



New Surgical Technique for Peritoneal Dialysis Catheter Placement: Early Peritoneal Dialysis and Catheter Migration Prevention

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Abstract

Introduction: The technique for Peritoneal Dialysis (PD) catheter placement is essential to the success of the renal replacement therapy through peritoneal dialysis. Our technique can reduce dialysis failure by decreasing the risk of catheter complications.

Catheter type and design: There are several shapes of PD catheters including pigtail curled, straight, and swan neck. In our technique, we used the pigtail-curved catheter.

Technique of implantation and surgical technique: The preferred techniques are open surgical and laparoscopic due to their good initial results and safety. Our new open surgical technique provides the advantages of being done under local anesthesia, fast, small sized incision, and the early use of the catheter for dialysis with low risk of fluid leakage.

Complications: After the procedure, complications are defined as early if less than 30 days or late if more than 30 days. Early complications include bowel perforation, bleeding, wound infection, outflow failure, or leakage of the dialysate. Late complications involve outflow failure, cuff protrusion, tunnel or exit-site infection, and hernia or dialysate leaks.

Conclusion: The advantage of our open surgical technique is its simplicity and its ability to be operated under local anesthesia. It requires fewer skills, so it is easier for surgical residents. Postoperatively less dialysate leakage due to the closure of the peritoneum and the rectus sheaths. In addition, the suture fixation of the catheter to the retropubic peritoneum prevents kinking, catheter displacement, or occlusion of the catheter by the omentum.

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Introduction

The technique for Peritoneal Dialysis (PD) catheter placement is essential to the success of the renal replacement therapy through peritoneal dialysis. The first effective PD was done by Richard Ruben in 1959 and his patient lived for 6 months. In 1963, Fred Boen utilized a device to treat two patients with End-Stage Renal Disease (ESRD) [1,2]. Due to the early achievements with the peritoneal dialysis, several techniques and modifications were applied for catheter placement [3]. Peritoneal dialysis has several benefits over hemodialysis including lower mortality and preservation of residual renal function. It is also simple and provides excellent quality of life due to patient independence and mobility. PD has a drawback of fluid overload that could lead to poor blood pressure [4].

Our technique can reduce dialysis failure by decreasing the risk of catheter complications.

Catheter Type and Design

There are several shapes of PD catheters including pigtail curled, straight, and swan neck. They also differ in number and length of Dacron cuffs for the ultimate fixation and ingrowth. It involves a flexible silicone tube with several side holes and open-end port for better absorption and drainage of the dialysate [1,5]. There are either one or two Dacron cuffs in the extraperitoneal segment of the PD catheter. In the adult population, a double cuff is usually used with the proximal cuff placed in the preperitoneal space responsible for keeping the catheter in place and the distal one implanted in the subcutaneous tissue that acts as a barrier to infection [1,5]. The ideal location for the catheter tip is the pubic symphysis which is a reliable marker in the pelvis [1]. The type of catheter chosen is generally based on the surgeon's preference. An optimal PD catheter should permit for ideal



Figure 1: Insertion of the PD catheter through a small midline suprapubic incision (4 cm) with the exit site of the catheter on the left lateral abdominal wall.



Figure 2: Placement of the tip of the catheter deep in the pelvis.

inflow and outflow and have no effect on the physiology of the abdominal tissues. It also should be resistant to infection and kinking, and lastly affordable [5]. Straight and curled catheters have comparable performance and the technique of implantation is simple and minimally varies [5]. However, the curled catheters have several advantages with little catheter tip dislocation and less pain while fluid inflow into the abdomen [1,5]. In our technique, we used the pigtail-curved catheter.

Technique of Implantation

There are multiple techniques for the introduction of the peritoneal dialysis catheter into the abdomen. The preferred techniques are open surgical and laparoscopic due to their good initial results and safety [1]. The advantage of laparoscopic technique is performing partial omentectomy if needed or adhesiolysis during the initial catheter implantation. The least invasive is the percutaneous catheter insertion, but it increases the risk of bowel perforation and unsatisfactory catheter placement [1,6]. Randomized prospective studies indicate similar results of open surgically and laparoscopically placed PD catheters [7]. The traditional procedure is quicker than the laparoscopic one (14.3 vs. 21.9 min, $P < 0.0001$), but there is no variation in the early complication rate [7]. Laparoscopic technique allows immediate start of dialysis with decreased risk of fluid leakage and other laparoscopic procedures can be done simultaneously [8-10].

Patients needing peritoneal catheter for dialysis are usually



Figure 3: Tunneling of the retroperitoneal peritoneal lining on top of the catheter using two interrupted non-absorbable prolene sutures.

critically ill and sometimes contraindicated for them to have laparoscopic procedures that need general anesthesia. Our new open surgical technique provides the advantages of being done under local anesthesia, fast, small sized incision, and the early use of the catheter for dialysis with low risk of fluid leakage.

Surgical Technique

The patient is placed in the supine position. Local anesthesia is initiated, and the intravenous antibiotics are given. A vertical incision of ~4 cm is made in the midline (suprapubic). Then dissection till we reach the sheath of the rectus abdominis muscle. Then the muscle fibers are bluntly dissected, and the anterior rectus sheath opened. Afterward, 3 cm of the posterior sheath is opened followed by the peritoneum. The abdominal wall is evaluated for any adhesions. Subsequently, a retractor is used to elevate the anterior abdominal wall. Lysis of adhesions done if seen near the abdominal wall. A tunnel is established to the preferred exit site and attention should be retained to make sure that the exit site is facing downward. 2 cm away from the exit site, the distal cuff is positioned subcutaneously. The exit site of the catheter is situated on the left lateral abdominal wall (Figure 1). The patient is placed in a Trendelenburg position and the catheter is advanced deep into the pelvis (Figure 2). Tunneling of the retroperitoneal peritoneal lining on top of the catheter using 2 interrupted non-absorbable prolene sutures (Figure 3). The cuff is advanced to the preperitoneal space and the peritoneum is closed around it. The operation of the catheter is examined by loading the abdomen with 200cc saline and the entrance site is tested for leakage. Rectus sheaths are closed with resorbable sutures, making sure not to impede the catheter and to avoid dialysate leak. Another test done with saline and the site is checked for leakage. Drainage of the saline and checking for any hemoperitoneum or fecal contamination. After hemostasis, closure of the incision and no fixation needed for the catheter.

Complications

After the procedure, complications are defined as early if less than 30 days or late if more than 30 days. Early complications include bowel perforation, bleeding, wound infection, outflow failure, or leakage of the dialysate [1]. Outflow failure may be anticipated to malpositioning of the peritoneal dialysis catheter in the omentum or into the upper abdomen. Other causes include a kink in the tunnel that is placed subcutaneously or displacement of clots or fibrin in the catheter. Identification of dialysate leakage is through a bulge below the entrance site or drainage at the exit site. This may arise owing

to the positioning of the proximal cuff on the rectus muscle, or the presence of hernia at the entrance site, or trauma [11,12].

Late complications involve outflow failure, cuff protrusion, tunnel or exit-site infection, and hernia or dialysate leaks [1,11]. Constipation is the usual cause of outflow failure that is beyond 30 days after the surgery. This is usually resolved by using laxatives. Peritonitis is generally the consequence of infection from skin flora or gram-negative bacteria associated with diverticulitis or diarrhea. Intraperitoneal or systemic antibiotics are administered, and the exchange volumes decrease. Generally, peritonitis will resolve with proper antibiotic treatment. If the infection perseveres, catheter elimination and usage of hemodialysis for approximately 4 to 6 weeks is adequate for resolving the peritonitis [11,12].

Conclusion

The success of PD catheter for dialysis is reliant on the proper placement and a good knowledge of the implantation techniques and complications. Generally, the catheter type does not alter the result. The advantage of our open surgical technique is its simplicity and its ability to be operated under local anesthesia. Surgical residents who are acquainted with opening the abdomen can carry out the surgery. Adhesions close to the incision site can be clearly dissected close to the abdominal wall and need less skills than those in the laparoscopic setting. Postoperatively less dialysate leakage is seen due to the closure of the peritoneum and the rectus sheaths. In addition, the suture fixation of the catheter to the retropubic peritoneum prevents kinking, catheter displacement, or occlusion of the catheter by the omentum.

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