................................................................................................................. 1
Introduction
Loay Salman, MD and Arif Asif, MD

Chapter 2 .................................................................................................................................. 3
Peritoneal Dialysis Catheters Designs and Overview of Placement Techniques
Stephen Ash, MD and Anil Agarwal, MD

Chapter 3 .................................................................................................................................. 31
Definition of Peritoneal Catheter Complications and Proper Function
Stephen Ash, MD and Anil Agarwal, MD

Chapter 4 .................................................................................................................................. 41
Surgical Placement of Peritoneal Dialysis Catheters (Dissective Placement)
Amer Rajab, MD, PhD and Mitchell Henry, MD

Chapter 5 .................................................................................................................................. 47
Laparoscopic Placement of Peritoneal Dialysis Catheters
Gazi B. Zibari, MD and Hosein Shokouh-Amiri, MD

Chapter 6 .................................................................................................................................. 57
Peritoneoscopic Placement of Peritoneal Dialysis Catheters
Jeffrey Packer, DO and Rick Mishler, MD

Chapter 7 .................................................................................................................................. 69
Fluoroscopic Placement of Peritoneal Dialysis Catheters
Kenneth Abreo, MD, Bharat Sachdeva, MD, and Ivan Maya, MD

Chapter 8 .................................................................................................................................. 83
Peritoneal Catheter Removal and Complications of Peritoneal Dialysis Catheters
Loay Salman, MD and Arif Asif, MD

Chapter 9 .................................................................................................................................. 93
CPT Coding of Peritoneal Dialysis Catheter Related Procedures
Donald Schon, MD and Shouwen Wang, MD
Contributors

Kenneth Abreo, MD
Division of Nephrology
LSU Health Sciences Center
Shreveport, Louisiana

Anil Agarwal, MD
Division of Nephrology
The Ohio State University
Columbus, Ohio

Stephen R. Ash, MD
Clarian Arnett Health
Ash Access Technology, Inc. and HemoCleanse, Inc.
Lafayette, Indiana

Arif Asif, MD
Division of Nephrology
Section of Interventional Nephrology
University of Miami Miller School of Medicine
Miami, Florida

Mitchell L. Henry, MD
Department of Surgery
The Ohio State University Medical Center
Columbus, Ohio

Ivan Maya, MD
Nephrology Associates of Central Florida
Orlando, Florida

Rick Mishler, MD
Arizona Kidney Disease & Hypertension Center
Phoenix, Arizona

Jeffrey Packer, DO
Arizona Kidney Disease & Hypertension Center
Phoenix, Arizona

Amer Rajab MD, PhD
Department of Surgery
The Ohio State University Medical Center
Columbus, Ohio

Bharat Sachdeva, MD
Division of Nephrology
LSU Health Sciences Center
Shreveport, Louisiana

Loay Salman, MD
Division of Nephrology
Section of Interventional Nephrology
University of Miami Miller School of Medicine
Miami, Florida

Donald Schon, MD
Arizona Kidney Disease & Hypertension Center
Phoenix, Arizona

Hosein Shokouh-Amiri, MD
Department of Surgery
Louisiana State University Health Sciences Center
Shreveport, Louisiana

Shouwen Wang, MD
Arizona Kidney Disease & Hypertension Center
Phoenix, Arizona

Gazi B. Zibari, MD
Department of Surgery
Louisiana State University Health Sciences Center
Shreveport, Louisiana

Editor

Steven Wu, MD
Interventional Nephrology
Nephrology Division
Massachusetts General Hospital
Harvard Medical School
Boston, Massachusetts
Chapter 7

Fluoroscopic Placement of Peritoneal Dialysis Catheters

Introduction
The success of a dialysis program depends on the careful evaluation of the individual patient, meticulous pre-end-stage renal disease (ESRD) care/education, planning ahead to select the best long term access/modality, and transplant evaluation.

Recent data have emphasized that up to 19% of the ESRD patients in the US are using tunneled dialysis catheters (TDC) as their permanent access (1). Of particular concern is the fact that the use of TDC as permanent dialysis access is steadily on the rise, with placement rates having increased since 1996 (1). Late identification of patients with chronic kidney disease and subsequent late referral to nephrologists contributes to a high rate of catheter use in incident dialysis patients with as many as 80% of patients commencing dialysis with a TDC (1).

Peritoneal dialysis (PD) offers a number of advantages such as slow continuous daily home dialysis, preservation of residual renal function, improved middle molecule clearance, better fluid and blood pressure control, cost-effectiveness, reduced mortality, and better quality of life. However, despite these advantages, this renal replacement modality remains largely ignored (2). Recent data have demonstrated that more that 50% of patients with ESRD who are informed about treatment options prefer and request PD as the modality of choice for renal replacement therapy (3, 4, 5). As many as a third of patients starting dialysis are PD candidates, provided the nephrologists taking care of these patients have the option available. (6).

Fluoroscopic peritoneal catheter placement offers an uncomplicated approach to establish a peritoneal access that is ready for use as early as within 24 hours of insertion in cases of emergency or if needed. This method has the benefit of little waiting time, a small incision, rapid wound healing, less pain/discomfort, and lower cost when compared to surgical placement methods. This procedure, first described in 1992 (7), has gained wide acceptance over the years by programs across the globe (7, 8, 9, 10, 11, 12, 13).

Preoperative Evaluation
A thorough history and complete physical examination are mandatory prior to peritoneal catheter placement. Selection of the dialysis modality based on the patient's clinical condition, co-morbidities, and preference should be addressed at every patient encounter.
Fluoroscopic peritoneal catheter placement is the least invasive method for a long term peritoneal access but suffers from the handicap of limiting the procedure to patients free of abdominal scars/adhesions. A history of extensive abdominal surgeries in the past, or a prior failed attempt at PD, would require placement of the catheter under direct visualization using advanced procedures including adhesionolysis, omentopexy, or catheter anchoring to the anterior peritoneal wall.

### Determination of the Exit Site
Prior to insertion, the exit site should be identified and marked on the skin. This can be done by the physician or an experienced PD nurse. It is advisable to avoid locations where there may be pressure during daily activities.

The exit site should be:
1. Above or below the belt line, should not lie on a scar, and should not be in abdominal folds.
2. Determined with the patient in an upright (seated or standing) position.
3. Directed laterally and facing downwards. (A stencil can be applied to demarcate the tunnel and exit site clearly.)
4. Locate to maximize self-care skills (dexterity, vision, handedness, strength, and motor skills).
5. Marked laterally to midline; placement through body of rectus muscle helps avoid catheter leakage.

A complete blood count, coagulation profile (PT/PTT/INR) and basic metabolic panel help screen patients with any contraindication for the surgical procedure and/or conscious sedation. Obtaining these the day prior to the scheduled procedure would help address any abnormal finding.

### Nasal Swab
Methicillin resistant staphylococcus (MRSA) is seen in almost 1 in 5 dialysis patients (14) and 1 in 3 are colonized with MRSA. While the use of nasal antibiotic prophylaxis compared with placebo has not been shown to reduce significantly the risk of peritonitis (15, 16) (RR 0.94 (0.67 to 1.33), 95% CI); nasal mupirocin when compared to placebo significantly reduces the exit-site and tunnel infection rate. (15) (RR 0.58 (0.40 to 0.85), 95% CI). Routine screening and treatment of carriers should be offered to patients initiating peritoneal dialysis treatment.

### Bowel Preparation
The rationale for the use of mechanical bowel preparation (MBP) is to decrease peritoneal contamination in case of bowel injury and to empty the bowel of its contents to improve the surgical field and handling of the bowel itself (17). Bowel complications with unexpected bowel opening, although relatively rare during benign peritoneal surgery (18), nonetheless represent one of the reasons behind routine administration of MBP. Over the past three decades, several randomized control trials have proven the safety of peritoneal/abdominal surgery without MBP (18), showing no difference in mechanical complication, perforation and infectious complications post procedure. On the contrary, mechanical bowel preparation has been shown to have the potential for bacterial translocation, (19) electrolyte disturbance, (20) and discomfort to patients (20).
Although most surgeons continue to advocate bowel preparation and believe in its beneficial role, an impressive body of evidence points otherwise. As of now, we are at the crossroads, uncertain as to whether we are facing a paradigm shift as far as MBP is concerned.

Bladder evacuation before the procedure ensures that the pelvic gutter has open space for accommodating the peritoneal catheter. A Foley catheter during the procedure helps to ensure an empty bladder, look for any evidence of bladder perforation (blood in urine, peritoneal fluid in the Foley bag) especially in patients with a dysfunctional bladder. However, most interventionalists place PD catheters without a Foley catheter in the bladder recommending that the patient empty the bladder prior to the procedure (10, 11, 12).

**Peri-Operative Antibiotic Prophylaxis**

The use of peri-operative intravenous antibiotic prophylaxis compared with no treatment significantly reduces the risk of early peritonitis (within 30 days of catheter insertion) (21, 22, 23, 24) (RR 0.35 (0.15 to 0.80) 95% CI). Gadallah et al. studied this in a randomized control trial (24). The study had three arms: placebo, vancomycin 1000 mg intravenous (single dose), and cefazolin 1000 mg (single dose) intravenous. The rate of peritonitis was 12% in the placebo arm, 7% after cefazolin, and 1% after vancomycin (p<0.05). Similarly Wikdahl et al. showed no incidence of peritonitis in the group that received cefuroxime 1500 mg intravenous prior to surgery (23).

**Figure 1.** Location of insertion site. (Reprinted with permission, reference 28)
Method of PD Catheter Insertion

Location of Insertion:
In most descriptions, a site 2-4 cm below (caudal) or above (cephalad) and left of the umbilicus is selected for catheter insertion (7, 8, 9, 10, 12, 25, 26). In general, the site chosen should be between the medial and lateral border of the rectus muscle (mid-rectus line). The left side is usually selected for convenience because most operators are right handed. There may be an advantage to placing the catheter on the right side rather than on the left since there is a tendency for the catheter tip to migrate to the right upper quadrant for left sided catheters. It has been hypothesized that peristaltic activity of the bowel is responsible for tip migration out of the pelvis (27). A more accurate method of determining the insertion site has been described by Crabtree (28). This can be done before the procedure as described earlier or when the patient is on the table. With the patient in the supine position, the upper border of the coiled segment of the catheter is aligned with the pubic symphysis and the catheter is laid on the abdomen along a paramedian line 3 cm lateral to the midline. The upper border of the deep cuff is the location of the insertion site as shown in Figure 1. The pubic symphysis has been recommended as a reliable landmark for the ideal location of the catheter tip in the true pelvis (29) and confirmed laparoscopically (30).

Peritoneal Entry:
The aim of this step is to enter the peritoneum safely without puncturing the epigastric artery, bowel, or bladder. After infiltrating the skin and underlying tissue with 2% lidocaine with epinephrine local anesthesia, a horizontal incision of about 2-5 cm is made. Obese individuals may need an appropriately longer incision. Blunt dissection of the subcutaneous tissues and fat is performed until the shiny anterior rectus sheath is visible. Bleeding blood vessels are either ligated with absorbable sutures or cauterized. The rectus sheath, rectus muscle, and peritoneum are infiltrated with local anesthesia and the needle is aspirated as it is withdrawn to ascertain that the epigastric artery is not in its path. An 18-gauge needle with a blunt trocar is inserted at an angle of 45 degrees (Figure 2), directed toward the lower pelvis. The needle will be felt to puncture the anterior rectus sheath followed by a second “pop” when passing the peritoneum. The location of the needle within the peritoneal cavity is confirmed by injecting 3-5 cc of contrast. If the needle has not entered the peritoneal cavity, a smudge or stain of contrast is seen on fluoroscopy; and if it has entered, the loops of bowel are outlined giving a scalloped appearance. Using the blunt end 18 Gauge needle instead of a micropuncture needle helps decrease the risk of bowel perforation. When using a micropuncture needle, 0.018-inch wire is then inserted through the needle and its course noted under fluoroscopy. When an 18 Gauge needle is used for peritoneal entry, 0.035-inch wire will pass directly through the needle and position is verified on fluoroscopy (Figure 3). After confirmation of its position in the lower pelvis, a 5-French catheter is inserted over the wire. Contrast can again be injected through the catheter to confirm its position (Figure 4). Perforation of the bowel with the micropuncture needle does not result in peritonitis. If perforation is suspected the best option is to abandon the procedure and administer broad spectrum antibiotics for 24 hours. No cases of peritonitis have occurred as a consequence to entering the bowel with a micropuncture needle (author’s personal experience). Use of blunt tipped 18 Gauge needle has been described to enter the peritoneal space (7, 26). Besides prevention of perforation, a pop and give can be felt on entry into the peritoneal space with a blunt tipped needle. In addition, a larger guide wire (0.035-inch) can be passed into the abdomen precluding the use of a micropuncture needle and wire.
Ultrasound guidance with a 10-15 MHz transducer has been used by Maya (10) and others (12) to gain safe access into the peritoneal cavity. Ultrasound measures the distance from the skin to the peritoneal cavity and color Doppler can locate the epigastric and hypogastric vessels. A skin incision followed by blunt dissection to the rectus sheath may not always be a necessary step before entry into the peritoneum. Maya has used ultrasound guidance to advance the micropuncture needle across skin, the subcutaneous tissue, the outer fascia of the rectus muscle, the muscle fibers, the inner fascia, and the parietal layer of peritoneum (10).

**Figure 2:** An 18 Gauge blunt needle is inserted through the rectus muscle and a 0.035-inch glide wire is then inserted through the needle.

![An 18 Gauge blunt needle is inserted through the rectus muscle and a 0.035-inch glide wire is then inserted through the needle.](image)

**Figure 3:** Course of the 0.035 inch wire introduced through the 18 Gauge needle noted under fluoroscopy.

**Figure 4:** Contrast injected through the 18 Gauge needle shows it outlining the bowel wall.

**Dilation, Catheter Placement, and Embedding of the Deeper Cuff:**
A 0.035-inch 150 cm long standard or stiff guide wire is passed through the 5-French catheter until sufficient guide wire forms a comfortable curve in the pelvis. Others have used a 0.038-inch with a 1.5 mm J-shaped end (7, 12). Dilators from 10F to 17F are advanced sequentially over the guide wire across the rectus sheath and muscle until the
final 18-French dilator with a peel-away sheath (Figures 5 and 6). The PD catheter is then either advanced over the guide wire or the guide wire is removed and the PD catheter is inserted over a metal stylet through the sheath. The radiopaque line on the PD catheter allows for confirmation of its position in the lower pelvis. The catheter can be rotated and moved at this point to ensure that the “pigtail” portion is located in the pelvis. Contrast can be injected into the catheter for better visualization. One liter of PD fluid is infused into the abdomen through the catheter to evaluate its function (Figure 7). Inflow should be rapid and pain free and outflow should be a fast drip or stream that increases with deep inspiration. The catheter can be repositioned until optimum function is achieved. The deeper cuff is buried in the rectus muscle with the use of the cuff pusher (9) or with a set of forceps with the peel-away sheath in place (10, 12). The peel-away sheath is split and removed once the deep cuff is in the rectus muscle. The cuff should be held in place when the peel-away sheath is removed to prevent its dislodgement. Some operators pass an absorbable suture through the deep cuff and the outer rectus sheath and subcutaneous tissues, and tie the suture once the cuff is buried in the rectus muscle to anchor the cuff (8, 25).

**Figure 5:** Dilators from 10F to 17F are advanced sequentially over the guide wire.

**Figure 6:** Fluoroscopic view of a catheter being advanced over a guide wire.

**Figure 7:** Contrast injected into the PD catheter for better visualization.
Exit Site and Superficial Cuff:
The exit site should be placed in a location on the abdomen so as to avoid the patient’s belt line. Various exit site locations are shown in Figure 8. Typically women have beltlines above the umbilicus whereas men below. The bent intercuff segment catheter (swan neck) is best suited for women as the exit site can be located in the lower abdomen and the straight intercuff segment catheter (straight) for men as the catheter can be bent slightly to emerge above the belt. Patients who are obese, have abdominal stomas, are incontinent of urine or feces, and who desire to take a deep tub bath would benefit from an extended catheter system that will allow for an exit site located in the upper abdomen or chest (28, 31).

Figure 8: Tenckhoff catheter modifications for a variety of exit sites (Reprinted with permission from reference 28)

After selecting the general location of the exit site (upper abdomen, lower abdomen, etc.), the specific location is selected by laying the catheter on the abdominal wall and marking a point 2-4 cm beyond the superficial cuff. Using local anesthesia, a stab wound is made such that the exit site would face downward. This prevents debris and fluids collecting in the exit site. A tunneling device or a Kelly clamp is inserted into the stab incision and tunneled into the subcutaneous tissues to engage or grasp the catheter tip and the catheter is pulled through the tunnel and out of the exit site (7, 9, 10, 26). The catheter can be embedded in the subcutaneous tissues if the patient does not require dialysis immediately. This technique was first described by Moncrief and subsequently modified by others (32, 33, 34). The technique described by Crabtree is the most straightforward (28). In brief, the catheter is brought out of a 1 cm long incision at the exit site and laid on the patient’s abdomen. A stab wound is made 0.5 cm beyond the tip of the
catheter and the catheter tunneled so that its tip lies within the tunnel. The 1 cm scar serves as the point at which the catheter will be exteriorized when needed.

**Closing the Wound:**
The subcutaneous tissue of the primary incision is closed with absorbable sutures and the skin is closed with non-absorbable sutures (9). The exit site should not be sutured as advocated by some authors (8), as this may cause an exit site infection. The two cuffs provide sufficient anchoring to prevent inadvertent falling out of the catheter. The catheter is flushed with saline and 7000 U of heparin are instilled in the catheter after the connectors are attached.

**Postoperative Management**
A small incision to access the peritoneal cavity and a minimally invasive technique offers the advantage of fast recovery. Patients are monitored post-operatively for a period of 2 to 6 hours and followed by the peritoneal dialysis nurse to resume peritoneal exchanges. A hemoglobin concentration is checked at 4 hours and if stable patients are discharged in some centers (10) whereas in others they are observed overnight (9).

In situations requiring immediate dialysis, low volume exchanges (≤1000 cc) can be started immediately after the catheter placement, preferably with the patient in the supine position, thereby avoiding placement of a central venous catheter and all its associated complications.

If there is no urgency to start dialysis immediately after the catheter insertion, the catheter should be accessed weekly after insertion with low volume peritoneal fluid. Full volume exchanges should be withheld for 2-3 weeks after the insertion to minimize the risk of pericatheter leak.

**Complications**
The major peri-operative complications of the fluoroscopic method are: bowel perforation, bladder perforation, early and late fluid leakage, peritonitis, exit site infections, catheter dysfunction, bleeding, muscle hematoma and death (Table 1).

Bowel and bladder perforation are rare with no bladder perforation reported by several authors and three bowel perforations mentioned of which one was a bowel puncture by the micropuncture needle, which was managed with retrieval of the needle, aborting of the procedure, and systemic antibiotic with good results (7, 10).

Early (2 weeks from implantation) peritonitis is rare and has been reported in two large series with less than a 3% complication rate (11, 12). Prophylactic antibiotics as mentioned in the pre-operative section help prevent infection in the first 30 days after catheter insertion. Late peritonitis (>30 days) is not linked to the implantation of the catheter.

Early fluid leak is more common in the surgically implanted catheters by laparoscopy or open laparotomy and very rare with the fluoroscopy technique. The leakage of dialysate fluid around the catheter has been reported from 8.6%
Fluoroscopic Placement of Peritoneal Dialysis Catheters

to 24% (35). The reason for minimal leakage with the latter technique is that the peritoneum is only punctured by an introducer or a needle without any incision of the peritoneum. Also, the inner cuff of the catheter is inserted into the abdominal wall musculature (rectus muscle) to prevent leaks. Usually PD is started between two to three weeks after placement of the catheter, to allow for wound healing and avoid leaks. Low-volume PD may be attempted within 24 hours of catheter placement, if no other dialysis access is available. The use of double cuffs, with the insertion of the inner cuff into the rectus muscle, and the swan-neck configuration of the peritoneal catheters has helped decreased the incidence of this complication.

Exit wound infection is low and is dependent on the local care after the implantation. The outer cuff is located in the subcutaneous tissue to create a dead space in between the two cuffs, which is believed to prevent migration of infections coming from the exit site. The subcutaneous tract and exit site face downward and laterally to avoid exit site infection. Three studies comparing the swan-neck and straight Tenckhoff catheters have demonstrated a similar rate for peritonitis and exit infection with the swan-neck design (36, 37, 38). A technique reported by Twardowsky, which modifies the Swan-Neck catheter to a pre-ternal exit site location, has shown an increase in access survival up to 95% at 2 years and also a decrease in peritonitis and exit wound infection (39). This technique is advocated to be performed in obese patients, patients with ostomies, children with diapers and fecal incontinence.

Arterial or venous bleeding with or without rectus muscle hematoma is also rare. The ultrasound technique has the advantage of visualizing the epigastric and hypogastric vessels under Doppler Color US, which helps avoiding these vessels.

Catheter dysfunction occurs most frequently weeks to months after the implantation. The intra-peritoneal portion of the catheter should be placed between the visceral and parietal peritoneum near the pouch of Douglas. The dysfunction is due to tip migration to the left or right upper quadrant from the pelvic area. Tip migration is a very common complication accounting for up to 35% by different authors, and is most commonly seen after surgical implantation (40). It usually causes problems with drainage of the PD fluid. This late complication can be managed by the use of laxatives, sometimes the surgical manipulation of the catheter or radiological intervention with the use of a Fogarty catheter (40, 41).

Comparison with Surgical Techniques

Surgeons mostly use laparoscopic and surgical techniques for PD catheter placement. These procedures require general anesthesia, sophisticated expensive equipment, and specialized training. Since there is a surgical opening of the peritoneum and abdominal wall, there is a tendency to leak and the peritoneal catheter therefore cannot be used for two to three weeks.

Interventional nephrologists favor either the peritoneoscopic or the fluoroscopic technique with or without the assistance of ultrasound. The former requires the purchase of expensive equipment (peritoneoscope) whereas the latter does not but requires an interventional suite to perform the procedure. Both are performed under conscious sedation and the catheter can be used almost immediately. These techniques are usually performed in an ambulatory setting, which benefits both patients and hospital. Patients can return home on the same day and
hospital expense is minimized. To be proficient, the interventionist has to master either one of the techniques. The direct visualization of the peritoneal cavity can be achieved by the peritoneoscopic technique, in contrast to indirect visualization is obtained by the fluoroscopic technique. Asif et al. have shown that the incorporation of PD catheter placement in the curriculum of an established interventional nephrology program increases the utilization of this dialysis modality (42). The success of catheter placement has increased from 95 to 100% using the fluoroscopic technique (Table 1).

<table>
<thead>
<tr>
<th>Author</th>
<th>Vaux</th>
<th>Moon</th>
<th>Reddy</th>
<th>Rosenthal</th>
<th>Jacobs</th>
<th>Zaman</th>
<th>Maya</th>
<th>Savader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheters</td>
<td>209</td>
<td>134</td>
<td>64</td>
<td>52</td>
<td>45</td>
<td>36</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>Success (%)</td>
<td>98</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>96</td>
<td>91</td>
<td>97</td>
<td>95</td>
</tr>
<tr>
<td>Complications:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bladder Perforation</td>
<td>0/200</td>
<td>0/134</td>
<td>0/64</td>
<td>NR</td>
<td>0/45</td>
<td>0/34</td>
<td>0/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Bowel Perforation</td>
<td>0/200</td>
<td>0/134</td>
<td>0/64</td>
<td>NR</td>
<td>2/45</td>
<td>0/34</td>
<td>1/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Early Leaks</td>
<td>10/200</td>
<td>0/134</td>
<td>1/64</td>
<td>2/52</td>
<td>3/45</td>
<td>1/34</td>
<td>0/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Exit Site Infection</td>
<td>13/200</td>
<td>11/134</td>
<td>0/64</td>
<td>1/52</td>
<td>NR</td>
<td>0/34</td>
<td>0/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Peritonitis</td>
<td>3/200</td>
<td>4/134</td>
<td>0/64</td>
<td>0/52</td>
<td>7/45</td>
<td>2/34</td>
<td>0/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Catheter Dysfunction</td>
<td>14/200</td>
<td>3/134</td>
<td>3/64</td>
<td>1/52</td>
<td>3/45</td>
<td>1/34</td>
<td>1/32</td>
<td>0/19</td>
</tr>
<tr>
<td>Bleeding</td>
<td>NR</td>
<td>1/134</td>
<td>4/64</td>
<td>1/52</td>
<td>3/45</td>
<td>1/34</td>
<td>0/32</td>
<td>0/19</td>
</tr>
</tbody>
</table>

Table 1: Success rate and complications of the fluoroscopic placement of PD catheters.

To our knowledge there is only one study in the literature comparing the complications and long-term survival of fluoroscopically-placed versus surgically-placed PD catheters. Rosenthal et al. reported that PD catheters placed percutaneously with fluoroscopy guidance is as safe as those placed by surgical technique and although the difference was not significant, the complication rate was lower in the fluoroscopic group (25).

References


