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Bulletin de la Dialyse à Domicile

Percutaneous insertion of peritoneal dialysis catheters by the nephrologist (modified Seldinger technique)

Insertion transcutanée de cathéters de dialyse péritonéale par le néphrologue (Technique de Seldinger modifiée)

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Résumé

Un accès fonctionnel à la cavité péritonéale est la première et principale exigence pour débuter une dialyse péritonéale. Le plus souvent, les cathéters de dialyse péritonéale sont implantés chirurgicalement. L'insertion d'un cathéter de dialyse péritonéale par laparoscopie est la technique chirurgicale recommandée car elle permet d'utiliser des procédures complémentaires élaborées qui minimisent le risque de complications mécaniques. Chez les patients présentant un faible risque de complications mécanique du cathéter, tels que les patients sans antécédent de chirurgie abdominale ou de péritonite, et chez les patients non éligibles à l'anesthésie générale, l'insertion transcutanée du cathéter de dialyse péritonéale par la technique de Seldinger est une alternative à l'approche chirurgicale. Elle peut être réalisée par un néphrologue dédié, un radiologue interventionnel, un chirurgien ou une infirmière praticienne sous anesthésie locale, avec ou sans guidage échographique ou fluoroscopique. Plusieurs rapports montrent des taux de fonctionnement des cathéters, taux de complications mécaniques et infectieuses et survie des cathéters similaires pour les cathéters de dialyse péritonéale insérés par voie percutanée par rapport à l'approche chirurgicale. Cet article décrit la technique d'insertion percutanée de cathéters de dialyse péritonéale adoptée à l'Universitair Ziekenhuis Brussel depuis 2015. Notre technique est une technique de Seldinger simple et modifiée, de faible technologie, réalisée par le néphrologue et n'utilisant pas de guidage fluoroscopique. Nous rapportons d'excellents résultats de nos cathéters de dialyse péritonéale insérés par voie percutanée et proposons un guide pratique pour mettre en place son propre programme d'insertion percutanées de cathéters.

Mots clés :insuffisance rénale chronique, dialyse péritonéale, cathéter de dialyse péritonéale, Seldinger

Summary

A proper functioning access to the peritoneal cavity is the first and foremost requirement to start peritoneal dialysis. Most commonly, peritoneal dialysis catheters are inserted using a surgical approach. Laparoscopic peritoneal dialysis catheter insertion is the recommended surgical technique because it offers to employ advanced adjunctive procedures that minimize the risk of mechanical complications. In patients with low risk of mechanical catheter complications, such as patients without prior history of abdominal surgery or peritonitis, and in patients ineligible for general anesthesia, the percutaneous approach of peritoneal dialysis catheter insertion is an alternative to surgical catheter insertion. Percutaneous insertion of peritoneal dialysis catheters can be performed by a dedicated nephrologist, interventional radiologist, surgeon or nurse practitioner under local anesthesia, either with or without image guidance using ultrasound or fluoroscopy. Several reports show similar catheter function rates, mechanical and infectious complications and catheter survival for percutaneously inserted peritoneal dialysis catheters compared to surgically inserted peritoneal dialysis catheters. This article describes the percutaneous insertion of peritoneal dialysis catheters technique adopted at Universitair Ziekenhuis Brussel since 2015. Our technique is a simple low-tech modified Seldinger procedure performed by the nephrologist and not using fluoroscopy guidance. We describe the excellent outcomes of our percutaneously inserted peritoneal dialysis catheters and offer a practical guide to set up your own percutaneous catheter insertion program.

Key words : kidney failure, peritoneal dialysis, peritoneal dialysis catheter, Seldinger

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OPTIONS FOR PERITONEAL DIALYSIS ACCES CREATION

The first condition to start peritoneal dialysis is having a working access to a functioning peritoneal cavity. Peritoneal dialysis catheters can be placed using a variety of surgical and percutaneous techniques, strategies that vary in technical complexity and required resources. According to the French Peritoneal Dialysis Registry (RDPLF), the vast majority of peritoneal dialysis catheters are inserted surgically (personal communication, 2021).

Advanced laparoscopic peritoneal dialysis catheter insertion, incorporating rectus sheath tunneling and adhesiolysis or prophylactic omentopexy, is associated with better outcomes in terms of catheter function compared to open or basic laparoscopic peritoneal dialysis catheter insertion[1]. Nevertheless, several reports showed similar catheter function rates, mechanical and infectious complications and catheter survival for percutaneously inserted peritoneal dialysis catheters compared to surgically inserted peritoneal dialysis catheters[2-12]. Therefore, the recent International Society of Peritoneal Dialysis (ISPD) guideline on creating and maintaining optimal peritoneal dialysis access suggests basing the peritoneal dialysis catheter insertion approach on patient characteristics, facility resources and operator expertise[13].

Percutaneous peritoneal dialysis catheter insertion is suggested for patients without major prior intra-abdominal surgery or peritonitis and is recommended for patients who are deemed ineligible for general anesthesia[13]. In this selected patient population, percutaneous insertion of peritoneal dialysis catheters offers a clinically- and cost-effective approach of dialysis access creation. This insertion strategy can be performed with or without image guidance by ultrasound or fluoroscopy. Important advantages for nephrologists performing peritoneal dialysis catheter insertions are better continuity of care and reduced waiting time given the need for operating room time is obviated. Several studies have suggested an increased uptake of peritoneal dialysis when nephrologists insert the catheter[14-15].

This article describes the methodology and outcomes of percutaneous insertion of peritoneal dialysis catheters at Universitair Ziekenhuis Brussel.

PERCUTANEOUS INSERTION OF PERITONEAL DIALYSIS CATHETERS AT UNIVERSITAIR ZIEKENHUIS BRUSSEL

At Universitair Ziekenhuis Brussel, percutaneous placement of peritoneal dialysis catheters is performed by a dedicated peritoneal dialysis nephrologist using a modified needle-guidewire Seldinger technique since June 2015. The procedure is performed bedside, in the dialysis or intensive care unit, under local anesthesia and low dose sedation (midazolam or propofol) and without image guidance by fluoroscopy.

Partient selection

Percutaneous insertion of a peritoneal dialysis catheter is offered to patients who have no prior history of abdominal surgery or severe peritonitis. We do not exclude patients based on waist circumference or BMI, but we assess the probability of interference of the truncal obesity with the procedure on a case-by-case basis. Indeed, abdominal obesity presenting with either an obese rotund abdomen or obesity with multiple skin folds hampers correct mapping and positioning of

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the catheter whenever our percutaneous subumbilical insertion strategy is applied.

Most often, the percutaneous approach of creating a peritoneal dialysis access is chosen for patients who require urgent or semi-urgent (peritoneal) dialysis initiation. According to the preference of the patient and the treating physician, a patient can also be scheduled for percutaneous peritoneal dialysis catheter insertion in case of a planned dialysis initiation.

Anticoagulant therapy is interrupted for the procedure. Preferably, patients are not taking more than a single antiplatelet drug. When patients are on dual antiplatelet therapy, its indication and risk-benefit of treatment interruption is evaluated.

At the time of procedure planning, insertion site and exit site location is assessed and defined by the interventional nephrologist. Prior to catheter insertion, the procedure and risks are explained, and informed consent is obtained.

Preparation of the patient prior to the procedure

The patient preparation is the same for the different peritoneal dialysis catheter insertion strategies. Routinely, the patient receives a 2L macrogol bowel preparation the evening before the procedure to avoid perioperative constipation. The patient is kept fasting overnight for the procedure and receives 1g intravenous Vancomycin 1-2 hours prior to catheter insertion.

We take precautions to avoid puncturing the bladder: before start of the procedure, the patient is asked to void and a post-void bladder volume is measured. In case of clinically significant post-void bladder volume and for patients performing intermittent self-catheterization of the bladder, an indwelling bladder catheter is inserted for the catheter insertion procedure.

The patient is preferably installed on a stretcher and not on a wider regular hospital bed to facilitate the procedure. Although the patient needs to stay supine during the procedure, the head can be lifted by 30° or more during preparation. Blood pressure, heart rate and oxygen saturation are monitored before and during the procedure. The patient and all personnel in the operating room have to wear a mouth-nose mask and a surgical cap.

The nurse prepares a perfusion stand with two 1L normal saline bags. If needed, the abdomen is shaved before disinfection with chlorhexidin digluconate 2% in 70% ethylalcohol. The interventional nephrologist and a second operator put on a sterile gown and sterile gloves. The operators prepare the instrumentation table, including a Veress needle which is a spring-loaded needle with an inner dull stylet and an outer sharp needle, and the dialysis catheter kit containing a Tenckhoff double-cuffed swan neck curled dialysis catheter, a guide wire and dilator with peel-away sheath. The dialysis catheter is soaked in normal saline to remove the air from the catheter cuffs prior to insertion. The two operators cover the patient with sterile drapes and disinfect the abdomen of the patient a second time. Before starting the procedure, the operators prepare the connection of a sterile Y-shaped infusion set to the two 1L saline bags.

Percutaneous insertion of the peritoneal dialysis catheter

At Universitair Ziekenhuis Brussel, the percutaneous insertion of the peritoneal dialysis catheter

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is performed under local anesthesia (lidocaine 2%) through a median infraumbilical incision of around 2 cm in length followed by blunt dissection onto the linea alba. Bleeding risk is low because there are no significant abdominal wall vessels in the infraumbilical region, in contrast to a paraumbilical incision where the inferior epigastric artery is located. After identification of the linea alba, the peritoneal cavity is punctured through the linea alba, the transversalis fascia and the parietal peritoneum using a Veress needle. This usually generates two dull clicks of the Veress needle: a first when the needle goes through the linea alba followed by a second when the transversalis fascia and the parietal peritoneum are punctured. The more inferior the puncture site, the larger the preperitoneal space between linea alba and parietal peritoneum is, hence, the higher the risk of ending up in the preperitoneal space.

Once the peritoneal space is punctured, intraperitoneal position is confirmed by injecting 10mL saline solution through the Veress needle. When smooth injection with immediate disappearance of the saline solution confirms intraperitoneal position of the Veress needle, it is connected to the infusion set and the abdomen is filled with 2L normal saline. This artificial ascites fills the retrovesical space, facilitating ideal positioning of the catheter tip. By experience, the infusion of the saline fluid should be smooth and steady with an infusion rate of at least 100mL/min. In case of a lower infusion rate, progressive decline in infusion rate or onset of lower abdominal pain, it is likely that the Veress needle is incorrectly positioned with the preperitoneal space being filled instead of the peritoneal cavity.

The generation of artificial ascites allows early detection of procedure-related intraabdominal complications such as blood vessel or bowel perforation. It will also allow to immediately and safely test catheter function later on during the procedure. During the filling of the abdomen, the peritoneal dialysis catheter is positioned onto the insertion stylet while paying attention to catheter orientation, i.e. the position of the radio opaque line and the direction of swan neck and catheter tip.

Once the abdomen is filled with 2 liters normal saline, the inner stylet of the Veress needle is removed. The risk of intraabdominal trauma by the outer needle is low in the setting of the artificial ascites. The removal of the inner stylet should be easy and without any resistance. If not, the tip of the needle is most likely positioned within fat tissue, omentum or other tissue and repositioning needs to be considered.

Once the inner stylet is removed, the outer needle is directed towards the pelvis and the guidewire is passed through the needle. Then, the needle is withdrawn and a dilator with overlying peel-away sheath is advanced over the guidewire. Keeping the peel-away sheath in the direction of the pelvis, the guidewire and dilator are removed and the catheter, straightened onto the insertion stylet, is inserted through the sheath towards the pelvis. Once the deep catheter cuff advances to the sheath, the sheath is peeled away. The deep cuff is then further advanced all the way up to the linea alba. When the stylet is removed from the catheter, the catheter needs to be clamped to avoid spill of the intraperitoneal fluid.

The dialysis catheter kit includes a plastic connector with luer lock. This connector piece is now mounted onto the catheter allowing drainage of the ascites using a sterile peritoneal dialysis drain bag. Once good outflow function is confirmed, outflow is stopped, the catheter is clamped and the connector piece is removed. Additional local anesthesia is provided at the level of the desired

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exit site and subcutaneous tunneling of the catheter to the selected exit site is performed using a tunneling stylet. Next, the titanium connector piece is mounted, and outflow of the catheter is again tested. Finally, the procedure ends by connecting the catheter extension line with roller clamp and by fully draining the abdomen. Sodium chloride 0.9% is an isotonic solution lacking a colloid osmotic agent. During dwell time, the fluid might be partially reabsorbed by the peritoneum preventing drainage of the instilled volume.

The incision site is sutured using two or three deep tissue absorbable 2-0 sutures, an intradermal skin suture and reinforced skin suture tape. A small absorbent dressing is applied onto the incision site and, upon our center's practices, gentamycin 0.1% cream is applied to the peritoneal dialysis catheter exit site and covered with an absorbent dressing. The dressings of both the exit and incision site are not opened for 7 to 10 days unless wet or bloody.

An overview of the procedural steps of the percutaneous insertion of a peritoneal dialysis catheter is shown in ***table 1 and figures 1-12***.

We have seldom performed a percutaneous insertion of a peritoneal dialysis catheter in patients presenting ascites in the setting of heart failure. It goes without saying that this clinical condition allows to avoid the time-consuming step of prefilling the abdomen with normal saline.

⬇ *Table I. Legend to table 1: procedural steps of our percutaneous peritoneal dialysis catheter insertion technique, including risks and clinical pearls*

Step	Action	Risk	Clinical pearls
1.	Local anesthesia infraumbilical midline using lidocaine 2% (Figure 1)	Allergic reaction to lidocaine 2%	
2.	Median infraumbilical incision of the skin using a scalpel (Figure 2)	Skin bleed	Check the ideal catheter position and catheter exit site prior to the procedure. As a general rule of thumb, the more superior (ie closer to the umbilicus) the deep cuff, the easier the procedure and the lesser risk of placing the catheter tip too deep in the pelvis.
3.	Blunt dissection onto the linea alba using a curved pean (Figures 3-4)	Low risk of bleeding	The larger the blunt dissection, the easier to get the deep cuff onto the linea alba afterwards
4.	Palpation of the linea alba using a fingertip	No specific risk	On the median, the linea alba ribble is (often) felt. This is where you should puncture the peritoneal cavity.
5.	Puncture of the peritoneal cavity using a Veress needle (Figure 5)	Extraperitoneal position of the needle tip	Make sure the Veress needle is closed before puncturing the abdomen to minimize infectious risks. Usually, you will hear 2 dull clicks from the Veress needle before arrival in the peritoneal space. Check the intraperitoneal position of the Veress needle by infusing 10 mL of normal saline. Injection should be without any resistance and the fluid should disappear quickly into the peritoneal cavity (Figure 6).
6.	Creation of an artificial ascites (Figure 7)	Preperitoneal infusion	Infusion speed should be steady throughout the infusion. In general, the infusion speed is around 100mL/min and 2L infusion has to be infused within 20-25 minutes. In case of lower infusion speed, consider the presence of preperitoneal infusion.
7.	Positioning of the peritoneal dialysis catheter on the insertion stylet		During the creation of the artificial ascites, the second operator prepares the peritoneal dialysis catheter onto the insertion stylet with special attention to the orientation of the radio-opaque line.
8.	Removal of the inner compartment of the Veress needle		If the decomposition of the Veress needle is difficult, consider intraperitoneal wrapping of the needle tip. Repositioning of the Veress needle might be warranted.
9.	Insertion of the guide wire (Figure 8)	Incorrect orientation; low risk of perforation	Ensure orientation of the tip of the Veress needle towards the pelvis
10.	Removal of the Veress needle		

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https://doi.org/10.25796/bdd.v4i4.63393
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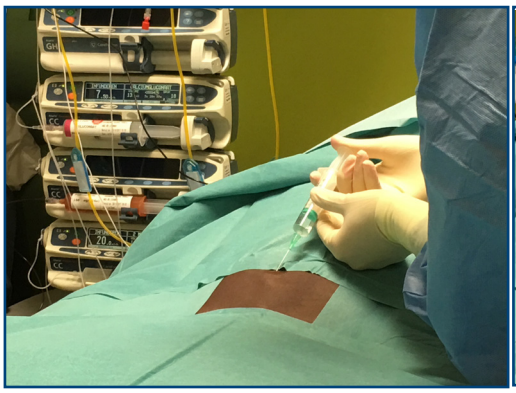
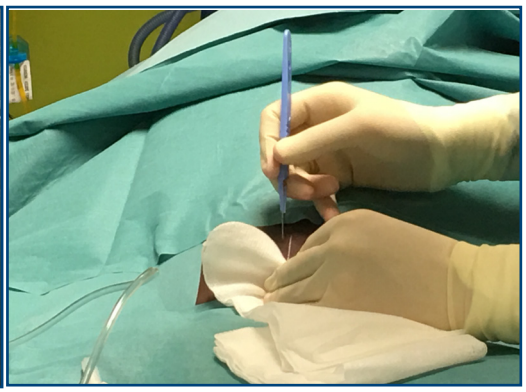
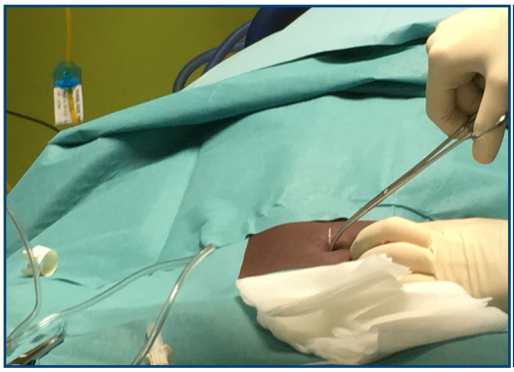
Step	Action	Risk	Clinical pearls
11.	Placement of the dilator with peel-away sheath over the guide wire (Figure 9)		Ensure that the dilator with peel-away sheath is oriented towards the pelvis.
12.	Removal of the guide wire and dilator		
13.	Insertion of the peritoneal dialysis catheter placed onto the insertion stylet (Figure 10)		Once the deep cuff reaches the peel-away dilator, peel the dilator while advancing the catheter further. The catheter has to be advanced until the deep cuff reaches the linea alba.
14.	Remove the insertion stylet and clamp the catheter		
15.	Place the temporary catheter connector that is included in the peritoneal dialysis catheter kit and connect the catheter to the peritoneal dialysis drain bag. Then, test the outflow function.		
16.	Local anesthesia using lidocaine 2% at the expected exit site and tunnel. Eventually, perform a dull dissection of the expected tunnel tract to create room for the swan neck of the catheter.	Allergic reaction to lidocaine 2%	
17.	Stop draining and clamp the catheter again. Remove the temporary connector and connect the catheter to the tunneling stylet. Tunnel the catheter. (Figures 11-12)		Ensure that no twisting of the catheter occurs during tunneling.
18.	Test catheter function prior to connecting the peritoneal dialysis catheter extension line using a titanium connector piece.		
19.	Connect the extension line to the peritoneal dialysis catheter and drain the abdomen until flow stops or drain pain.		
20.	Deep sutures of the incision and skin suture. Apply reinforced skin sutures to the incision and dressing to the incision and the exit site.	Bleeding and infection risk.	



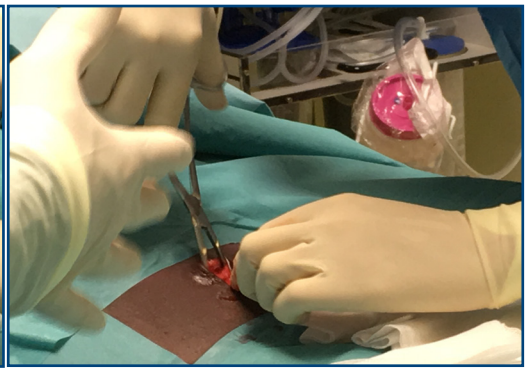
⬆ *Figure 1. Local anesthesia infraumbilical on the mid-line using lidocaine 2%*



⬆ *Figure 1. Median infraumbilical incision of the skin using a scalpel*



⬆ *Figure 3. Blunt dissection onto the linea alba using a curved pean*



⬆ *Figure 4. Blunt dissection onto the linea alba using a curved pean*

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https://doi.org/10.25796/bdd.v4i4.63393
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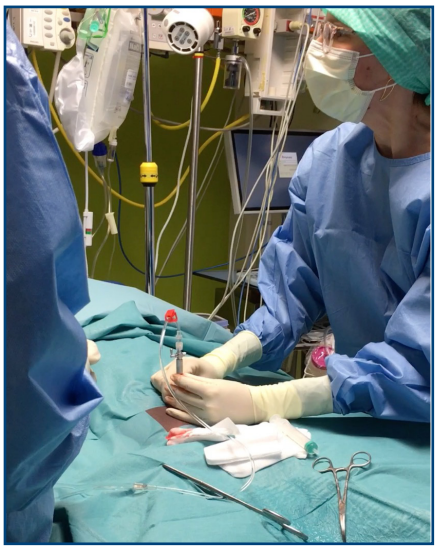
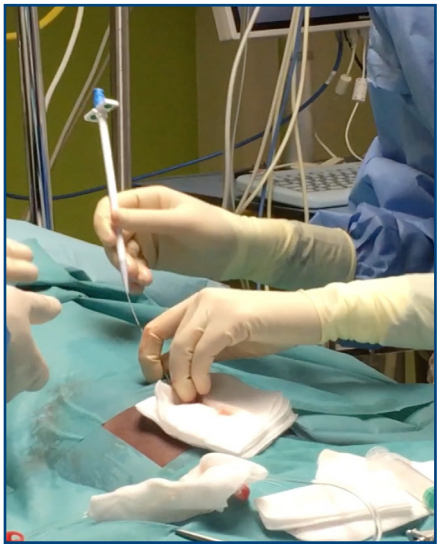
⬆ *Figure 5. Puncture of the peritoneal cavity using a Veress needle*

⬆ *Figure 6. Check the intraperitoneal position of the Veress needle by infusing 10 mL of normal saline. Injection should be without any resistance and the fluid should disappear quickly into the peritoneal cavity*

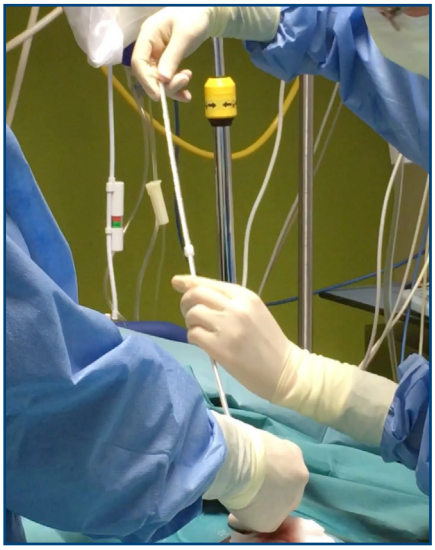


⬆ *Figure 7. Creation of an artificial ascites: filling of the abdomen with 2L normal saline*

⬆ *Figure 8. Insertion of the guide wire*



⬆ *Figure 9. Placement of the dilator with peel-away sheath over the guide wire*



⬆ *Figure 10. Insertion of the peritoneal dialysis catheter placed onto the insertion stylet*

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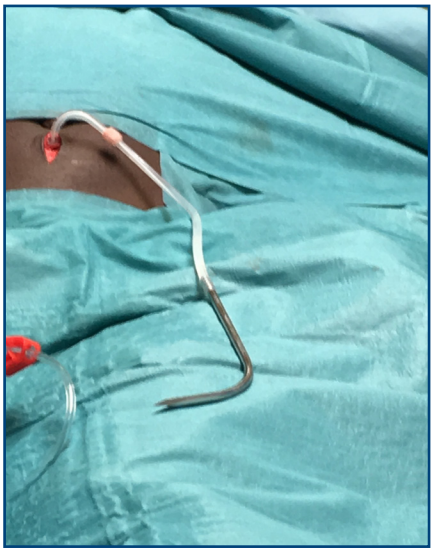
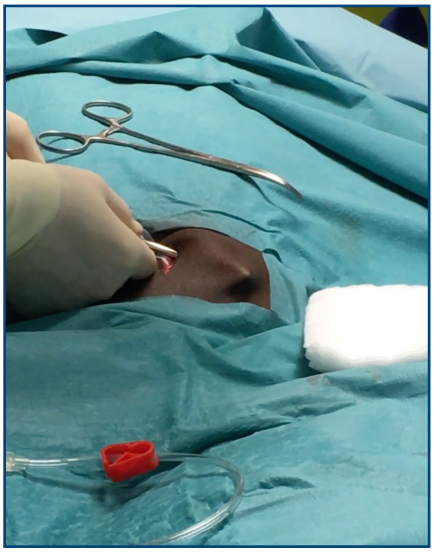
https://doi.org/10.25796/bdd.v4i4.63393
ISSN 2607-9917



⬆ *Figure 11. Connection of the catheter to the tunneling stylet*



⬆ *Figure 12. Tunneling of the catheter*

Postprocedure care and peritoneal dialysis start

The postintervention care does not differ between percutaneously inserted peritoneal dialysis catheters and surgically inserted catheters. When peritoneal dialysis is started urgently, defined as

a break-in period of less than 14 days, the precautions related to urgent start peritoneal dialysis need to be applied.

OUTCOMES AFTER PERCUTANEOUS PERITONEAL DIALYSIS CATHETER INSERTION AT UNIVERSITAIR ZIEKENHUIS BRUSSEL

At Universitair Ziekenhuis Brussel, an annual audit of peritoneal dialysis catheter insertion outcomes is performed according to the latest ISPD guidelines[13]. We primarily evaluate catheter patency at 12 months and overall catheter survival which is defined as no catheter removal, catheter replacement or the requirement for surgical or radiological intervention for flow dysfunction or irremediable drain pain. Other causes of catheter loss including patient, successful kidney transplant, transfer to hemodialysis because of inadequate dialysis, psychosocial reasons or medical problems, infection or peri catheter leakage, are censored within the catheter survival analysis, in line with ISPD audit recommendations. The presence of exit site or tunnel infection or peritonitis within 30 days of catheter insertion, the presence of procedure-related complications such as visceral injury or hemorrhage requiring transfusion or surgical intervention and peri catheter leaks up to 30 days of catheter insertion are also monitored.

Up till now, the percutaneous insertion of peritoneal dialysis catheters has been primarily performed for late referrals at our center. Since January 2015, 20 peritoneal dialysis catheters have been inserted percutaneously in 20 patients; in an additional patient, the procedure was interrupted before catheter insertion because of doubt on the intraperitoneal position of the Veress needle. In this case, catheter insertion strategy was shifted to a surgical approach. The 20 patients who underwent percutaneous peritoneal dialysis catheter insertion at UZ Brussel presented a length of 172±7 cm (range 155-185 cm) and a body weight of 69.8±15.3 kg (range 40-90.1 kg), represen-

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ting a body mass index of 23.8±5 kg/m2 (range 11.7-31.9 kg/m2).

Fifteen of the inserted catheters were implanted bedside in the dialysis unit, three in the intensive care unit and two in de operating theater because of increased bleeding risk and the availability of bipolar coagulation in the operating theater. The median age of the patients who got a peritoneal dialysis catheter inserted percutaneously was 62 years old (IQR 41-72; range 15-82). Four of these 20 patients did not start dialysis:
- 1 patient recovered renal function,
- 1 patient received a kidney transplant during the break-in period,
- 1 patient needed a peritoneal dialysis catheter insertion for draining ascites in the setting of cardiac amyloidosis and the fourth patient ultimately refused peritoneal dialysis during his training and transferred to hemodialysis.

The sixteen other patients started peritoneal dialysis after a median break-in period of 20 days (IQR 5-35; range 0-65). The median age of these 16 patients was 60 years old (IQR 39-69; range 15-82). At 3 months after insertion, 15 out of 16 catheters were functioning. One patient had a peritoneal dialysis catheter replacement in the context of a liver biopsy induced hemoperitoneum complicated with catheter obstruction by blood clots. According to the ISPD guidelines, this catheter loss is considered a censored event because the surgical intervention was secondary to the complicated liver biopsy. At 12 months after insertion, 8 additional catheter losses were censored: 3 patients were transplanted, 3 patients died, and 2 patients had catheter removal because of peritonitis 6 months and 9 months after initiating peritoneal dialysis respectively. Five catheters were functioning 12 months after insertion and the remaining two catheters were not yet 12 months implanted at the time of writing this manuscript, but functional 5 and 4 months after percutaneous insertion. None of the 16 patients that started peritoneal dialysis after the percutaneous insertion of a peritoneal dialysis catheter required a catheter removal or revision because of outflow obstruction or catheter migration. None of the patients presented exit site infection, tunnel infection or peritonitis 30 days after catheter insertion. None of the procedures was complicated with visceral injury, hemorrhage and no peri catheter leak occurred at 7 days, 14 days and 30 days after insertion.

The excellent functional outcomes of our percutaneously inserted peritoneal dialysis catheters and the lack of mechanical and infectious complication related to this procedure within our unit are in line with published result[2,5,10,14,15].

Among the set-up of a structured predialysis clinic, the use of presternal peritoneal dialysis catheters and an urgent start peritoneal dialysis program, the development of the percutaneous peritoneal dialysis catheter insertion technique has supported a significant growth of our peritoneal dialysis program from around 10 prevalent peritoneal dialysis patients in 2015 to 35-40 prevalent peritoneal dialysis patients nowadays.

PRACTICAL REQUIREMENTS TO START YOUR OWN PERCUTANEOUS PERITONEAL DIALYSIS INSERTION PROGRAM

In *table II* we provide a list of disposable and non-disposable material, medication and infrastructure needed to perform a percutaneous peritoneal dialysis catheter insertion.

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⬇ *Table II.*

Infrastructure: - quiet room - stretcher - monitor to observe blood pressure, heart rhythm and oxygen saturation - instrumentation table
Non-disposable material: - 1 Veress insufflation needle 120 mm (+ sterilization mesh box) - 1 kidney tray dish - 2 pean curved 160 mm - 1 pean straight 200 mm (to anchor infusion set) - 1 forceps - 1 needle holder - 1 mayo scissors - 1 stylet 62 cm (+ sterilization mesh box) - 1 tunneling stylet - titanium peritoneal dialysis catheter connector
Disposable material: - shaving material to remove body hair of the abdomen if applicable - masks, caps, gowns, sterile gloves - peripheral venous catheter in place - peritoneal dialysis catheter kit - sterile lubricant - infusion set with double Y-shaped infusion ports - peritoneal dialysis drain bag - sterile peritoneal dialysis clamp - sterile drapes (at UZ Brussel: 2x 150*175cm and 4x 75*75cm) - gauze 10x10 cm and 5x5 cm - 10 mL syringes, pull-up needles and injection needle for Lidocaïne - peritoneal dialysis extension line with roller clamp - dialysis catheter cap - absorbable suture 2-0 and 4-0 - reinforced skin suture tape - dressing tape - standard dextrose peritoneal dialysis solution in case postprocedure rinsing is indicated
Medication: - antibiotics for prophylaxis according to center practices (vancomycin, cefazolin) - midazolam or propofol for IV sedation - lidocaïne 2% for local anesthesia (20 mL) - normal saline 500 mL (for irrigation) - normal saline 2X 1L infusion bag - chlorhexidine disinfectant - antibiotic ointment for exit site care according to center practices

CONCLUSIONS

The percutaneous insertion of peritoneal dialysis catheters using the above-described blind Seldinger technique is a simple, safe and efficient strategy for peritoneal dialysis access creation in a selected patient population. Adopting this technique has shown to increase peritoneal dialysis uptake.

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