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Peritoneal dialysis catheter placement technique

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Abstract:
Correct implantation of a peritoneal dialysis (PD) catheter, among many factors, is the main aspect of the success of this method of renal replacement therapy and the avoidance of complications associated with dialysis access and its mechanical function. There are many types of peritoneal catheters: a simple Tenckhoff catheter, a catheter with a coiled spiral-shaped intraperitoneal part of the coli type, a catheter with a curved extraperitoneal part of the swan-neck type, a self-positioning catheter, a pre-bridge catheter. The article describes implantation techniques for peritoneal dialysis (PD) catheters in renal replacement therapy. Complications associated with Tenckoff's catheter still cause significant morbidity and mortality, necessitating the transition to hemodialysis (HD) treatment.

Key words: peritoneal dialysis, tenckhoff catheter, catheter implantation

Introduction:

In 1959, Richard Ruben was the first to successfully use peritoneal dialysis in a patient with end-stage renal disease for six months. In 1968, Henry Tenckhoff developed a permanent peritoneal catheter, which was established in accordance with open surgical technique. It wasn't until 1970 that Popovich and Moncrief developed continuous outpatient peritoneal dialysis (CAPD) (1-2). The introduction of percutaneous and later laparoscopic techniques was an important step towards the implantation of peritoneal dialysis catheters (3). The method of implanting the catheter into the peritoneal cavity is one of the important elements of preparing the patient for renal replacement therapy by peritoneal dialysis (PD). It affects not only the early but also distant results of treatment (4). An ideal catheter should ensure proper dialysis fluid flow with as few complications as possible. Of course, the implant technique is of the greatest importance for its proper function. The procedure should meet all the requirements of a medical procedure: be safe for the patient and simple to perform. (5). The right time to start peritoneal dialysis is important. As a rule, it is 1-2 weeks after implantation of the catheter. However, in some situations it is possible to start dialysis immediately after catheter implantation. However, early start increases the risk of postoperative wound infection and scar hernia. Therefore, only absolute indications authorize immediate commencement of peritoneal dialysis (6).

Catheter type and design:

An important factor affecting the operation of the peritoneal catheter is the material from which it is made. Current catheters are made of silicone, which is a delicate, soft material ensuring long-term effective and safe use (5). Previous short-term catheters were made of polyurethane, which were associated with a greater risk of mechanical tissue damage including gastrointestinal perforation (7). The current catheters additionally have a radiological marker enabling trouble-free identification of their position by means of an x-ray image. Most often the intraperitoneal catheter consists of a twisted tube with numerous small holes at the end. Above this section, there is an distal cuff placed under the fascia and a proximal cuff that is part of the subcutaneous segment, which ends with the external opening of the catheter. Cuffs are dacron rings about 7 millimeters long surrounding the catheter, preventing the catheter from removing itself and sealing the implantation site (8). The most commonly used modifications are the Tenckhoff „pig coil" catheter with a spiral intraperitoneal section. Fig. 1.2. The differences in catheter design were to bring the golden mean to gain dialysis access. However, the studies did not show that any of the catheters had a clear advantage over the remaining ones especially in terms of infectious complications. The only proven difference is the advantage of double-cuffs catheters over single-cuff (9). However, it was found that it was very important to use appropriate protocols for implantation of catheters into the PD and to comply with accompanying procedures and recommendations. These include, inter alia, the prophylactic use of antibiotics prior to implantation, as recommended by ISPD (International Society for Peritoneal Dialysis) (10).

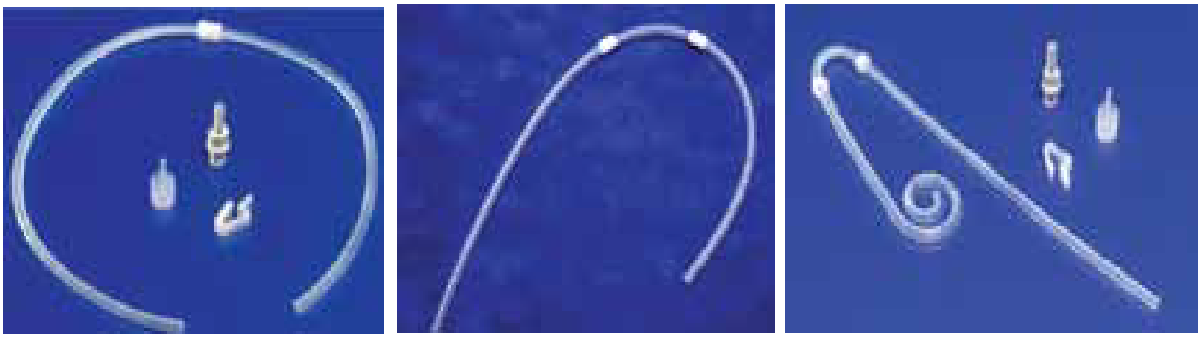


Fig. 1 Tenckhoff catheter types: one cuff catheter, two cuff catheter, pig coil catheter

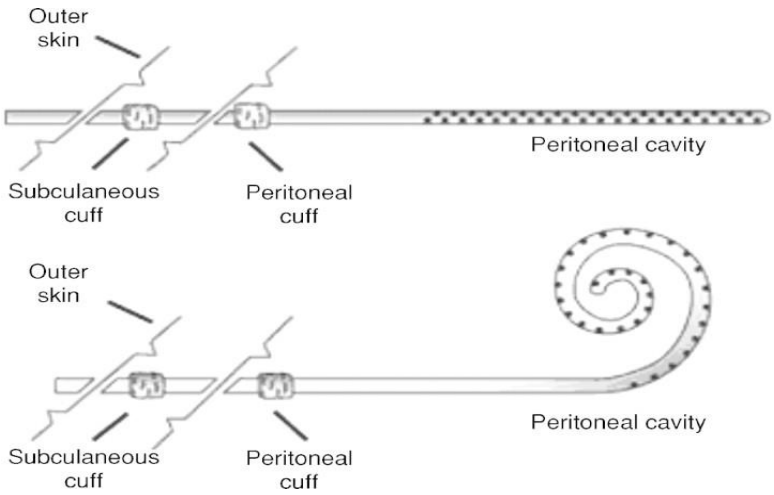


Fig. 2 Two-cuffed straight (top) and curled Tenckhoff catheter types.

Technique of implantation:

There are several techniques for introducing peritoneal dialysis (PD) catheters into the abdominal cavity. Open and laparoscopic surgical techniques are preferred because of their safety and good results after implantation. Laparoscopic technique is becoming more and more popular due to the possibility of releasing intraperitoneal adhesions during catheter implantation. The percutaneous method is associated with the risk of inaccurate catheter insertion and internal organ damage, and is only reserved for exceptional cases

Open surgical technique

In this technique, the patient is placed in a back position. After the introduction of general or local anesthesia and the administration of a prophylactic dose of antibiotics, a vertical incision is made about 3-5 cm in the medial line 2-3 cm below the umbilicus. Subcutaneous tissue is prepared reaching the anterior rectus sheath. The fascia is cut and the muscles stratified, reaching the posterior rectus sheath and peritoneum. Lifting the peritoneum puts the patient in the Trendelenburg position with the catheter on the mandrel inserted into the peritoneal cavity. The distal cuff will be placed under the first fascia sheet and the seams of the rectus abdominis are closed with single sutures. A tunnel is then made to the preferred location for the catheter exit. Most often it is to the right or left iliac pit. The exit site should be located below the peritoneal catheter insertion site and face down. The distal cuff is placed subcutaneously about 2-3 cm below the catheter mouth. After haemostasis, the incisions are

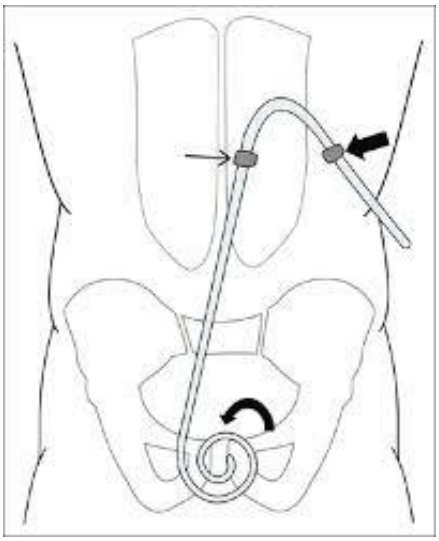
closed. The function of the catheter is checked by filling the peritoneal cavity with saline of approximately 100 ml. After a short while, the salt is dropped and checked for hematoma and fecal contamination (11-12).

Laparoscopic technique

In this technique, the patient is placed on his back. General anesthesia is introduced and a prophylactic dose of antibiotic is given. Peritoneal pneumothorax up to 12-14 mmHg is produced. Then a 5 mm trocar is inserted into the umbilicus and the optics are placed. The peritoneal cavity is fully inspected for intraperitoneal adhesions and other possible pathologies. An additional 5 mm trocar is inserted at the site of the intended external exit of the catheter PD. Peritoneal adhesions should be released. Then a small medial incision is made about 2-3 cm below the umbilicus. The subcutaneous tissue is dissected, the fascia of the rectus abdominis is cut and the muscle is dissected reaching the posterior rectus sheath and peritoneum. Now, using the guide, the catheter is inserted and placed under the eye control in the Douglasi cavum. Fig. 3 The distal cuff should be located between two sheath of the rectus abdominis muscle. A catheter is passed through the tunnel created between the place of introduction of the additional trocar and the place of implantation of the price list, leaving the proximal mandrin in adipose tissue. A catheter patency test is performed analogously to the open method and trocar places are closed (13).

Precutaneous technique

The Seldinger method is relatively simple, but requires cooperation with the patient during the procedure. The procedure can be performed under local anesthesia. It is also not required to perform the procedure in operating room conditions. A small incision is made at the catheter insertion site. An 18F needle is inserted and the peritoneal cavity is filled with 500 ml of saline. The patient should not feel pain when the needle is correctly positioned. The needle is then removed and a catheter is placed on a special delaminated mandrel. The catheter will be placed at the lowest point in the peritoneal cavity until the distal cuff is between the sheaths of the rectus abdominal muscle. Then the catheter is led out through the subcutaneous tunnel at the expected location. The catheter's function is checked by releasing the previously introduced saline (14).



Ryc. 3. Position of Tenckhoff catheter (small arrow position of distall cuff, thick arrow position of proximal cuff, bent arrow position of end of catheter).

Comparison of implantation techniques

Randomized studies show similar results for open and laparoscopic methods of inserting PD catheters. Fluid leakage is more common in patients after the traditional surgical method. The frequency of catheter migration and peritonitis occurs with the same frequency and does not exceed 10% (15). It can therefore be concluded that the laparoscopic method seems to be better. In addition, laparoscopic insertion of a PD catheter allows you to start dialysis immediately without fluid leakage. Another advantage of laparoscopy is the ability to simultaneously release adhesions (16) Both open and laparoscopic techniques can be used in patients who have a catheter for the first time and have not had abdominal surgery before, which could lead to catheter malfunction. After surgery, the laparoscopic method is preferred. The cause of catheter dysfunction can also be assessed during diagnostic laparoscopy. The percutaneous method is particularly suitable for patients who cannot tolerate general anesthesia (17).

Summary:

The correct course of peritoneal dialysis treatment depends on the proper implantation of the Tenckhoff catheter. Usually the type of cathetter does not affect the clinical effect. The advantage of the open technique is its simplicity and any surgeon who knows how to open the abdomen can do it. The advantage of laparoscopic technique is the ability to carefully control the peritoneal cavity and the ability to release adhesions. The biggest advantage of peritoneal dialysis is the ability of patients to lead an active lifestyle and no restrictions associated with hemodialysis. A multidisciplinary approach to the problem combining good patient qualification, correct catheter implantation and proper patient training definitely improves long-term peritoneal dialysis treatment results.

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