PREPERITONEAL TUNNELING – A NOVEL TECHNIQUE IN PERITONEAL DIALYSIS CATHETER INSERTION

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◆ **Introduction:** This study describes a new preperitoneal tunneling (PPT) method for inserting a peritoneal dialysis catheter (PDC), thereby lessening surgical complications and increasing the catheter's survival.

◆ **Methods:** This new technique was used in 23 cases from December 2005 to January 2007 and followed up until March 2011 (63 months). The procedure was performed laparoscopically under local (16 cases) or general (7 cases) anesthesia by one surgeon. Catheter survival is reported by Kaplan-Meier analysis.

◆ **Results:** The catheters were mechanically obstructed in 2/23 cases (8.7%); and were withdrawn due to a peritonitis in 2 cases and inadequacy of peritoneal dialysis in 1 case. Ten patients received kidney transplantation and six died before completing this follow-up period. The patients still reaped the benefits of the PDC until receiving a kidney transplant or death. The 5-year survival rate of the catheter was 89%. No incidence of catheter migration, omental wrapping, herniation or leakage was noticed.

◆ **Conclusion:** Preperitoneal tunneling is a simple and safe method for insertion of PDC, and can effectively prevent catheter migration, dislocation and omental wrapping.

The catheter problems regardless of placement technique are variable as 2 to 31% for flow dysfunction and catheter displacement (1,2) and 1 to 27% for pericatheter leak and hernia (3,4). The most common causes of catheter dysfunction are migration, fibrin clot and omental wrapping (5).

Insertion of PDC under direct visualization by laparoscopy affords a number of advantages including decreased operating time, less perioperative pain and fewer complications compared to an open surgical approach (6,7). Various laparoscopic techniques have been described for catheter placement to reduce complications and improve results (7–9). These efforts include rectus sheath tunneling, omentectomy, selective prophylactic omentopexy, catheter fixation by suturing and selective resection of epiploic appendices and adhesiolysis.

The aim of this study is to present a novel technique for laparoscopic placement of PDC through a preperitoneal tunnel which can reduce complications and improve catheter survival.

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Different types of surgical techniques for catheter placement have been developed, which include conventional surgical insertion, insertion under peritoneoscope, and radiologic insertion with fluoroscopy.

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PATIENTS AND METHODS

This project was designed as a prospective interventional study, approved by the Research Committee and financially supported by the Research Deputy of Mashhad University of Medical Sciences. To reduce ambiguous results, we excluded patients who had a possibility of existing abdominal adhesion due to several abdominal operations, intestinal or urinary ostomy, or severe coagulopathies. With their informed consent, the patients were systematically examined. From December 2005 to March 2007, 23 patients sequentially underwent laparoscopic operations for placement of the PPT technique. All the patients were followed up monthly until March 2011, death, renal transplantation or catheter removal.

OPERATIVE TECHNIQUE

Patients were placed in a supine position on the operating table. General anesthesia in some patients and local anesthesia in other patients was performed. Nasogastric tube and Foley catheter were inserted for patients under general anesthesia. Patients under local anesthesia were asked to void before starting the procedure. Pneumoperitoneum was established by using a Veress needle placed at the supraumbilical region. The abdomen was insufflated to 14 mmHg with carbon dioxide in patients under general anesthesia and to 10 mmHg in awake patients. Intravenous sedation was used only if needed. The insertion site was determined by placing the coiled section of the catheter parallel to the symphysis pubis and the exit point was marked on the skin. Then only one 5mm port was inserted for videoscopic monitoring through the right side of abdomen. The abdominal cavity was evaluated with 5mm, zero degree laparoscope (Karlstorz, Tuttlingen, Germany) for adhesions and hernia. In awake patients, a syringe containing anesthetic agent was entered at a point just lateral to the margin of right rectus muscle to reach the preperitoneal space and an anesthetic agent was injected through the preperitoneal space to the skin. A 10mm incision was made at the marked skin just lateral to the left margin of the rectus muscle. Under direct vision, the subcutaneous tissue and musculofascial planes were dissected by hemostat up to the preperitoneal space. Peritoneal puncturing can be avoided because of exact laparoscopic visualization.

The catheter on a guidewire was gently pushed forward through the incision toward the pelvis while moving right and left slightly to create a preperitoneal tunnel. Meanwhile, damage to the inferior epigastric vessel was to be avoided. The tunneling continued just after passing through the left medial umbilical ligament. At this point, the guidewire entered into the peritoneum and then the guidewire pulled back slightly and the coiled part of catheter pushed forward and directly into the true pelvis behind the bladder.

After placement of the coiled part into the retrovesical pouch, the guidewire was removed. Special care was taken to assure that all the holes and even a small part of hole-less segment of the catheter had been inserted inside the peritoneum (Figure 1).

Due to elasticity, it may be somewhat difficult to enter the guidewire and catheter into the peritoneum. Using excessive force was to be avoided at this stage as it may cause overshooting injury to the bladder and rectum.

The first cuff was to be in preperitoneal space, to bring the catheter out. Another cut in an appropriate place (lateral and distal to the catheter entering) was made

Figure 1 — A to B: preperitoneal course; B: passing behind medial umbilical ligament and entrance into the peritoneal cavity; C: crossing inferior epigastric vessels.

and the tip of the catheter pulled out using a clamp to place the second cuff 1.5 cm subcutaneously.

Eventually, laparoscopic evaluation was carried out for hematoma or any damage to the abdominal viscera and also to make sure that the catheter tip had been correctly inserted into the peritoneum inside the pelvis. Afterwards, the camera was removed and the abdomen was gradually deflated. Then the function was tested to ensure adequate inflow and outflow. The operation was completed only by skin repair (10).

RESULTS

From Dec. 2005 to Jan. 2007, 23 PD catheters were inserted for patients (12 men and 11 women) using PPT technique. All the catheters were double-cuff swan neck coil. Patients were in the range of 17 – 79 years old with the average of 45.7 ± 19.2 years. The average time interval between the operation and commencing peritoneal dialysis was 15.95 ± 4.2 days (range of 11 – 31 days). Local anesthesia was used for 16 patients and was tolerated well. There were no cases requiring switching to general anesthesia during operation. There were no perioperative complications in any of the patients. Flow of the fluid was also satisfactory in all patients after operation.

Catheter dysfunction was observed in only two patients, one and six months after the operation, resulting in catheter removal but no hematoma, catheter migration, port site hernia, leakage or the surgically important complications that occurred during follow-up for other patients. Follow-up lasted for 57 months and all the patients were monitored until removal of the catheter, renal transplant or death. The incidence rate of peritonitis was 1 episode

per 17.72 per month (0.68 episode/year); only 2 cases ended up in catheter removal due to resistance to antibiotics. Incidence rate of infection in the catheter exit site was 1 episode every 109 months (0.11 episode/year) and peritonitis did not occur in any of these patients. Ten patients (43.5%) were referred for kidney transplantation and the catheters were functional until transplantation. It was also fully-functional in 5 out of 6 patients who died during the follow-up period, and in the sixth patient peritoneal dialysis was never started due to gastric hemorrhage which occurred shortly after catheter insertion due to gastric bleeding. Inadequate PD due to ultrafiltration failure was the indication for catheter removal from another patient. Finally, the catheter remained fully functional in two patients through the follow-up period (51 and 57 months). Using the Kaplan-Meier test, the mean of the catheter's longevity was measured as 51.68 ± 3.57 months. As mentioned before, the five-year longevity rate was 89% (Figure 2).

DISCUSSION

Laparoscopic implantation of PDC reduces the rate of issues such as bleeding, damage to internal organs, incisional hernia, and catheter dysfunction. Direct vision into the peritoneum and performing interventions like repairing hernia, omentectomy, and adhesiolysis are also mentioned as the other advantages of this technique (11,12).

There is no significant difference in peritonitis, catheter displacement or technique failure comparing laparoscopy and laparotomy (13).

Various laparoscopic techniques have been adopted to achieve technique modification and solve complication problems. Rectus sheath tunneling maintains the pelvic orientation of the catheter tip by using a long musculofascial tunnel passage of the transmural segment of the catheter through the abdominal wall (14). Oblique tunneling through musculofascial layers reduces the risk of pericannular leak and hernia (14). Crabtree *et al.* (15) pass the catheter through a perpendicular passage as the short distance (4 – 6 cm) through the muscle. Soontraporanchai *et al.* (16) also tunneled the catheter through the rectus sheath and in addition they sutured the catheter to the pelvic peritoneum.

In our method, we created a tunnel just lateral to the rectus muscle. The rectus muscle was not involved in this procedure, which we believe reduces the possibility of trauma to the intramuscular vasculature, muscular pain and possibility of pressure on the catheter with patients' motion. Moreover, the long preperitoneal tunnel fixes the extraperitoneal catheter without suturing, which can

Figure 2 — Longevity of PD catheters.

make this technique more effective in preventing catheter migration and reducing omental wrapping. Keshvari *et al.* (16) introduced a modification of Crabtree's technique and the aim of their study was to describe outcomes of using N2O pneumoperitoneum with the patient under local anesthesia, but the length of the tunnel is the same.

The most similar technique to our method is Comert *et al.* (11), except for passing the catheter through the rectus muscle in their method. The length of the tunnel is similar to our method but they advanced the catheter toward the symphysis pubis, which we believe increases the possibility of catheter kinking. In our method, the catheter enters the pelvis laterally which can reduce this phenomenon. Additionally, we used one port (instead of two) without any instrumentation.

In our technique, only the coil tip of the catheter with holes and a few centimeters more of the proximal part were placed inside the peritoneum. Therefore, there was no need for intraperitoneal fixation, omentectomy or omentopexy. It was not necessary to release intra abdominal adhesions due to the preperitoneal course of the catheter.

The catheter survival was 89.9%, up until the end of the follow-up term which is comparable to the maximum reported survival rates in the other studies (17,18).

Catheter dysfunction after a laparoscopic approach is reported 12% (19) to 31% (20), which in some studies have been reported as low as 0%-4.6% (13,14), compared to 8.69% in our study.

In our study, catheter dysfunction only happened twice, but the patients did not agree to be investigated. However, based on our later experiences, it may have resulted from a fibrin clot or catheter entrapment inside the pelvis.

Reported incidence of port site hernia is 7 – 20% (20,21), which, however, did not occur in our patients.

The mean waiting period was two weeks and despite an earlier start, the leakage was 0% compared to 1.3%–13% reported incidence (12). Abdominal positive pressure seals the peritoneal tunnel and theoretically makes it possible to start dialysis immediately after insertion of catheter in this study.

CONCLUSION

PPT is effective in preventing catheter migration and there is also very low probability of omental wrapping, fluid leakage and hernia in the port site. There is no need for omentectomy and omentopexy, or releasing small intraperitoneal adhesions. Theoretically, dialysis can be started shortly after the operation. Therefore, the technique is recommended as a preferred method for PDC insertion.

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DISCLOSURE

The authors have no conflicts of interest to declare.

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