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Nephrology
Dialysis
Transplantation

3 Peritoneal access

Guidelines

A. Each centre should have a dedicated team involved in implantation and care of catheters.
(Evidence level A)

B. Each centre should analyse its catheter survival and complications: reasonable targets should include a catheter survival of >80% at 1 year and peritonitis rate of not more than one episode/24 patient-months.
(Evidence level C)

C. Whenever possible, the catheter insertion should be performed at least 2 weeks before starting peritoneal dialysis. Small dialysate volumes in the supine position can be used if dialysis is required during this period.
(Evidence level C)

D. Catheters should preferably be implanted operatively or by laparoscopy, but the Seldinger technique in selected cases can achieve comparable outcomes.
(Evidence level A/B)

E. Antibiotic prophylaxis should be done preoperatively.
(Evidence level A)

F. Post-implantation care should consist of aseptic management of the exit site during the healing phase. A dressing should be applied aiming for immobilization of the catheter to avoid trauma and bleeding in the exit site.
(Evidence level C)

G. The dressing should not be changed more than once a week during the first 2 weeks, unless bleeding occurs or infection is suspected.
(Evidence level C)

H. Both during the early post-implantation care and after the healing period, the exit site should be kept dry. Therefore, occlusive dressings should not be used. When dressings are used after the healing period, daily changes are recommended.
(Evidence level C)

I. Use of mupirocine or gentamicin cream at the exit site is recommended to reduce exit site infections.
(Evidence level A)

J. Exit site infections should be treated according to the guidelines of the International Society for Peritoneal Dialysis.
(Evidence level C)

Topical treatment should be applied in equivocal cases or as adjuvant therapy.
(Evidence level C)

K. Catheter removal for exit site infection should be considered (i) when a peritonitis episode with the same microorganism is present; (ii) if antibiotic treatment is unsuccessful; and (iii) in the case of recurrent exit site infections with the same organism.
(Evidence level C)

L. Mechanical complications, such as hernias, leakage and obstruction, should be managed according to the recommendations of the International Society for Peritoneal Dialysis.
(Evidence level C)

Commentary on Guideline 3: peritoneal access

Guideline A. PD team and type of catheter

Management of access is a key factor for the improvement of peritoneal dialysis (PD) technique survival. It requires the establishment of a dedicated team that should ideally consist of nephrologists, surgeons and nurses. Nowadays, laparoscopists or interventional radiologists may also be part of the team. The experience of the team is more important than the type of catheter and the implantation technique used.

Tenckhoff catheters are the most widely used catheters, also because other types have not consistently shown better results [1,2]. Double-cuffed catheters have been associated with a better catheter survival [3–5], a longer interval between implantation and the first peritonitis episode, and a reduced number of exit site complications in some studies [6,7]. However, a prospective randomized controlled study failed to establish such benefits [8]. Coiled catheters offer the theoretical advantage of better flow, less inflow pain, and less catheter migration, omental wrapping or risk of visceral trauma. These advantages were indeed found in one randomized controlled trial [9], but not in another one [10]. A downward-directed exit site was associated with lower peritonitis rates in early studies. This benefit is especially underlined by the encouraging reported results with permanently bent catheters ('Swan neck'): less exit site and tunnel infections, besides reduced incidence of cuff extrusion and pericatheter leakage, and better catheter survival [11]. These effects were also reported with

the pre-sternal Swan neck catheters [12]. However, other studies [13], including three level A trials [14–16], were unable to confirm the results of the previous studies.

Specific catheters may be chosen for certain patients, e.g. pre-sternal catheters for obese patients or those with colostomies.

Guideline B. Quality control

Recent reviews [17] report that the peritonitis rate has decreased and averages one infection per 25 patient-months. Catheter survival is also often reported to be superior to 80% at 1 year. Therefore, the aim should be to achieve these targets. It is desirable that each centre should develop a system of continuous treatment quality control, evaluation of outcome parameters and patient satisfaction.

Guideline C. Time of catheter insertion

The time between catheter insertion and continuous ambulatory peritoneal dialysis (CAPD) beginning, i.e. the break-in period, should preferably be at least 2 weeks to avoid early leakage. Immediate PD is however feasible, especially if the catheter was implanted with a peritoneoscope. In this case, intermittent automated dialysis with a low (1 l, for an adult patient) intraperitoneal volume should be prescribed.

Although rinsing the catheter with saline solution during its placement should be done to check for patency, post-operative lavage with peritoneal solution is not necessary and may even be irritating, promoting catheter displacement or obstruction. There is no consensus as to whether a peritoneal washing should be performed once per week during the break-in period, either with peritoneal solution or with heparinized solution. The Moncrief technique of catheter implantation, leaving the external catheter buried, subcutaneously, and therefore not in use until later exteriorization, has not shown an increased rate of catheter obstruction.

Guidelines D and E. Method of implantation and pre-operative prophylaxis

Catheter implantation can often be safely managed as an out-patient procedure, reducing the costs involved. Before catheter implantation, a careful examination of the abdominal wall should be done, to search for hernias and scars and to make an adequate choice of the placement of the exit site. Hernias should be corrected either before or at implantation. Pre-marking the catheter exit site with the patient in the sitting position will help to avoid the belt-line and fat folds. The patient should be instructed to empty their bladder before the catheter insertion. Local anaesthaesia with some intravenous sedation usually is sufficient for most catheter implantations, either in an out-patient procedure room or in a surgical theatre.

Regardless of the implantation technique, the placement of the catheter demands strict asepsis.

A minilaparotomy is the most widely used technique for implantation of the catheter. An experienced and skilled operator, either a physician or a surgeon, in a dedicated room, under sterile conditions, is required. To choose the localization of catheter placement, the left side is recommended because it avoids the caecum. Actually, the most usual procedure is a paramedian incision on the left side, with a trans-rectus dissection of the muscle. Blind implantation of a catheter using a Seldinger technique is also possible, but it should be avoided in obese patients and in those with previous abdominal surgery and suspected intra-abdominal adhesions, because of the risk of bowel perforation. However, in selected cases, bedside placement by the nephrologist has outcomes at least comparable with the surgical technique [18]. The Moncrief technique of leaving the external part of the catheter buried subcutaneously until PD is initiated has been associated with fewer infection episodes, but no increase in catheter survival [19,20]. A prospective randomized study of the effect of a subcutaneously 'buried' peritoneal catheter technique *vs* the standard technique showed no difference in the risk of contracting peritonitis or exit site infection [21]. A greater risk of seromas and haematomas has also been reported [22]. A number of studies have been published on laparoscopic catheter implantation [23,24], including randomized controlled trials [25–28]. The technique has been associated with a reduced number of exit site infections, a lower incidence of peritonitis, a decreased risk of leakage and an improved catheter survival, although the latter could not be confirmed in one study [25]. In addition, the laparoscopic technique enables the simultaneous correction of adhesions and hernias. One single-centre study reported no beneficial effect of the laparoscopic technique [28]. This underlines the importance of the experience obtained in every centre, and the impossibility of generalization.

Pre-operative antibiotic prophylaxis is recommended [2,29–31]. For all methods of chronic catheter placement, a first-generation cephalosporin, such as cefazoline 1 g, can be administered orally 1–2 h before or parenterally 30 min before the procedure. Alternatively, vancomycin 1 g intravenously can be used.

Guidelines F, G, H and I. Exit site care

Prophylaxis of access-related infections relies mainly on skilled peri-implantation care, high quality training and good exit site management. Aseptic management of the exit site during the healing phase, carried out by specially trained staff, avoids early infection and bacterial colonization of the access. For the same reason, that the dressing should be kept dry and be changed only once a week, during the early healing phase, except if bleeding, infection or wetness is suspected.

A number of studies have been published on various aspects of exit site care [2,32–39], but level A

evidence-based consensus on a specific protocol cannot be achieved. Povidone iodine and hydrogen peroxide have been recommended previously for cleaning the early exit site, but these agents are cytotoxic and will delay exit site healing. Therefore, these should be avoided in the fresh exit site sinus, and normal saline can be used preferably. Later, a non-ionic surfactant agent (such as 20% poloxamer 188, Shur-Clens®) and pure soap are possible alternatives for daily management, although one study [39] reported that povidone iodine was better than soap only for chronic exit site care.

Immobilization of the catheter with a dressing is also a mandatory procedure, especially during the healing phase, in order to avoid trauma and bleeding, a risk factor for exit site infection.

Before catheter implantation, nasal swabs to identify *Staphylococcus aureus* carriers and treat them with a course of intranasal mupirocine, twice daily for 5 days, are recommended [2].

For the maintenance care of the access, there is now sound evidence that mupirocine, either intranasally or as daily topical administration at the exit site, reduces the rate of *S.aureus* exit site and tunnel infections and *S.aureus* peritonitis [40–45]. Topical use at the exit site after its healing is preferable because it avoids repeated nasal swabs and courses of nasal treatment with consequent higher compliance, lower cost and wider efficacy. After its long-term use, resistance of *S.aureus* to mupirocine may occur [46,47], but this does not preclude the beneficial effect of regular prophylaxis. Moreover, mupirocine resistance in *S.aureus* carriers did not increase significantly after 7 years of routine prophylatic use [48]. The cost/benefit ratio is dependent on the incidence and morbidity of *S.aureus* infections in each individual centre [49,50]. Patients, who are at higher risk for *S.aureus* infections include nasal carriers of *S.aureus*, patients with diabetes mellitus and immunocompromised patients [40]. Spontaneous rupture of a polyurethane catheter associated with the use of mupirocine ointment, but not mupirocine cream, has been reported [51].

One recently published randomized double-blind trial of antibiotic exit site cream showed that gentamicin cream reduced *Pseudomonas aeruginosa* and Gram-negative catheter infections and peritonitis and showed a similar low rate of *S.aureus* exit site infections [52]. Microbiological resistance after its long-term use has not been investigated yet. Therefore, daily exit site application of mupirocine or gentamicin cream is recommended.

Guideline J. Exit site infections and catheter removal

Previous International Society for Peritoneal Dialysis (ISPD) guidelines on peritonitis and exit site infections [53] have been developed. After a swab of the purulent drainage is obtained, empiric therapy may be initiated immediately with an oral penicillinase-resistant penicillin derivative, cephalexin, or sulfamethoxazole trimethroprim. Adjustments can be considered depending on the sensitivity patterns of microorganisms in the unit. In slowly resolving *S.aureus* exit site infection, rifampin 300 mg twice daily should be added. Gram-negative organisms may be treated with oral quinolones such as ciprofloxacin 500 mg twice daily. If the organism is *P.aeruginosa*, intraperitoneal ceftazidime should be added. Treatment should be prolonged until the exit site appears completely normal.

Chronic exit site infections are difficult to treat with antibiotics. Shaving of the external cuff [54] or partial reimplantation of the external part of the catheter [55] may be considered. An ultrasound examination of the subcutaneous tunnel may diagnose an unsuspected tunnel infection [56,57]. Removal of the catheter should be considered when an exit site infection is associated with peritonitis, caused by the same microorganism, except for coagulase-negative staphylococci [58]. It is also indicated in relapsing or refractory peritonitis. A salvage adjuvant therapy with urokinase injected in the catheter after draining the peritoneal cavity has been successful in 29–67% of patients with recurrent peritonitis [59–61]; tissue plasminogen activator (tPA) is also effective [6 ml of tPA (1 mg/ml into the catheter for 2 h dwell time)] in conjunction to intraperitoneal antibiotic therapy [62,63].

Simultaneous catheter removal and insertion of a new catheter can be done in peritonitis with a tunnel infection and in cases of recurrent peritonitis, both caused by Gram-positive microorganisms. The dialysate leukocyte count should be $<100/mm^3$ before replacement [58]. It is not recommended in the presence of peritonitis with ongoing inflammation, an active infection, Gram-negative or fungal organisms, or when evidence of intra-abdominal adhesions is present [64,65]. It is advisable to use antibiotic coverage during catheter removal and reinsertion if it is being done for infectious reasons such as relapsing or recurrent peritonitis.

Guideline L. Mechanical complications

The recommendations of the ISPD [2] for mechanical complications should be followed. Early leakage usually needs a change in PD prescription to decrease intraperitoneal pressure, either with lower CAPD volumes or with intermittent peritoneal dialysis. However, depending on the degree of residual renal function, an interruption of PD or a temporary switch to haemodialysis is often needed. Considering catheter obstruction, conservative strategies such as body position change, laxatives or flushing with heparinized saline ('push-and-suck' manoeuvre) should be tried. Thrombolytic therapy with heparin (250–500 U/l in the instilled peritoneal solution), intra-catheter urokinase (75 000 IU diluted to 40 ml in 0.9% saline or 5000 U diluted to 40 ml in 0.9% saline) or tPA (1–2 mg) may be tried as well [66]. Streptokinase is less expensive but rarely may induce an anaphylactic reaction. Fluoroscopic-guided manipulation of malfunctioning straight catheters due to dislocation may be a rescue therapy in experienced hands, avoiding

surgery [67–71]. If a conservative approach fails, laparoscopy may be preferable to conventional surgical revision or replacement.

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