Peritoneal Dialysis Catheter Insertion

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The success of peritoneal dialysis as renal-replacement therapy depends on a well-functioning peritoneal catheter. Knowledge of best practices in catheter insertion can minimize the risk of catheter complications that lead to peritoneal dialysis failure. The catheter placement procedure begins with preoperative assessment of the patient to determine the most appropriate catheter type, insertion site, and exit site location. Preoperative preparation of the patient is an instrumental step in facilitating the performance of the procedure, avoiding untoward events, and promoting the desired outcome. Catheter insertion methods include percutaneous needle-guidewire with or without image guidance, open surgical dissection, peritoneoscopic procedure, and surgical laparoscopy. The insertion technique used often depends on the geographic availability of material resources and local provider expertise in placing catheters. Independent of the catheter implantation approach, adherence to a number of universal details is required to ensure the best opportunity for creating a successful long-term peritoneal access. Finally, appropriate postoperative care and catheter break-in enables a smooth transition to dialysis therapy.
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Reliable access to the peritoneal cavity is essential to the success of peritoneal dialysis (PD) as renal-replacement therapy. Peritoneal access is attained with a catheter device that traverses the abdominal wall to provide an avenue through which dialysis solutions can be exchanged. The two most common reasons for PD failure are infectious and mechanical complications of the catheter. Knowledge of best practices in catheter placement can minimize the risk of these complications and optimize the likelihood for successful therapy.

Selection of catheter devices and insertion techniques often varies depending on the geographic availability of material resources and local provider expertise in placing catheters. The discussion herein will focus on peritoneal access for the adult chronic renal failure patient, describing the most commonly used catheter types, matching the most appropriate device to the patient, placement methods, avoidance of procedure-related complications, postoperative care, and catheter break-in procedures (Figures 1 and 2).

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CATHETER TYPES

The most commonly used PD catheter types are shown in Figure 1. The standard double Dacron (polyester) cuff, straight- and coiled-tip Tenckhoff catheters, and their swan neck variants with a preformed arc bend in the intercuff segment comprise the core of PD access devices around the world (Figure 1A and B). The primary difference among these catheters is that the coiled-tip configuration and the preformed arc bend increase the cost of the device. No significant difference in functionality has been shown convincingly between straight- and coiled-tip catheters with or without a preformed arc bend.[1–10] The incidence of inflow discomfort is thought to be greater with straight-tip catheters because of the jet effect of the dialysate from the end hole of the catheter. Coiled-tip catheters are said to provide for better dispersion of the dialysate during inflow. However, these claims associated with catheter tip configuration have not been studied specifically; therefore, the effect of catheter-tip design on inflow pain remains speculative. Standard abdominal catheters can be inserted by any of the implantation methodologies.

Figure 2 depicts a PD catheter showing its relationship to abdominal wall structures. Catheters equipped with two cuffs provide better immobilization of the tubing within the abdominal wall. The deep cuff is best implanted in the muscle to provide for firm tissue ingrowth and fixation of the catheter. The superficial cuff is positioned in the subcutaneous tissues 2 to 4 cm from the exit site. A properly positioned superficial cuff serves as an effective barrier to entry of cutaneous debris and bacteria into the subcutaneous track and minimizes the piston-like motion of the catheter in and out through the exit site that can propel contaminants into the track.

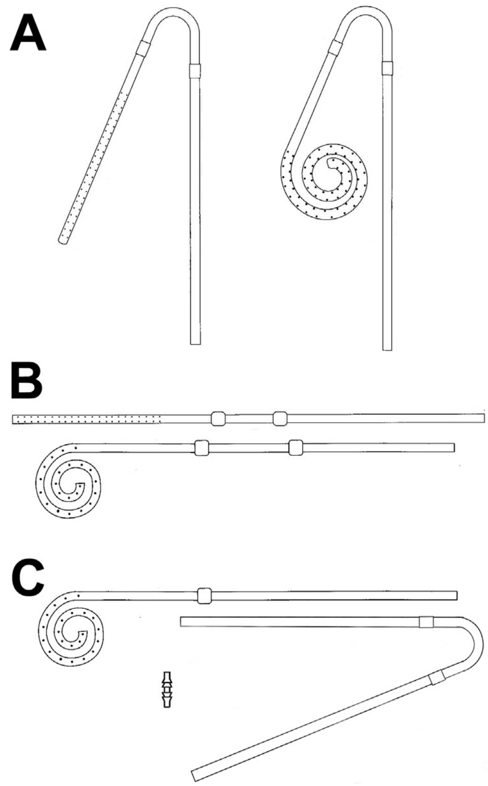

Figure 1. Commonly used peritoneal catheters are shown. (A) Tenckhoff catheters with preformed intercuff arc bend, two cuffs, and straight or coiled tips. (B) Tenckhoff catheters with straight intercuff segment, two cuffs, and straight or coiled tips. (C) Extended catheter with one-cuff, coiled-tip abdominal catheter, two-cuff extension catheter with preformed intercuff arc bend, and titanium double-barbed connector.

Extended two-piece catheters originally were designed to create a presternal exit site (Figure 1C). The extended catheter consists of a one-cuff abdominal catheter segment that attaches to a two-cuff subcutaneous extension segment using a double-barbed titanium connector to permit remote location of the exit site to the upper chest.[11] Extended catheters also are used to provide remote exit site locations to the upper abdominal and back regions.[12,13] The abdominal catheter can be placed by any insertion method. The subcutaneous extension catheter is implanted using a vascular tunneling rod or similar device supplied by the catheter manufacturer.

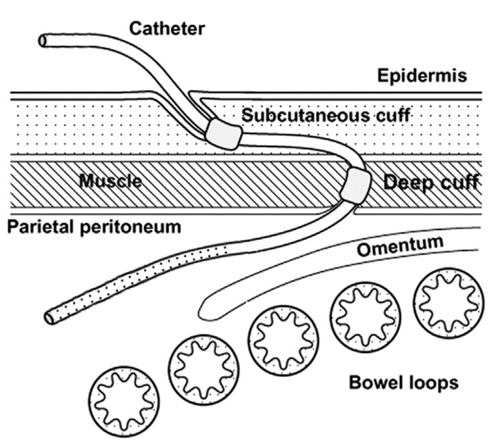

Figure 2. Schematic of a straight-tip Tenckhoff peritoneal catheter showing its proper relationship to adjacent anatomic structures.

Most currently manufactured chronic catheters possess a white radiopaque stripe along the longitudinal axis of the tubing that enables radiographic visualization. The stripe also can serve as a guide during catheter implantation to avoid accidental twisting or kinking of the catheter tubing.

Various modifications of the basic Tenckhoff catheter designs have been made to address the common mechanical problems of tissue attachment, tip migration, and pericatheter leaks.[14] However, none of these alternative configurations have been shown to outperform the standard Tenckhoff catheter design, but do increase the cost and difficulty of device insertion. Concerns for these common mechanical problems are addressed more reliably by proper insertion technique than by a catheter design.

CHOOSING A PD CATHETER

Choice of catheter type should take into consideration the patient's belt line, obesity, skin creases and folds, presence of scars, chronic skin conditions, incontinence, physical limitations, bathing habits, and occupation. The provider's familiarity with a basic inventory of catheter types is indispensable in enabling a customized peritoneal access that addresses the specific needs of the patient and affords maximum flexibility in exit site location. An exit site that is located in an environmentally hostile zone or in a position that the patient cannot easily see or take care of predisposes the exit site and tunnel to infection.

Figure 3 shows how a basic catheter inventory might be used. Patients with belt lines below the umbilicus generally are best matched with a catheter with a straight intercuff segment that is bent to produce a laterally directed exit site emerging above the belt line (Figure 3A). Patients with belt lines above the umbilicus often are best suited to a catheter with a preformed swan neck bend that allows the exit site to emerge below the belt line (Figure 3B). Individuals with large rotund abdomens, severe obesity, intestinal stomas, feeding tubes, suprapubic catheters, urinary or fecal incontinence, or a desire to take deep tub baths are candidates for extended two-piece catheters to produce upper abdominal or presternal exit sites (Figure 3C and D).

The correct catheter choice is the one that produces the best balance of pelvic location of the catheter tip, an exit site easily visible to the patient, and can be inserted through the abdominal wall with the least amount of tubing stress. The catheter insertion site is