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Tunneled catheter care in hemodialysis — Gdańsk experiences

ABSTRACT

Properly maintained vascular access in hemodialysis is the basis for the well-being of the patient undergoing chronic dialysis. Invariably, for more than half a century, the best vascular access for hemodialysis has been the arteriovenous fistula. In exceptional situations, a tunneled catheter is an alternative to dialysis fistula. Dialysis catheter care determines the quality of hemodialysis and the patient's well-being. Professional care of the catheter consists of meticulous adherence to the principles of asepsis, prevention of infectious complications, and maintaining catheter patency. This article broadly describes important aspects of special dialysis catheter care supported by many years of nursing experience.

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Key words: dialysis nursing, modern anticoagulants, quality of nursing care, tunneled catheter

INTRODUCTION

Obtaining and maintaining vascular access for hemodialysis is a very serious challenge for almost every nursing team in a dialysis center. One of the reasons for this challenge is the high prevalence of comorbidities and the aging population of dialysis patients, which creats a serious obstacle to acessing appropriate blood vessels (veins) suitable for creating an arteriovenous fistula. Another limitation is the constant shortage of specialists (surgeons/internists) willing to help patients by creating arteriovenous fistulas. However, creating an arteriovenous fistula alone does not guarantee success. There is also a need for special preparation (strengthening) of the fistula for repeated puncturing. This requires knowledge and experience on the part of the nurse and the doctor to achieve the expected result. Sometimes a newly created fistula requires vascular correction, which delays its use in hemodialysis. An alternative to having a well-functioning arteriovenous fistula is a long-term (tunneled) catheter that can be used soon after insertion. Many dialysis centers prefer this type of vascular access instead of creating an arteriovenous fistula. The long-awaited standard of care in nephrology nursing [1] defines, among other things, the basic principles for the use of a dialysis catheter but does not standardize operating procedures in more complicated situations. Despite many years of advance in nephrology nursing, no uniform or clear recommendations regarding long-term dialysis catheter care have been defined so far. This publication presents detailed information on the principles of tunneled catheter care based on the considerable experience gathered at the Gdańsk center.

SOME HISTORY

Vascular access has been a serious limiting factor in the development of hemodialysis treatment since its beginning. The first use of a dialysis catheter prototype dates back to 1961. Stanley Shaldon gained vascular access by inserting a hand-made catheter into the femoral vein and femoral artery, which allowed immediate hemodialysis. In the following years, further attempts were made to insert dialysis catheters into two separate blood vessels. The biggest problem was the safe, long-term maintenance of such a catheter inside a vessel; therefore, separate venous and arterial catheters had to be inserted each time before hemodialysis. This caused multiple complications in the form of hematomas and stenoses. For this reason, the widespread use

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of dialysis catheters was abandoned. At the same time, first attempts were made to create an external arteriovenous fistula. This procedure was done by Scribner (1960) and then by Brescia, Cimino, Appel, and Hurwich (1965). No alternative vascular access for hemodialysis was developed for the following 20 years. As late as the mid 1980s tunneled catheters with a Dacron cuff were developed and introduced, which enabled the catheter to be fixed inside the vessel, and, thus, protected the patient against infections. This type of catheter partially replaced the arteriovenous fistula and became a much more durable, convenient, and safe solution compared to temporary catheters. Currently, about 30% of hemodialysis patients in Poland have a patent hemodialysis fistula; the remaining patients undergo dialysis with the use of a tunneled catheter.

CONDITIONS FOR SAFE DIALYSIS CATHETER INSERTION

The procedure for hemodialysis catheter insertion (central vein catheter, CVC) is not difficult and is performed by both anesthesiologists and nephrologists. The procedure must be performed by an experienced specialist. The first problem that usually arises is the correct identification of the blood vessel and placement of the catheter. Despite multiple known methods of locating vessels to ensure effective cannulation, vessel assessment using ultrasonography (USG) has become standard [2, 3]. This is most commonly due to multiple past catheterizations in many patients, which means an increased risk of vascular abnormalities, stenoses, or past thrombosis. Using special probes, USG enables evaluation of vessels before and during the procedure. However, the limitations of this imaging method are its inability to assess deep veins and poor assessment of subclavian veins. It is worth noting that the right internal jugular vein is the first choice for cannulation, followed by the left internal jugular vein, then subclavian and femoral veins. At the same time, translumbar access is an interesting alternative. The procedure of catheter insertion is significantly more difficult but gives very good results. So far, this technique has been rarely used and is not popular. Catheter insertion is performed using the Seldinger method or its modifications. The peel-away sheath system is currently very popular and enables the insertion of a catheter without the risk of damaging it. In addition, this method minimizes the risk of bleeding. It is important to position the guidewire correctly. Numerous and insufficiently careful maneuvers might damage the vein, and the guidewire may become bent, looped, or inserted into a different, smaller vessel. The insertion of the guidewire should be done under the guidance of X-ray fluoroscopy [3]. Another method of monitoring the guidewire position is electrocardiography (ECG), although it is not recommended by everyone [4]. An X-ray scan is necessary after the insertion of a catheter into a vein. Incorrect position of the catheter may lead to vascular perforation, thrombosis, and catheter malfunction. The correct placement of a CVC tip is the right atrium. It should be considered whether the location is comfortable for the patient; the catheter lumens cause discomfort or increase infection risk, or even hinder regular physical activity. The sutures around the CVC should be maintained until the Dacron cuff supporting the catheter has healed (4 to 6 weeks). There is no need for permanent stitches.

RISK OF CATHETER-ASSOCIATED INFECTIONS

Before each patient's hemodialysis procedure, the dressing should be assessed for cleanliness, and catheter channels should be checked for any clamps, clips, or plugs. The next stage is to check the efficiency (patency) of the catheter. This initial assessment sets the stage for further risk management in terms of catheter-related infections. Taking a short medical history from a patient (before each dialysis) particularly symptoms that might indicate a potential infection is a very important aspect of catheter infection prevention. The task of dialysis nurses is early detection of symptoms of ongoing inflammation as well as signs of catheter malfunction that could precede infections and thrombotic complications. Table 1 contains practical guidelines on history taking and observation for the detection of catheter-associated infections. The aseptic non-touch technique (ANTT) is a requirement for catheter infection prevention, and it means performing activities related to vascular access, surgical wound, or urinary catheters in a way that prevents the introduction of microorganisms into sterile and infection-prone places. This specific method of touching sensitive places (Fig. 1–3) at risk of microbial exposure enables the elimination of infections transmitted directly by medical personnel. The use of ANTT is especially

Table 1. Elements of physical examination – prevention of catheter-associated infection (own proposal)

Area	Scope of medical history and/or observations
Patient's well-being	• pain around the catheter/tunnel • chills and/or fever
Catheter exit site	• tenderness • redness • swelling around the exit site • redness around the sutures • serous or purulent effusion from the exit site
Dressing/ /catheter condition	• soiled dressing or no dressing • difficult aspiration of medicinal product from one or both channels • no cap/caps on channel ends

Figure 1. Aspiration of a pharmacological agent from the catheter lumen

important during the connection, adjustment, and disconnection of the patient from the hemodialysis machine. In the prevention of catheter-related infections, special attention is paid to the dressings around the catheter. A change of dressing is recommended before every procedure, as described in Table 2.

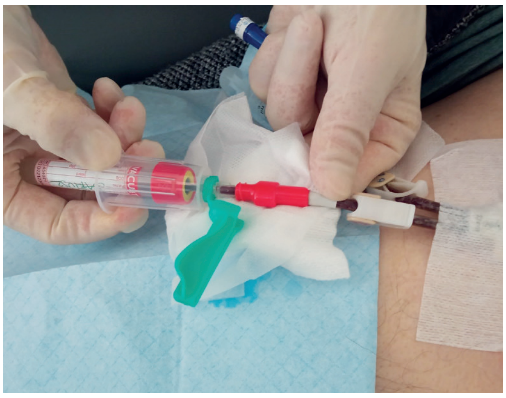

Figure 2. Blood sampling from a catheter

CATHETER DYSFUNCTION AND PROBLEMS WITH MAINTAINING ITS POTENCY

The National Kidney Foundation (KDOQI) defines vascular access (CVC) dysfunction as the inability to achieve or maintain blood flow through the pump (QB) above 300 mL/min in the first 60 minutes of dialysis with arterial blood pressure lower than 250 mmHg and blood recirculation above 10%. Therefore, a careful assessment of catheter function is necessary during each dialysis [5]. The priority in catheter care is undoubtedly to maintain optimal patency with blood flow in each channel at least 250–300 mL/min. Channel patency determines the quality of the procedure and, thus, the patient's well-being. The dysfunction of a catheter due to the formation of fibrin clots can lead to catheter-related infections. The most common cause of catheter malfunction includes intracatheter or pericatheter thrombosis, which account for 30–40% of cases of vascular access failure. The direct cause of thrombus formation is the catheter itself — a foreign body made of plastic. The internal vein walls are irritated by the presence of a large-diameter catheter, leading to an increased risk of occlusion and coagulation. The process of intravascular coagulation in patients with chronic kidney failure is quite complex and based on deficiencies in antithrombin III, proteins C and S, as well as increased levels of factor VIII and homocysteine and the presence of anticardiolipin antibodies and lupus anticoagulant in approximately 30% of patients (thus more commonly than in the general population) [6]. Moreover, in contact with the dialysis membrane, these patients' platelets show excessive activation. The coagulation cascade also has a complex association with reduction of vasodilating potential factors

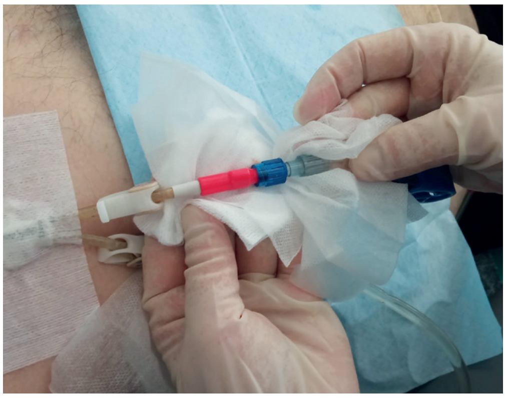

Figure 3. Connecting a patient with a catheter

Table 2. Change of dressing around the dialysis catheter (own proposal)

1. Provide the patient with information about the planned procedure and ensure the patient is resting in a comfortable position. Take medical history for the presence of symptoms indicative of complications with the hemodialysis vascular catheter (pain, heat, discharge, displacement, or damage).
2. Change the dressing around the exit site of a vascular catheter for hemodialysis.
   - Disinfect your hands before performing any procedures around vascular access for hemodialysis.
   - Dressing change should be performed in a treatment or surgical dressing room.
   - Disinfect the worktop.
   - Prepare a sterile drape on the clean worktop next to the patient; using the aseptic technique, lay out sterile dry swabs, swabs soaked in an alcohol solution containing chlorhexidine intended for disinfection of distal parts of the catheter, a sterile towel, and an appropriate dressing (without packaging) for fixing and securing the catheter exit site.
   - Put on a surgical mask (nurse and patient).
   - Disinfect your hands. Put on disposable, non-sterile gloves.
   - Remove the old dressing, and visually assess the catheter exit site and the catheter fixation.
   - Remove non-sterile gloves, place them in medical waste, and disinfect your hands.
   - Put on sterile gloves.
   - Disinfect the exit site by wiping, starting from the center, and moving the swab in a single half-turn motion. **Warning! Rule: One move, one swab**. Repeat after disinfecting the area, extending beyond the intended area of dressing.
   - The skin should always be disinfected by wiping, bearing in mind the amount of time the manufacturer recommends for the product to completely dry out.
   - Clean the catheter using the swabs soaked in alcohol and chlorhexidine, including the ports, hubs, caps, and other difficult-to-reach places.
   - Apply a new sterile dressing to the dry skin in a way that protects all sensitive places (exit area, sutures, etc.).
   - Tidy up the worktop.
   - After the procedure is completed, remove the gloves, surgical gown, and mask from your and the patient's face. Dispose of medical waste appropriately. Disinfect the worktop.
   - Disinfect your hands.
3. Document the procedure performed.

and increase in pro-inflammatory and pro-aggregation activity, as well as dysfunction of endothelial cells of varying severity. This overly complicated synergy is reflected in endothelial activation and increased concentration of von

Table 3. Restoring catheter patency using TauroLock™-U25.000

1. Flush the catheter channel with 10 ml of saline solution.
2. Dissolve urokinase by adding 5 ml of TauroLock™ to the vial (using a suitable needle) and withdraw the clear solution of TauroLock™-U25.000 from the vial using a proper syringe. The reconstituted solution has to be used immediately.
3. Instill the TauroLock™-U25.000 solution slowly into the catheter/port lumen (not more than 1 mL/s; for infants and children under 2 years of age, not more than 1 ml per 5 seconds) in quantity sufficient for the system used. Consult the manufacturer's instructions for the specific fill volume or specify the fill volume during implantation. The instruction regarding the volume has to be strictly respected. TauroLock™-U25.000 remains inside the access device until the next treatment (for a maximum of 30 days).
4. Before the next treatment, TauroLock™-U25.000 must be aspirated from all catheter channels and discarded according to the center's policy for infectious waste disposal.
5. As the last step, flush all catheter channels with 10 mL of saline.

Willebrand factor, tissue plasminogen activator (t-PA), together with its type 1 inhibitor, and increased expression of adhesion molecules. The consequence of t these changes is increased adhesion and aggregation of leukocytes and platelets, activation of the local and systemic pro-inflammatory response, as well as increased prothrombotic readiness. CVC dysfunction associated with impeded patency is a very strong predictor of catheter-related infections. If CVC function is impaired, thrombolytic therapy should be introduced, and later a change to the anticoagulant to another treatment should be considered. Urokinase has been a well-known and established drug of choice to restore CVC patency for many years. Currently, a preparation consisting of several drugs, including urokinase, is widely available. Table 3 shows how the treatment is used.

CATHETER-ASSOCIATED INFECTIONS

Each infection weakens the patient, lowering their quality of life and functioning. In addition to cardiovascular events, infections in dialysis patients are the leading cause of death among patients with end-stage renal disease. Catheters, including tunneled catheters, are an independent infection risk factor in dialysis patients [9]. The relative risk of bacteremia is many times higher in end-stage renal disease in patients with vascular catheters than in end-stage renal disease in patients with arteriovenous fistulas [10]. The risk of death associated with catheter-related bloodstream infections (CRBSI) is 1.5–2 times higher in patients with tunneled catheters than in patients with arteriovenous fistulas, while mortality associated with such an infection can be as high as 25%. The pathogens that cause CRBSI are skin bacteria (*Staphylococcus epidermidis coagulase-negative, Enterococcus, Staphylococcus aureus*) that live around the exit site or come from colonized clothing or are transmitted by medical staff. Attention should be paid to an unusual pro-inflammatory reaction in hemodialysis patients and, thus, the absence of obvious signs of infection. This is due to their weakened immune system. Leukopenia occurs in the initial stage of hemodialysis. The complement cascade leads to neutrophile activation and increased adhesion to the pulmonary endometrium, ultimately resulting in hypoxia. This complex reaction impairs neutrophiles' ability for phagocytosis and oxidative metabolism and reduces their ability to kill microorganisms. Despite the efforts of the nephrology nursing community, a uniform procedure for the prevention of catheter-associated infections has not yet been established. This creates a lot of controversies and negatively affects the quality of catheter care. Due to the frequency of CRBSI, it is reasonable to periodically (once every 4 weeks) draw blood and test for catheter and peripheral bacteremia. This type of procedure creates a chance for the early detection of infection and effective antibiotic therapy. Nursing experience shows that in dialysis centers, it is necessary to develop written standards for handling the dialysis catheter, including the proper use of aseptic techniques during catheter adjustment. Frequent training of staff on the importance of routine hand hygiene before and after patient contact is also important.

PRACTICAL GUIDELINES FOR USING AND MAINTAINING A TUNNELED CATHETER

A tunneled catheter should only be used for dialysis purposes. Only in exceptional life-saving situations can a catheter be used for drug delivery or blood collection by authorized staff, i.e., medical personnel able to properly operate this type of vascular access. It is important to protect the catheter channels against infection during their adjustments related to catheter insertion. In cases like this, it is necessary to create optimal conditions limiting the transfer of pathogens from the environment and hands of the staff. A key element of catheter care is the ability to handle sterile material and use of ANTT in everyday professional practice. Figures 1–3 and Table 4 present correct contact risk mitigation behaviors.

INTERVENTION MANAGEMENT, OR WHAT TO DO WHEN A CATHETER STOPS WORKING?

Impaired catheter function creates many professional dilemmas regarding the correct way to deal with a specific situation. So far, no uniform standard procedures have been developed in this regard, and essentially every dialysis center bases its intervention management on its own experiences. Table 5 presents the methods for dealing with a malfunctioning tunneled catheter based on the experience gathered at the Gdańsk center. It is worth noting that before taking any corrective actions due to frequent arterial or venous blood pressure alarms during the hemodialysis procedure, the basic causes of catheter dysfunction should always be assessed, e.g., perhaps the arterial and venous lines are pinched or folded by patients. After the initial assessment of the direct causes of poor functioning, the patient should rest comfortably on the dialysis chair or bed, and appropriate corrective steps should be taken (Tab. 5). All kinds of adjustments associated with opening the catheter should be performed according to ANTT and by observing absolute asepsis. Both the nurse and the patient should be wearing surgical masks covering the mouth and nose.

MODERN ANTICOAGULANTS OR WHAT MODERN MEDICINE CAN OFFER

SODIUM HEPARIN

Heparin was first used in medicine in 1968 and has been the longest-used coagulant in dialysis to date. It is administered as a means of reducing clotting outside the patient's body, but for many years it has also been administered as a channel filler for dialysis catheters. The efficacy of heparin depends on its concentration. Based on the summary of product characteristics for HEPARINUM WZF, 5000 IU/mL contains porcine-derived unfractionated heparin, which has anticoagulant

Table 4. Practical guidelines for using a tunneled catheter (own proposal)

Recommendation	Comment
Dressing change before every hemodialysis	Changing the dressing before every dialysis creates an opportunity to observe any worrying changes and to immediately implement corrective actions
Scrupulous use of aseptic techniques in professional practice	Compliance with the principles of sterility at every step of medical procedure implementation and the ability to use sterile material is a prerequisite for limiting infections
Monitoring catheter function for occlusion indicators: • blood pump flow < 300 mL/min • venous blood pressure > 250 mL/min • arterial blood pressure < 250 mL/min • lack of blood aspiration from catheter channels • urea reduction index (URR) < 65% (or KT/V < 1.2) • frequent alarms related to arterial and venous blood pressure instability, the need to reposition and/or flush catheter channels during hemodialysis	Gradual assessment of catheter function encourages preventative measures. The use of thrombolytics followed by a switch to another anticoagulant is the treatment of choice. This type of procedure reduces the need for radical decisions about catheter replacement.
Monitoring catheter-associated infections in the dialysis center. Creation of an electronic database.	Catheter dysfunction poses a risk of catheter-associated infection. There is a reasonable need to monitor the dysfunction (obstruction) and, therefore, the sterility of the catheter. The presence of pathogens inside the catheter threatens the safety of the patient. It is reasonable to introduce standard procedures for dealing with an infected catheter. A decreasing rate of catheter-associated infections is an important marker of the quality of care in a dialysis center.
Potential use of thrombolytics in selected patients	In the case of a high coagulation risk, filling catheter channels with thrombolytic agents should be considered (once a week during the longest dialysis interval).
Educating staff about infection reduction and periodic discussion of CVC status in a dialysis center	Raising staff awareness of symptoms indicating catheter dysfunction and adequate response, including preventive and corrective actions.

properties. Heparin inhibits reactions that lead to blood coagulation and fibrin clot formation. In small quantities, in combination with antithrombin III, it inactivates the active form of plasma factor X (Xa) and inhibits the conversion of prothrombin to thrombin. Heparin may prolong the prothrombin time. In larger quantities, heparin inactivates thrombin and prevents the conversion of fibrinogen to fibrin. It prevents the stabilization of fibrin and inhibits the activation of the fibrin stabilizing factor. It does not show any fibrinolytic activity; it does not dissolve the existing fibrin clot either. Moreover, heparin does not have any bactericidal properties and, therefore, should not be used in patients with high risk of catheter-associated infections. Overall, it is important to administer heparin directly into the patient's vein (or the venous channel of the dialysis catheter) to reduce coagulation in the dialyzer in order to achieve high-quality dialysis. This is strongly recommened as after intravenous administration, the onset of anticoagulant activity occurs within a dozen or so seconds, and the maximum effect occurs after 10 minutes. The effect of heparin lasts for 2–4 hours. Heparin binds to low-density lipoproteins (including alpha globulin) and fibrinogen.

TAUROLIDINE WITH HEPARIN

The TauroLock™-HEP500 solution contains substances with anticoagulant and antibacterial properties. Unlike antibiotics, taurolidine acts through a chemical reaction with bacterial cell wall structures. Bacteria are killed, and the resulting toxins are neutralized. *In vitro*, the destruction time is 15–30 minutes. Taurolidine is characterized by a very broad antibacterial and antifungal spectrum, including methicillin-resistant and vancomycin-resistant bacteria (MRSA, VISA, VRE). The solution can be used in ports and dialysis catheters. It is used between treatments to protect catheter channels from clot formation, as well as bacterial and fungal infections. The TauroLock™-HEP500 solution contains two active substances — (cyclo)-taurolidine, citrate (4%), and heparin (Mucosa, 500 IU/mL) — and water for

Table 5. Tunneled catheter dysfunction — practical guidelines (own proposal)

Problem	Suggested course of action
It is difficult or impossible to aspirate medicinal product from one or both channels before hemodialysis	• change the patient's position • induce a cough reflex in the patient • attempt to aspirate the contents of the channels using a 20 mL syringe • consider the use of thrombolytics if there are difficulties in aspirating the medicinal product from the catheter channels. If the problems persist, consider switching to a different fill for the catheter channels.
Inability to obtain adequate blood flow from one or both channels	• change the patient's position, rinse catheter channels with 20 mL of saline solution
Frequent alarms related to arterial and venous blood pressure instability	• change the patient's position, rinse catheter channels with 20 mL of saline solution • connect the patient to the hemodialysis device using reversed lines • increase blood flow through the pump gradually until the desired effect is obtained
Catheter rupture (any part of it)	• clamp (secure) the catheter line using a replacement clamp • in the case of damage in the external channel area, consider using a repair kit
Total catheter obstruction	• consider catheter replacement
Serous/purulent or bloody effusion from catheter tunnel and/or redness and/or swelling and/or exit site pain	• take a swab from the catheter exit site • take a blood sample for microbiological examination (blood residue content from catheter channels) • monitor the patient for infection
Elevated body temperature and/or chills	• take a blood sample for microbiological examination (blood residue content from catheter channels) • monitor the patient for infection
Dirty or missing dressing around the catheter and/or lack of hubs/end caps on catheter lines	• monitor the patient for infection • educate the patient on the consequences of hygiene negligence

injections. The pH value is adjusted with citrate and sodium hydroxide. The product is filtered in sterile conditions and supplied as a clear, apyrogenic solution filled under sterile conditions. The TauroLock™-HEP500 solution can only be used as a catheter-filling solution. The TauroLock™-HEP500 solution cannot be used in patients who are allergic to citrate, heparin (Mucosa), or (cyclo)-taurolidine, and in patients who are currently taking medications that may cause adverse interactions when combined with citrate, heparin (Mucosa), or (cyclo)-taurolidine. The TauroLock™-HEP500 solution cannot be used in patients with thrombocytopenia caused by heparin or in patients with increased risk of bleeding. There are currently no known adverse effects linked to the concentration of active substances in TauroLock™--HEP500, provided that the solution is used according to instructions.

TAUROLIDINE WITH UROKINASE

The TauroLock™-U25.000 solution contains a substance that prevents catheter clogging and has antibacterial properties. The solution is used in ports and dialysis catheters. It is administered into catheter channels to preserve their patency as well as protect against bacterial and fungal infections. The TauroLock™-U25.000 solution contains active substances – (cyclo)-taurolidine, citrate (4%), and urokinase (25.000 IU/mL) — and water for injections. The pH value is adjusted with citrate and/or sodium hydroxide. The product is filtered in sterile conditions and supplied as a clear, apyrogenic solution filled under sterile conditions. Urokinase is contained in a separate vial with a removable cap and a rubber stopper; it is dissolved in the solution immediately before use. Each vial contains 5 mL of the solution. The TauroLock™-U25.000 solution cannot be used in patients who are allergic to citrate, urokinase, or (cyclo)-taurolidine and in patients who are currently taking medications that may cause adverse interactions when combined with citrate, urokinase, or (cyclo)-taurolidine. TauroLock™-U25.000 can be used as a standard catheter channel fill after hemodialysis and also for restoring catheter patency as a thrombolytic agent. Table 3 describes the use of TauroLock™-U25.000 in detail.

Table 6. Connecting the patient to the hemodialysis machine (own proposal)

1. Disinfect your hands and put on a surgical mask (nurse and patient) and disposable non-sterile gloves.
2. Secure the external part of the catheter by covering it with a sterile drape, and disinfect catheter channels with swabs soaked in an alcohol and chlorhexidine solution.
3. Make a visual assessment for possible mechanical damage that would constitute a contraindication to its use.
4. Remove the end caps from the catheter tails, and use sterile syringes to aspirate the anticoagulant filler (approximately 3 ml). Dispose of the aspirated blood and syringe in a medical waste container. Flush each catheter channel with 10 ml of 0.9% NaCl.
5. **Administer an anticoagulant into the venous channel** as ordered by the physician.
6. Disinfect catheter channels with swabs soaked in alcohol and chlorhexidine solution once again.
7. **Do not leave the catheter channels open -** always check the placement of the safety clip.
8. Connect the dialysis lines and begin hemodialysis or perform the procedure of securing catheter channels after use.
9. Protect the junction between the catheter and the dialysis line with sterile gauze or towel for the duration of hemodialysis.
10. Tidy up the worktop.
11. After the procedure, remove gloves and surgical masks, and dispose of them appropriately.
12. Disinfect the worktop.
13. Disinfect your hands.

Table 7. Tunneled catheter maintenance with the use of an anticoagulant after dialysis (own proposal)

1. Disinfect your hands, and put on a surgical mask (nurse and patient). Put on disposable, non-sterile gloves.
2. Using sterile swabs soaked in an alcohol and chlorhexidine solution, disinfect the distal parts of the catheter, and flush the individual channels with 20 mL of 0.9% NaCl by using two 10 mL syringes. Catheter channels should be flushed using the push-pause technique in 1 mL increments.
3. Fill the catheter channels with undiluted anticoagulant as ordered by the physician, using an amount corresponding to the volume of the catheter channels.
4. Disinfect catheter channels with swabs soaked in an alcohol and chlorhexidine solution once again and secure the channels with sterile plugs.
5. In order to reduce the risk of the anticoagulant entering the patient's bloodstream, catheter channels should be filled slowly, using the appropriate technique (1 mL/3 seconds).
6. Check the placement of the safety clip each time. Do not leave the catheter channels open.
7. Tidy up the tray or table, all the while observing the rules of medical waste segregation.
8. Remove gloves and surgical masks, and dispose of them appropriately.
9. Disinfect your hands.

SODIUM CITRATE

Sodium citrate is a modern anticoagulant with a broad spectrum of activity and has been used in Poland for over 10 years. Citra-Lock™ is recommended by the European Renal Best Practice (ERBP) advisory board of the European Renal Association (ERA) and the American Society of Diagnostic and Interventional Nephrology (ASDIN). Citra products are used for catheter maintenance and show high efficacy in maintaining catheter patency. Sodium citrate demonstrates anticoagulant properties within the human body by chelating calcium ions in extracorporeal circulation and the formation of a soluble complex. Since calcium is an ion involved in the clot formation cascade, removing it with the use of citrate prevents the activation of coagulation factors, factor X, prothrombin, and, consequently, fibrin formation. There is no systemic activation. It has antibacterial properties and limits biofilm layer formation by binding and removing $Ca2+$ from the surrounding environment. Calcium cation may affect certain bacterial genes responsible for growth and survival. Provided it is used in accordance with the manufacturer's instructions, it generally has no adverse effects. Catheter channels should be filled with precision, and after each dialysis and each channel has been flushed with an appropriate volume of saline, the Citra-Lock™ solution should be slowly injected within 5–10 seconds. Currently, 4%, 30%, and 46.7% solutions are available in 5 ml vials. The efficacy of the drug depends on its concentration. The citrate solution for catheters can be safely used in all types of dialysis catheters.

GDAŃSK EXPERIENCES WITH TUNNELED CATHETERS

There are 105 patients currently under the care of the Gdańsk center for long-term hemodialysis. About 80% of patients (n = 79) undergo dialysis using a tunneled catheter, including 15% of patients (n = 14) who have had the same catheter for more than 5 years, with 1 patient who has had her catheter for more than 10 years. The remaining patients have had tunneled catheters for 1 month up to 5 years. Currently, the University Clinical Center in Gdańsk uses all of the abovementioned anticoagulant treatments. Half of the patients (n = 52) have their dialysis catheters maintained using sodium heparin. Twenty percent of patients (n = 22) receive taurolidine with heparin; 5 patients have their catheters maintained using the highest possible concentration of sodium citrate after each dialysis. Temporary catheter dysfunction has been observed in only 4 patients who have had their catheters for over 3 years and receive taurolidine with heparin. In these cases, interventions are undertaken according to the protocol described earlier. During the last 5 years, only 3 patients experienced catheter-associated infections (Pseudomonas aeruginosa, Klebsiella oxytoca) that resulted in catheter replacement. It is important to note the small number of infections despite the very large number of catheters. This is strictly related to the diligence and adherence to procedures and compliance with the principles of asepsis by the entire nursing team. Tables 6 and 7 describe these special procedures.

SUMMARY AND CONCLUSIONS

Long-term care and maintenance of dialysis catheters are undoubtedly of great clinical importance for the patient. Based on extensive professional experience, it seems that compliance with asepsis principles by the nursing staff at every stage of the dialysis procedure is very important for overall dialysis catheter care. Furthermore, prevention of catheter dysfunction consists of careful monitoring of each catheter and appropriate response to symptoms indicating issues related to its patency. In long-term care, it is important to choose the right treatment that will reduce the formation of clots and bacteria. There is a broad choice of available anticoagulants. It is worth making a choice tailored to the individual to achieve the expected result and to protect the patient from the trauma of catheter replacement.

It is important to pay attention to hygiene and make the patient feel responsible for proper maintaining of a dialysis catheter. The patient should report infection symptoms as soon as possible and protect the catheter from getting dirty or wet during personal hygiene procedures. This co-responsibility may bring positive results in renal replacement therapy, which offers patients a good quality of life despite the hardships of their disease.

CONFLICT OF INTEREST

None to declared.

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