Long-term intravenous access in cancer patients

Elwira Góraj, Małgorzata Lipiec

The Palliative Unit affiliated to the Oncological Diagnostic Clinic and Cardio-Oncology and Palliative Medicine

Key words: totally implantable venous access devices (TIVADs), intravenous chemiotherapy, catheter-related bloodstream infections, catheter-related thrombosis

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According to the authors and editors, this report contains the most justified principles of diagnostic and therapeutic procedures prepared considering the scientific value of evidence and category of recommendations. These principles should always be interpreted in the context of an individual clinical situation. The recommendations do not always correspond to the current reimbursement rules in Poland. In case of doubt, the current possibilities of reimbursement of individual procedures should be established.

1. The quality of scientific evidence

I — Scientific evidence obtained from well-designed and conducted randomized clinical trials or meta-analyses of randomized clinical trials

II — Scientific evidence obtained from well-designed and conducted prospective observational studies (non-randomized cohort studies)

III — Scientific evidence obtained from retrospective observational studies or case-control studies

IV — Scientific evidence obtained from clinical experiences and/or experts, opinions

2. Category of recommendations

A — Indications confirmed unambiguously and absolutely useful in clinical practice

B — Indications probable and potentially useful indications in clinical practice

C — Indications determined individually

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Introduction

Port-chamber catheters are a useful means of intravenous access because they are the most comfortable and safest way of conducting long-term intravenous therapy. Providing a central venous access to each patient who has been qualified to chemotherapy should be a rule. If a predicted time of therapy is shorter than 12 months, cannulation of a main jugular vein by placement of a peripherally inserted central catheter (PICCs) may be considered [1].

The Polish Club of the Intravenous Access has been active for 10 years. The aim of the society is to integrate different societies of intravenous access specialists, circulation of knowledge, development of national standards, organisation of meetings and conferences, as well as publishing.

During the Sixth Symposium of the Polish Club of Intravenous Access: "Port-chamber catheter-implantation, care, complications', we tried to systematise the terminology concerning the procedure of implantation and use of port-chamber catheters.

In the description of placement of a totally implanted venous access devices — ports — into the patient's body, as correct we acknowledged the term "port-chamber catheter implantation" and its synonyms port implantation or port-a-cath implantation. In the Polish version of the ICD-10 classification, the procedure "Adjustment and placement of the implantable devices — adjustment and placement of devices ensuring access to the blood vessels" is encoded as Z45.

The term "removal of a (port)" is not disputatious and linguistically correct.

The word "lock" for filling the catheter and port-chamber (reservoir) with a solution has been accepted. The colloquial meaning of this word is totally different, but the terms "heparin, antibiotic, citrate, tauridin, and ethanol-plug" have been deeply implanted into the medical terminology. The above-mentioned terms have received recommendations of the Polish Language Council: the decision of the Polish Language Council from 28th July 2014, RJP-182/W/2014.

The most frequently translated English terms have also been standardised [2]:

— a-port;
— port-a-cath;
— access port;
— vascular port;
— vascular port access;
— venous port system;
— intravenous port;
— central venous port;
— totally implanted venous access port;
— totally implanted central venous port;
— venous access system;
— VAD — vascular access device;
— IVD — intravascular device;
— TIVAD — totally implantable venous access devices.

This publication presents recommended by experts' standards of (port-a-Cath) port-chamber catheter implantation and care. These standards are based on recommendations of oncological scientific associations (e.g. European Society for Medical Oncology — ESMO; and the American Society of Clinical Oncology — ASCO).

Indications for placement of a totally impalanted venous devices

The need for an easy venous access and repetitive drug administration in a patient is an indication for implantation of a port-chamber catheter.

The port should always be used from the beginning of chemotherapy in children.

Indications for placement of a totally impalanted venous (Tab. 1).

In recent years the indications for implantation of port have been significantly broadened. Some of them (e.g. taking blood samples) are a definitive solution because frequent blood taking via the port shortens its functioning time. Some of the indications could be performed via PICCs, which in Poland are still used sporadically. There is no final definition of the reimbursement for this procedure [1, 3–5].

Table 1. Indications for placement of a totally impalanted venous

Standard indications
No possibility of administration of chemotherapy via peripheral veins
Predicted high number of courses and toxicity of chemotherapy
Acute reactions to the administered drugs are present
No possibility of peripheral vein cannulation
Non-standard indications
Parenteral alimentation
Repetitive administration of fluids, drugs
Repetitive transfusion of blood products in haematological diseases
The need to take frequent blood samples
Renal replacement therapy
Administration of fluids with different Ph, hypertonic, hyperosmolar
Administration of catecholamines
Chronic diseases e.g. cystic fibrosis, asthma

Table 2. Preoperative assessment. Rules of qualification for totally implanted venous devices implantation procedure

Qualification for procedure	Absolute contraindications	Relative contraindications
Physical examination of a patient	No patient's informed consent	Relative coagulation disorders/
— no local changes at the potential area	INR > 1.3	/therapy with anticoagulants
of catheter implantation	Thrombocytopaenia < 60 G/L	Therapy with acetylsalicylic acid
— no signs of generalised infection	Leukopaenia < 3 G/L	derivates or platelets inhibitors
in a patient	Neutropaenia < 1 G/L	in the previous 7 days
— patient's condition permits being	No technical-skills to perform implantation	No possibility to perform
in horizontal position for 30 minutes	Skin changes at the site of a planned implantation	a control radiologic test
Laboratory tests:	Infection at the site of the planned catheter	
— result of coagulation test INR, APTT	placement	
and d-dimers	Generalised infection	
— peripheral blood platelets count	Active vein thrombosis in the area of a planned	
— peripheral blood leukocytes count	implantation	

INR — international normalised ratio; APTT — activated partial thromboplastin time

Qualification to implantation

The principles for qualifying patients for vascular port implantation are summarized in Table 2.

If there is a relative contraindication, then other parameters of the clinical evaluation must be normal.

The anamnesis (standardised as a questionnaire or repetitive questions) should be taken by a qualified nurse or physician. Its aim is to evaluate the general health condition of a patient and to identify problems that may influence the appropriate procedure (e.g. local oedema at the planned implantation area, acquired or inherited anatomical deviations, claustrophobia, important anxiety). The evaluation of function of the lungs is very important. If one lung is involved with the diseases then the implantation should be done on that side. A potential risk of pneumothorax on the healthy side may lead to fatal complications.

If possible, any serious coagulation disorders should be corrected before the procedure. In some exceptional cases of thrombocytopenia, a procedure is done up to two hours after transfusion of platelet concentrate. Persons who receive oral anticoagulants should be switched five days before the procedure to low molecular weight heparin [1, 3, 5, 6]. It is not commonly recommended that the acetylsalicylic acid derivates are stopped (especially in patients who experienced, during the previous six months, a thrombotic event or underwent a coronary angioplasty with insertion of a stent). During the administration of low molecular weight heparins (LMWH), a safe time from the injection of the last dose is 12 hours for prophylactic doses and 24 hours for therapeutic doses.

Signed, informed consent of the patient is required before performing a procedure.

The patient should be well hydrated in order to facilitate cannulation of the vein. On the day of the procedure, patients should be fasting; however, they can drink water until two hours before the implantation [3, 5, 6].

Technical and organisational conditions of safe implantation of a port-chamber catheter

Implantation of port-chamber catheters should be done in the strictly sterile conditions of an operating room or doctor's surgery (II, B). A procedure should be performed according to rules of asepsis, and complete access to resuscitation facilities and to the X-ray machine must be provided. An operating-table should be radio-transparent with the possibility to set up a Trendelenburg position (inclination of 10 degrees). During the procedure it is required to monitor life functions (arterial blood pressure, heart rate, oxygen saturation of the peripheral blood) and to use oxygen therapy via nasal prong or face mask. A procedure is done using local anaesthesia (usually 1% lidocaine in volume of 10–20 ml). A premedication can be given upon the patient's request (e.g. midazolam or alprazolam). Intravenous sedation during the procedure is possible only when an anaesthesiology nurse is present [1, 3–5, 7, 8]. Chlorhexidine with alcohol should be used for skin disinfection (I, A). A planned antibacterial prophylaxis is not recommended (I, A) [1, 4–6, 9, 10].

A prophylaxis with antibiotics is recommended in selected patients with increased risk of infections. After implantation, a port should be radiologically checked by performing after the procedure an anteroposterior and lateral chest X-ray [3, 11–13]. The placement of the port-chamber, localisation of the catheter and of its tip, as well as a potential iatrogenic pneumothorax, are being evaluated. Intraoperative fluoroscopy does not provide appropriate control. Radiological control accuracy is limited by a mistake caused by an effect of parallax (discrepancy of different images of the same object observed from different directions) or due a low quality of image (II, B) [1, 3, 5].

The optimal site of placement of the catheter tip is a junction of the superior central vein and of the right atrium, which decreases the risk of thrombotic complications and of occlusion of the catheter.

The appearance of transitional cardiac arrhythmias (increased amplitude of the P wave and its characteristic shape, depending on the placement of the blunt guidewire) is an indirect method to confirm the correct positioning of the catheter. This method is not authoritative in the case of weak contractibility of the heart muscle, atrial fibrillation, or in patients with implanted heart peacemakers (V, D) [1, 3, 9]. Radiological control after the procedure is mandatory also if the procedure is unsuccessful.

If the repeated attempts to insert a catheter at one site are unsuccessful, a radiological control of the chest must be done in order to rule out the pneumothorax.

Any attempt to insert the catheter at the opposite site cannot be done earlier than 12 hours after the previous procedure. The current guidelines underline the necessity to use one of the accessible methods to control the placement of the catheter tip (fluorescence or ultrasonography method). Use of ultrasound is specially recommended for all types of cannulations of man veins because it permits assessment of the presence, alignment, and patency of the vessels. A direct visual control facilitates the cannulation and increases the precision of the puncture of a vessel. On the USG image, we may evaluate the lumen of the vessel and visualise the eventual phlebothrombosis. If the operator has experience in interpreting the images, the time of the procedure is shorter and the risk of complications (e.g. incidental puncture of an artery) lower. The main factor influencing the duration of a procedure and the complication rate is the experience and technical skills of the operating physician.

The presented recommendations concern both the implantation of the port-chamber catheter and PICCs cannulation when the peripheral veins are not visible and palpable. However, performing an intraoperative fluoroscopy is not mandatory [1, 5, 10].

A first control of a port is done on the operating table, by the puncture of the port-chamber and aspiration of blood followed by flushing with 10–20 ml of 0.9% saline solution (II, B) [1].

Normal saline is recommended and non-inferior comparing with heparin to lock TIVADs (III, C) [1, 3, 5, 6]. Heparin flushing is controversial and acceptable in case of high risk of thrombosis or thrombosis of previos port. In that case may be left the heparine lock of 300 U calculated 0.5 ml for chamber and 0.1 ml for each 1 ml of the catheter.

The system port-reservoir-catheter should be filled with heparinised saline solution 300 U, computing 0.5 ml for the chamber and 0.1 ml for each centimetre of the catheter.

Automatic safety Huber needles are used to puncture the membrane of the port-chamber. The size, length, and shape of the needle must be individually adjusted to the dimensions of the port, to patients anatomy, and type and time of a planned infusion. It is recommended that 10-ml or larger syringes are used in order to avoid high pressure during the administration [1, 3–6]. In the documentation of the procedure we should inscribe the remaining length of the catheter (in centimetres).

The selection of site is influenced by the anatomical factors (deformations, short neck, obesity). A subclavian access should not be chosen in patients with coagulation disorders. In some exceptional situations, it is acceptable to cannulate a femoral vein; however, this procedures is associated with an increased risk of infections and thrombosis [1, 3, 13].

The proximity of any other catheters, stoma, implants, uncomfortable covers, infiltrations, tumours, oedemas, or areas of radiation induced reactions. Active necrotic and inflammatory changes preclude aseptic use of a port. The choice of intravenous access should be adjusted to a patient, but also to the technical skills of the operating physician. In many analyses of the frequency and type of complications, it is emphasised that their number decreases proportionally to the experience of the operating person [3, 5].

Observation after implantation

After the procedure, a patient requires a four-hour observation — it is necessary to monitor heart rate, blood pressure, respiration rate, and body temperature. Another chest X-ray is necessary in case of reported or observed dyspnoea and chest pain (II, C) [1, 3].

Criterion for discharge of a patient after port implantation (Tab. 3).

Table 3. Criteria for discharge of a patient after port implantation

Absence of signs of pneumothorax, of bleeding into the pleural cavity, or mediastinum on the radiological image
Stable general state (not worse than before the procedure)
Stable blood pressure, heart rate, and respiration rate
No symptoms of local bleeding
Absence of any significant pain
Absence of any dyspnoea (dyspnoea of known aetiology not worse than before the procedure is a contraindication to discharging a patient)
Assistance of an adult person, trained how to manage dyspnoea, bleeding, or fever

Prevention and treatment of infectious complications

The frequency of intravenous port related infections is estimated at 0.8–7.5%. The risk of catheter related bloodstream infections is lower compared to the peripherally inserted central catheter line (PICC-line) [13].

To prevent infection, every use of port must follow the rules of aseptic technique. The solutions of chlorhexidine with alcohol are recommended for disinfection (I, A). After using a disinfecting agent the skin should be allowed to dry (I, A) [1, 3, 5, 6, 14]. We may distinguish local infections, infections of the port-chamber/ /tunnel, and catheter-related blood-stream infection (CRBSI).

The mortality ratio in the case of catheter-relater blood-stream infection in oncologic patients reaches 12–25% [3, 15, 16].

Complications of CRBSI:
— infectious endocarditis;
— infected venous thrombosis;
— central osteitis;
— ulcers of the internal organs.

In cases of suspicion of CRBSI it is recommended to take blood samples for blood culture from the port--chamber and from the peripheral vessel (II, A) before starting the antibiotics (I, A) [1, 3, 5, 16–20].

Diagnostic criteria of CRBSI:
— the number of colonies cultured form the blood taken from the port chamber is three times higher or
— a semi-quantitative method — more than 15 CFU/ml of the same pathogen are present in the sample from the port chamber and from the peripheral blood and/or
— growth of bacterial cultures taken from the port--chamber at least two hours earlier than from the peripheral blood.

Aetiology of CRBIS:
— gram-positive bacteria — about 60%;
— gram-negative bacteria — about 25%;
— fungi — about 10%.

The most common pathogens causing CRBSI:
— coagulase-negative staphylococci;
— *Staphylococcus aureus*;
— *Candida spp*.

and much less frequently:
— gram-positive bacillus (*Bacillus spp*.);
— *Enterococci*;
— mycobacteria (*Mycobacterium spp*.)
— non-fermenting gram-negative bacillus.

Vancomycin is a drug of choice in the empirical antibiotic therapy of CBRSI (II, A), whereas linezolid is not recommended for empirical use (I, A) [1, 3, 15, 17, 21].

In case of severe infections (sepsis, neutropaenia) it is recommended to start an empirical therapy that also covers gram-negative bacteria (e.g. IV generation cephalosporins, carbapenems, or beta lactam antibiotics in combination with/or not with aminoglycoside) (II, A) [5, 15, 20, 21].

The pathogenic factors of infections may differ between medical centres. A permanent monitoring of infections related with defined procedures and reporting the presence of alarm pathogens on the given ward, as well as cooperation with the Division of Clinical Microbiology in order to define the profile and drug-sensitivity of pathogens, are mandatory (II, A) [5, 15, 17, 21].

The removal of the port-chamber catheter is recommended in cases of (II, A) [1, 5, 6, 21]:
— severe sepsis;
— infected venous thrombosis;
— infectious endocarditis;
— infection of a tunnel;
— ulcer of the port-chamber catheter;
— persisting bacteraemia despite the use of an adequate antibiotic therapy for 48–72 hours;
— infection caused by staphylococcus aureus, *Mycobacterium spp*., and fungi.

The pathogens listed below are associated with an increased risk of infection reoccurrence and necessity to remove a port:
— *Bacillus spp.;*
— *Corynebacterium jeikeium;*
— *Stenotrophomonas maltophilia;*
— *Pseudomonas spp.*;
— vancomycin-resistant enterococci.

Recommended management of the following clinical conditions.

Patient with fever of unknown origin:
— a port-chamber catheter should not be used;
— the patient should be referred to a treating physician;
— after excluding causes of fever other than port, the patient should be referred to a port centre [1, 5, 18].

Chills and fever in a patient during the infusion through the port:
— the infusion should be stopped;
— a blood culture should be taken from the port and from the peripheral vessel;
— the use of a 70% alcohol or antibiotic lock should be considered (filling the system of a port-chamber catheter with antibiotic in 100–1000 × higher concentration than during the intravenous administration);
— the port should not be used;
— considering the risk of sepsis a patient should be admitted to the ward [1, 5, 18, 21–23].

Detected bacteraemia:

In the case of detection of a bacterial colonisation (positive bacterial culture of blood sample taken from the port-chamber), the following are recommended:
— use an alcohol or antibiotic lock (in the majority of cases together with systemic antibiotic therapy);

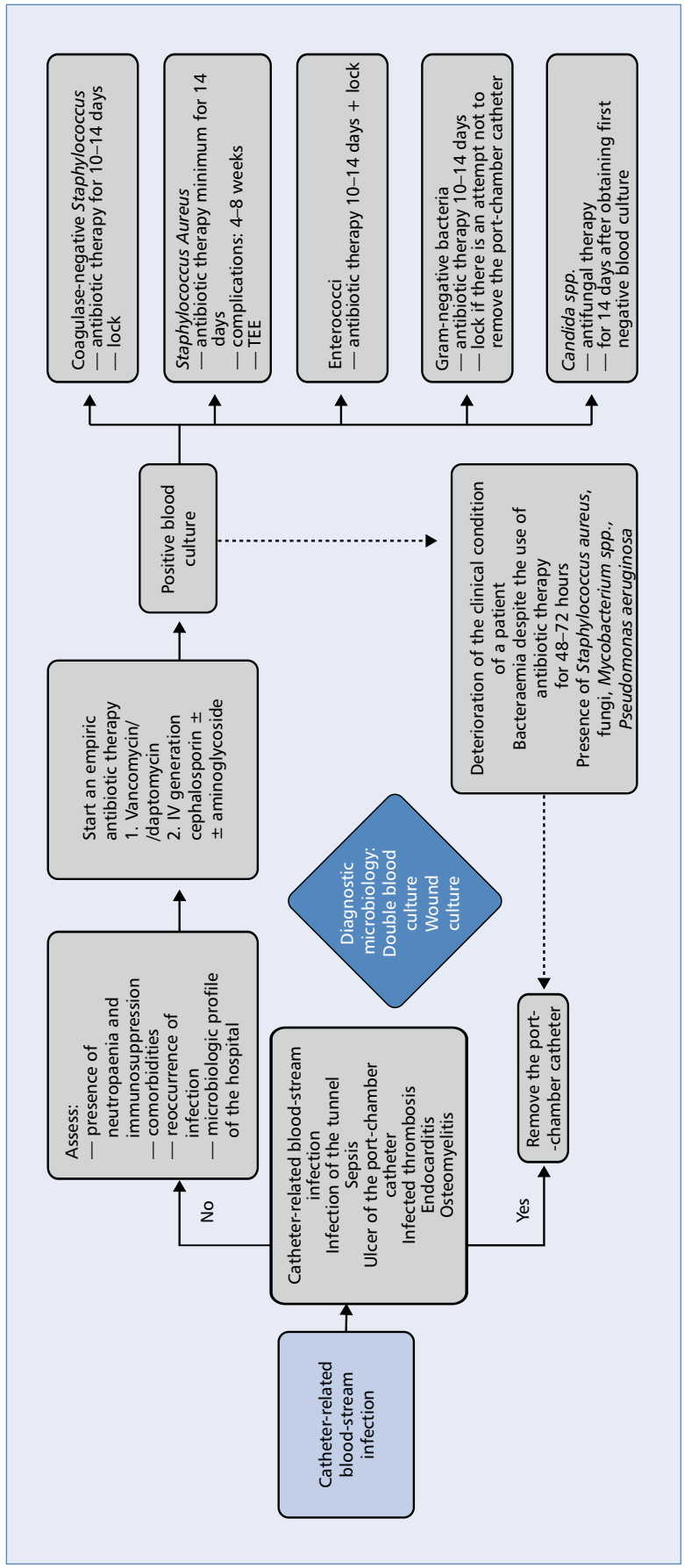

Figure 1. Algorithm for the management of catheter-related bloodstream infections — European Society for Medical Oncology 2015 [1]. TEE — transesophageal echocardiography

— in the case of ineffective therapy, the port should be removed.

In case of septic shock the following are recommended:
— immediately remove the port;
— start an empiric antibiotic therapy, and then targeted therapy.

In case of mild clinical symptoms the following are recommended:
— do not remove the port, but administer antibiotic therapy for 10–14 days;
— in the case of ineffective therapy, the port should be removed.

In the case of a fungal infection the following are recommended:
— remove the port;
— continue antifungal therapy for 14 days after obtaining the first negative result of the blood culture [1, 5, 15, 18, 21–23].

In case of infection with staphylococcus aureus the following are recommended:
— remove the port;
— use an antibiotic therapy for a minimum of 14 days;
— treatment of complications (osteitis, endocarditis) should be continued for 6–8 weeks;
— perform a control trans oesophageal echocardiography [1, 5, 18, 21].

Catheters covered with antibiotics, impregnated with antiseptic agents (e.g. chlorhexidine, silver ions, sulfadiazine, minocycline/rifampicin) have some advantage in the prophylaxis of infections. However, due to their high costs they are recommended only in high-risk patients (i.e. patients after haematopoietic stem cell transplantation, persons treated due to leukaemia, or in places with high percentage of BSI) (III, C) [3, 5].

Thrombotic complications

The frequency of thrombotic complications related to the presence of an intravenous port-chamber catheter is estimated at 0.5–6.5%. We may distinguish a clot of the catheter tip or venous thrombosis.

In order to prevent thrombotic complications during the use of the port, it is recommended to:
— perform a single control of a blood back flush only by puncturing the chamber;
— flush the port chamber and catheter in a pulsatile way (10 × 1 ml) after each use (II, B) [1, 3, 5, 6];
— remove the needle form the port with the concomitant, creating a positive pressure.

The advantage of the heparin solution over the 0.9% NaCl used to flush the port-chamber catheter in the aspect of a decreased risk of catheter occlusion has not been proven. The flushing of an unused port may be performed every three months. In order to maintain the patency of the of the port that is not in use, it is recommended that the port should be flushed every four weeks (III, C) [1].

We may distinguish a complete or partial thrombosis of a port-chamber catheter. In the case of the complete thrombosis, it is necessary to remove the device. In the case of a partial thrombosis, resulting in no possibility to aspirate blood, but with preserved possibility to infuse fluids into the port, it is recommended to:
— repeat an attempt to aspirate blood in a different position (lying, Trendelenburg, aside);
— repeat an attempt to aspirate blood after a quick administration of a bolus of 10 ml of 0.9% NaCl;
— refer a patient to his/her treating physician in order to perform a diagnostics of vein thrombosis or other pathology;
— perform a dynamic RT with use of a contrast material;
— if a port is visualised (its whole length) and its patency and tightness are confirmed, a port-chamber catheter may still be used.

In the case of dynamic RT image with contrast demonstrating a thrombus at the tip of the catheter or of a fibrine cuff, an antithrombotic and fibrinolytic therapy should be started.

The frequency of the thrombosis related to a port depends on the site of implantation (the risk is decreasing as follows: femoral vein, subclavian vein, right internal jugular vein). In the therapy of the symptomatic thrombosis (Fig. 2), it is recommended to use anticoagulants for three months; LMWH preparations are recommended [1, 3, 24]. If the port maintains a partial patency and is not infected, it should not be removed and may be used [1, 3, 5, 25–27].

Other complications

All complications occurring within the 30 days post implantation of the port are classified as early complications. They are divided according to their frequency (Tab. 4).

Early complications of the procedures results from technical mistakes or from incorrect qualification of a patient [3, 13, 28, 29].

Late complications after port implantation are listed in Table 5.

Other, rare problems related to the implantation of a port are:
— displacement of the catheter upward (e.g. due to the intense, long-lasting caugh, physical forces acting on the catheter);
— mechanical injury of the device (e.g. leakage, detachment).

In such cases the management depends on the individual situation. It is possible to make a correction of the position of the catheter and exchange the damaged

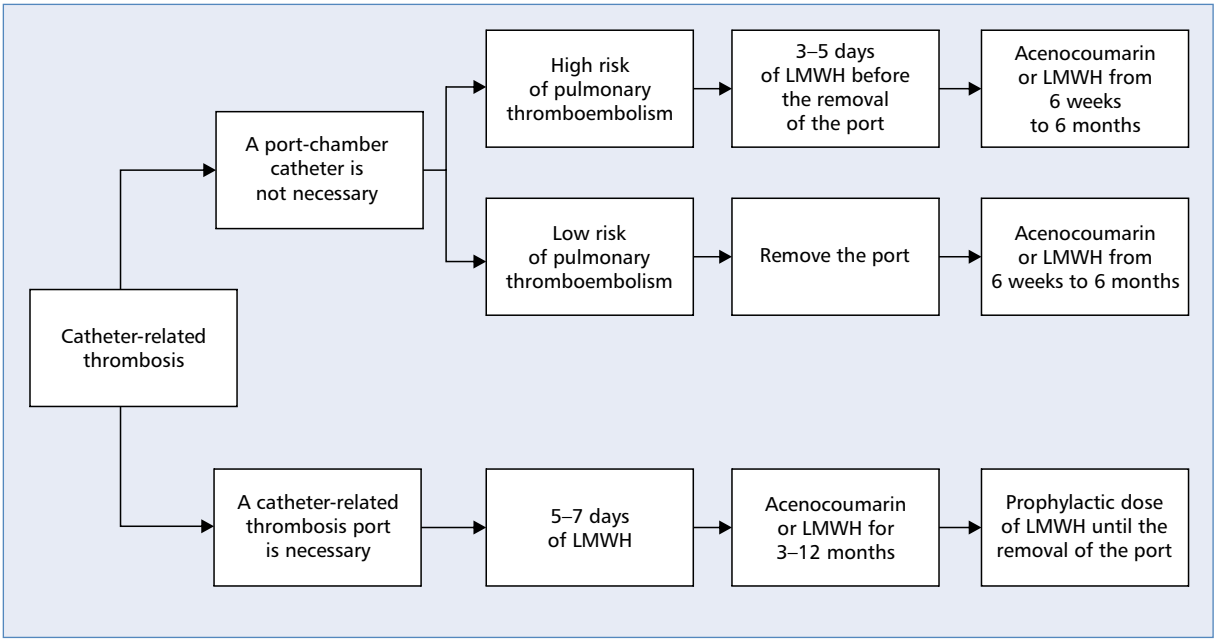

Figure 2. Algorithm for the management of catheter-related thrombosis — European Society for Medical Oncology 2015 [1]. LMWH — low molecular weight heparin

Table 4. Classification of early complications after Totally implantable venous access ports according to prevalence

Frequent early complications
Puncture of an artery (5.3%) — this complication is easy to diagnose and results from the direct proximity of the vessels. It is not very dangerous, it requires 5–10 minutes of compression of a bleeding vessel and to change the location of the puncture of the vein. An ice-bag is recommended
Haematoma at the site of the port (0.4%) — sometimes it comes to the extravasation of blood at the area of the puncture. In the majority of cases, at home, putting an ice-bag and vessel compression (intermittent) for two hours is sufficient. If there is no improvement, the patient should visit a physician
Pneumothorax (0.4%) — the puncture of the pleural cavity leads to a decrease of the lung surface, which results from the direct proximity of the lung top and the site of vessel puncture. Depending on the grade of intensity, it requires observation or even hospitalisation with use of thoracic drainage
Wound dehiscence — sometimes it requires new sutures
Puncture of the thoracic lymphatic duct (0.2%)
Arrhythmias that can be seen on the cardiac-monitor may occur while a catheter is being introduced too deeply. The catheter should be pulled forward under control of ECG
Rare and very rare early complications
Pleural haematoma — requires pleural drainage; a massive bleeding constitutes an indication for thoracotomy
An early migration of the catheter — during the perioperative period, a correction may be done under radiological control with use of fluoroscopic method
Infections, wound dehiscence
Air embolism (introduction of the external air to the veins)
Vein thrombosis resulting from the coagulation disorders and presence of clots
Haemothorax, pneumothorax
Injury of the vessel wall or of the heart
Injury of the thoracic lymphatic duct
Hydrocele of the thorax, haemothorax
Inflammation of the vein, endocarditis, osteomyelitis of the clavicula
Injury of the brachial plexus

Table 5. Late complications after port implantation

Late complications
Obstruction of the catheter: complete or partial
Vein thrombosis
Inflammation at the area of the port
Catheter-related infection
Catheter rupture; catheter tip migration
Catheter rupture, rupture of a catheter between the rib and clavicula, a "pinch-off" syndrome, catheter displacement
Port leakage
Allergic reaction to a port dome with formation of a skin fistula
Inflammation of the chamber, tunnel
Deep vein thrombosis

element. However, the removal or the exchange of the whole device is the most effective method.

The complications related to the use of the intravenous port involves mechanical damage of the membrane of the port chamber or of the catheter. The first one is usually related to the evulsion of a part of a membrane by a hooked needle that has been abruptly introduced into the port chamber, or use of an inappropriate needle. The most frequent injury of the catheter is its disruption or less frequently its incidental puncture. If the port is implanted from the supraclavicular access, the disruption of the catheter may be due to local pressure, squashing, or a blow on the area where the catheter crosses the clavicular. It is easy to detect, there is no catheter palpable at its primary location, under the skin, or during the attempt to administer fluid into the port — the leakage of the fluid to the subcutaneous tissue may be observed.

If a port is implanted from the subclavian access then the catheter may be disrupted at the site of the crossing of a first rib and the clavicular due to the catheter wear secondary to tearing and scissoring effect ("pinch-off--syndrome"). This complication is difficult to detect undiagnosed, may result in administration of fluids and drugs to the mediastinum [3, 8, 13, 14, 28, 29].

Thrombosis is more common in women when a procedure duration exceeds 45 minutes and an intravenous anaesthesia has been administered. If the tip of the catheter remains beyond the central vein, the risk of thrombosis is also higher [13].

Thrombosis of the cannulated veins is detected in about 60% of patients if a Doppler-ultrasonography is used. Some cases have an asymptomatic course [3, 5, 26].

The indications for removal of the port include:
— end of chemiotherapy;
— patient's wish;
— vein thrombosis associated with infection;
— infectious endocarditis;
— blood stream infection that persists for more than 72 hours of targeted antibiotic therapy (based on the antibiogram);
— ulceration of the area around the port or infection of the tunnel;
— infection with *Staphylococcus aureus*, mycobacteria, and fungi;
— mechanical damage of the port (II, A) [1, 3, 5, 6].

Extravasation during the chemotherapy

The incidence of extravasations during the chemotherapy reaches 0.1–7% of injections. The consequences depend on the chemotherapeutic agent and involve the following:
— necrosis related to the extravasation of the vesicant drugs (anthracyclines, Vinca alkaloids, mechlorethamine);
— inflammation related to the extravasation of some irritant drugs (cyclophosphamide, platinum derivates, fluorouracil, irinotecan).

The non-vesicants do not cause clinically significant complications (bleomycin, cytarabine, methotrexate).

In the case of the administration of the drug outside the port, it is recommended to:
— aspirate the maximal volume of the extravasated drug by use of a needle placed in the port;
— administer pain killers, apply locally dry cold compresses, and consider administration of an anti-inflammatory and anti-swelling drug;
— apply algorithms of management depending on the cytostatic drug that has been extravasated;
— observe the site of extravasation if the extravasated drug is not a cytostatic.

Use of compresses after the extravasation:
— dry warm compresses (four times a day for 20 minutes for 1–2 days) this results in vasodilatation, which leads to acceleration of the circulation of the blood, haemodilution, and better absorption of a drug, they should not be used in the case of irritants; they are recommended in cases of extravasation of Vinca alkaloids and taxanes;
— dry cold compresses or ice-bags (for an hour, then four times a day for 20 minutes for 1–2 days) it results in vasoconstriction, which enables the location of the extravasated drug and increased degradation of the toxic metabolites as well as decreased local inflammation and pain. They are recommended in the case of extravasation of anthracyclines.

Antidote use after extravasation:
— hyaluronidase (injection to the extravasation site): Vinca alkaloids and taxoids;
— sodium thiosulfate (injection): mechlorethamine, cisplatinum;

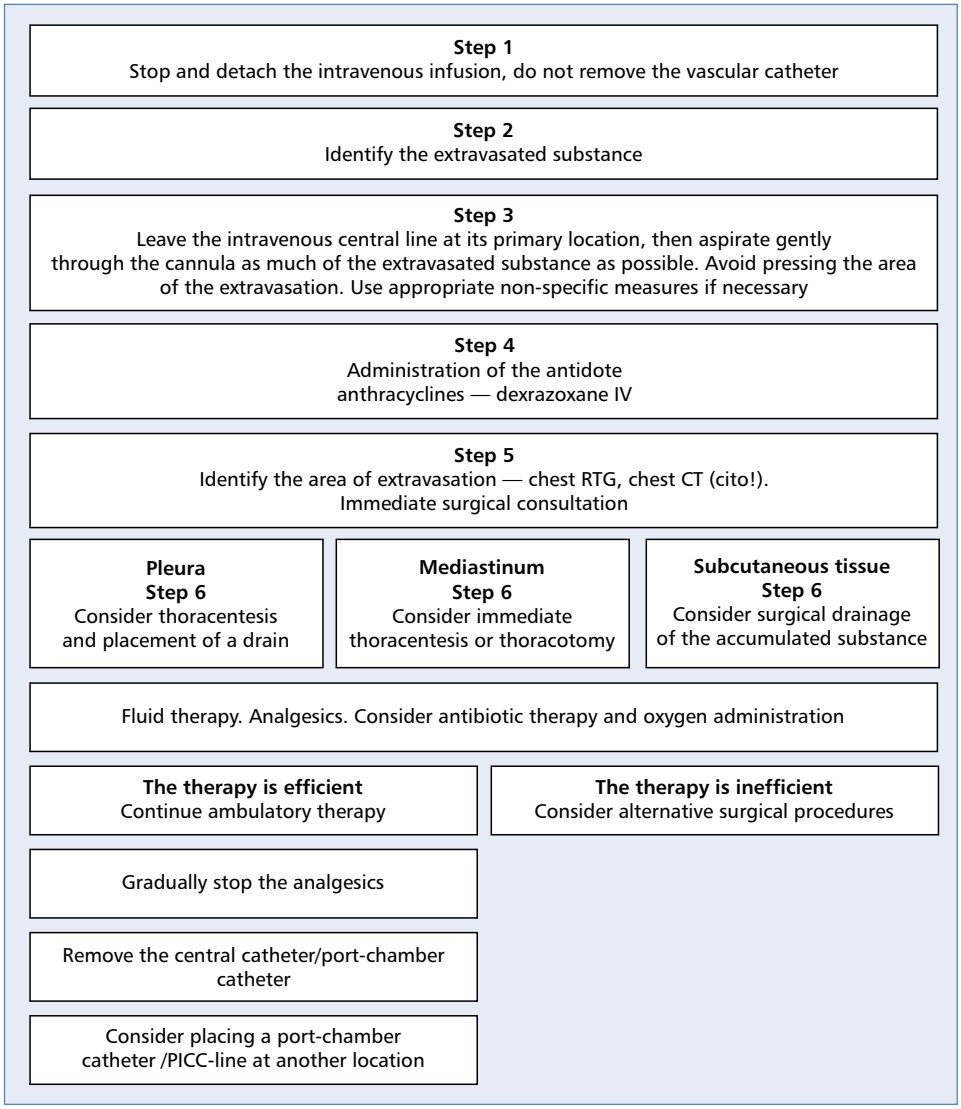

Figure 3. Management of extravasation through the central catheter/port-chamber catheter — EMO-EONS 2012 [38]

— DMSO (dimethyl sulfoxide-compress): anthracyclines;
— dexrazoxane (intravenously): anthracyclines.

Additional information

Flushing of the port

Level of evidence by ESMO

Flushing is recommended with physiological saline after termination of each infusion or blood taking (II, B) [1, 5, 6]. In order to avoid obstruction of the port that is not in use, flushing it every four weeks is recommended (III, C) [1]. The port-chamber catheter should be flushed every 4–6 weeks, (III, C); however, it is suggested that in the case of regularly used port this interval may be prolonged to three months (or even to six months in the case of port no longer used) [6, 30, 31]. Central catheter PICCS type should be flushed every week (III, C) [1, 3, 14].

Use of saline solution is recommended for flushing (III, C) [1, 3, 5, 6]. Flushing with heparin remains controversial. However, use of heparin lock is recommended [32, 33].

The occlusion of the catheter may impede the use of a port. Flushing of the chamber catheter system is the first step undertaken by the nurses. It is very important to define a standard of management as well as to understand its significance. Preventing blood backflow to the catheter and to the port chamber protects also against blood-related infections. Flushing and locking the port with fluids other than 0.9% NaCl (taurolidine) decreases the risk of blood-related infections of this central line and of the formation of a biofilm [34, 35].

If the infusion time exceeds 24 hours, the central line should by flushed every 8–12 hours [1, 3, 6].

Transfusions of blood products

A thick needle should be used when transfusing blood products through the port. After each unit of erythrocyte mass or platelet mass the intravenous line should be flushed with at least 20 ml NS or heparinised physiologic saline solution. After termination of the transfusion a port should be flushed with a quick infusion of crystalloid and then administered a "heparin or citrate lock".

A needle of thickness 18–19 G should be used when transfusing blood products, contrast materials, or using parenteral nutrition [3, 6].

Taking blood samples for tests

After the puncture of the port, in order to take a blood sample, it should be flushed with minimum of 10 ml normo saline (NS), and then 5 ml of blood taken, which is poured away, and then a blood sample taken for tests. It must be checked whether all flushing fluids (e.g. heparin, taurolidine) have been removed. If the blood is taken for blood culture, the port-chamber catheter should not be flushed and a sample taken directly for tests, and then the central line must be flushed with 10 ml of NS or heparinised physiological saline [3, 6, 35].

The risk of heparin use is infection because heparin stimulates *S. aureus* biofilm formation [32] also the risks associated with drug incompatibilities. Moreover, guidelines recommend the use of heparin in many different ways ranging from no heparin but NS as locking solution for peripheral cannulas to heparin at 10 to 100 U/mL for central venous catheters and TIVADs. For all these reasons, the use of alternative locking solutions should be considered. No clear evidence to indicate whether NS flushing is superior to flushing with heparine solution. [32, 39, 40].

If infection of the port is suspected (which may be confirmed by blood culture from both the port and from the peripheral vessel), the volume of the heparin lock should be limited and no infusions should be given through the port-chamber catheter (with the exclusion of the catheter-related infection) [1, 3, 5, 6].

Imaging test and planned radiotherapy

So-called 'power ports' signed with a violet colour are adjusted for administration through the pump of the radiological contrast materials. Radiological scans reveal the presence of a CT symbol on the base of the port-chamber. A contrast material should have a temperature of 37°C degrees, in order to decrease its viscosity.

Both the cost and the influence of this technique on the quality of the obtained image should be considered.

Silicon catheters have a high plasticity and elasticity and do not change their proprieties after irradiation [3, 36].

Personnel training

Only a trained nurse and treating personnel are authorised to use the central lines. Appropriate preliminary proceedings and use of port are important for the lifespan of these devices. The right training of the personnel who service the central lines improves the safety of patients and decreases the incidence of complications. The nurses who take care of patients should complete theoretical and practical training at a centre accredited to train and to certify, and they should then have practical training under the supervision of an experienced nurse. Each centre should have standards of port management; including all steps of the control, clinical use, and flushing of the port (PICC). The standards should involve questions considering the pain complaints at the area of the catheter, which may be a sign of an infection, displacement, or thrombosis. During the control exam, the placement of the port-chamber should be checked by palpation. Observation of the implantation site is necessary in order to detect any signs of infection. In case of any doubts, patients should be consulted by a physician — a member of the port-implanting team. It is mandatory to use aseptic techniques during all procedures associated with use of the port-chamber catheter according to the operative procedures. The port needles used during the long-lasting infusions must be changed as often as is indicated by the producer in the product manual.

Continuous improvement and practical training of the personnel is necessary to develop the right skill in port-a-cath use [37, 38].

Information for patients

Following the rules of good clinical practice, patients should receive complete information concerning the device and procedure. Then the patient may sign an informed consent form for implantation of the intravenous port.

A patient information folder for patients and their families has been prepared in order to facilitate the work of the "port team" (Fig. 4). The contents of this folder have also been published on the website of the Oncology Centre-Institute (www.coi.pl), as a Standard of Medical Proceedings of our clinic.

After implantation of totally implantable venous access devices (TIVADs), patient receives identification card and bracelet (power port), which ease device recognition.

It contains following information:

— data concerning the implanted port, including the length of the remaining catheter;
— the date of implantation;
— the name of the hospital and department;

ODDZIAŁ MEDYCYNY PALIATYWNEJ
KLINIKA DIAGNOSTYKI ONKOLOGICZNEJ I KARDIOLOGII

STANDARD POSTĘPOWANIA MEDYCZNEGO PR10.15_ST2

PORTY DOŻYLNE — WSKAZANIA, KWALIFIKACJA, IMPLANTACJA, POWIKŁANIA, UŻYTKOWANIE / PIELĘGNACJA I USUNIĘCIE

Opracowała: Dr Małgorzata LIPIEC
Sprawdziła pod względem merytorycznym: Dr n. med. Elwira GÓRAJ
Zatwierdziła: Dr n. med. Beata JAGIELSKA

Egz. nadz. nr
Egzemplarz informacyjny

WYDANIE 1

WSKAZANIA DO ZAŁOŻENIA PORTU DOŻYLNEGO:

1. Brak możliwości podawania chemioterapii przez żyły obwodowe.
2. Przewidywana duża ilość kursów i toksyczność chemioterapii.
3. Długotrwałe żywienie pozajelitowe.
4. Brak możliwości kaniulacji żył obwodowych.

KWALIFIKACJA DO ZABIEGU:

1. Badanie przedmiotowe pacjenta:
a. Brak zmian miejscowych w przewidywanej okolicy wkłucia.
b. Brak cech uogólnionej infekcji u chorego.
c. Stan chorego umożliwia położenie około 30-minutowe na wznak.
2. Badania laboratoryjne:
a. Wynik INR i APTT, D-dimery.
b. Poziom płytek krwi.
c. Poziom leukocytów krwi.

BEZWZGLĘDNE PRZECIWWSKAZANIA:

1. INR > 1,3
2. Trombocytopenia < 60 g/l.
3. Leukopenia < 3 g/l
4. Neutropenia < 1 g/l

JAK WYGLĄDA ZABIEG WSZCZEPIENIA PORTU DOŻYLNEGO?

Procedurę wykonuje lekarz anestezjolog w warunkach sali operacyjnej w trybie jednodniowym. W czasie zabiegu pacjent leży na plecach. Po odkażeniu skóry znieczulany jest miejscowo środkiem znieczulenia miejscowego przy pomocy nakłucia okolicy bocznej szyi i okolicy podobojczykowej. Wybraną żyłę (w zależności od indywidualnych warunków anatomicznych pacjenta) nakłuwa się specjalną igłą, następnie przy pomocy cienkiej prowadnicy dociera się tą drogą do żyły głównej górnej. Po prowadnicy wprowadza się miękki cewnik silikonowy, który następnie łączony jest ze specjalną komorą, wszywaną pod skórę, wyczuwalną jako kopułka. Najczęstszym miejscem wszycia komory jest okolica 4-5 cm pod obojczykiem. Sprawdzenie drożności portu (płukanie roztworem soli fizjologicznej), założenie szwów na skórę oraz opatrunku kończy zabieg.

Po zabiegu jest wymagana krótka obserwacja (do ok. 1 godziny) oraz wykonanie zdjęcia rentgenowskiego klatki piersiowej. Kontrola rentgenowska pozwala na potwierdzenie prawidłowego położenia portu. Pacjent powinien otrzymać opis zdjęcia. Po zabiegu pacjent może odpoczywać w pozycji siedzącej. W tym czasie można stosować ucisk miejsca operowanego. Implantowane aktualnie porty naczyniowe są bezpieczne podczas badania rezonansu magnetycznego (w przeciwnym wypadku pacjent zostanie o tym poinformowany).

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POWIKŁANIA WCZESNE:

1. Nakłucie tętnicy (5,3%) —łatwe do rozpoznania powikłanie wynikające z bezpośredniego sąsiedztw a naczyń. Nie stanowi dużego zagrożenia, wymaga zastosowania ucisku przed 5–10 min. i zmiany lokalizacji nakłucia. Korzystny jest okład z lodu.
2. Krwiak w okolicy portu (0,4%) —niekiedy w okolicy wkłucia dochodzi do wynaczynienia krwi. W większości przypadków wystarczającym postępowaniem w warunkach domowych jest ucisk i okład z lodu przez około 2 godziny. W przypadku braku poprawy należy zgłosić się do lekarza.
3. Odma opłucnowa (0,4%) —nakłucie przestrzeni opłucnowej prowadzące do zmniejszenia powierzchni płuca
4. wynikające z bezpośredniego sąsiedztw a szczytu płuca z miejscem implantacji portu. W zależności od stopnia natężenia może wymagać obserw acji albo nawet hospitalizacji z zastosowaniem drenażu klatki piersiowej.
5. Rozejście się rany —niekiedy wymaga ponownego zszycia chirurgicznego.
6. Nakłucie przewodu piersiowego, w którym płynie limfa (0,2%).

KRYTERIA WYPISU PACJENTA PO ZAŁOŻENIU PORTU:

1. Nieobecność objawów odmy opłucnowej, krwawienia do jam opłucnowych lub śródpiersia w obrazie radiologicznym.
2. Stabilny stan ogólny (nie gorszy niż przed zabiegiem).
3. Stabilne wartości ciśnienia tętniczego, tętna i liczby oddechów.
4. Nieobecność objawów krwawienia miejscowego.
5. Nieobecność istotnego bólu.
6. Nieobecność duszności (duszność o znanej przyczynie nie większej niż przed zabiegiem nie wyklucza możliwości wypisania chorego).
7. Zapewnienie opieki osoby dorosłej, pouczonej o zasadach postępowania w wypadku wystąpienia duszności, krwawienia lub gorączki.

POWIKŁANIA PÓŹNE:

1. Niedrożność cewnika (25%)
a. całkowita (2%).
b. częściowa (23%).
2. Zakrzepica żylna (6%).
3. Stan zapalny wokół portu (3,7%).
4. Zakażenie cewnikopochodne (1,2%).
5. Nieszczelność portu (1,4%).
6. Uwanie części cewnika (0,2%).
7. Martwica skóry nad portem powodująca przetokę (1,6%).

PIELĘGNACJA PORTU DOŻYLNEGO, MOŻLIWE PROBLEMY Z UŻYTKOWANIEM

Cewnik wymaga regularnego przepłukiwania — roztwór soli fizjologicznej. Płukanie układu powinno odbywać się co 4-6 tyg. Konieczne jest również utrzymywanie okolicy kopułki w czystości. Należy zawsze przestrzegać zachowania szczelności układu podczas infuzji. Do nakłuwania portów należy używać wyłącznie specjalnych igieł (igły Hubera lub igły o szlifie łyżkowym o rozmiarach 20-22G).

Najczęstszym problemem związanym z użytkowaniem cewnika jest jego niedrożność częściowa (podawanie przez port odbywa się bez przeszkód, a występuje brak cofania się krwi do strzykawki), której główną przyczyną jest powstanie skrzepliny w okolicy końcówki cewnika w żyle. W tym wypadku, aby wykluczyć nieszczelność układu cewnik-komora, lekarz, który zakładał port, wykonuje kontrolne dynamiczne badanie radiologiczne. W przypadku szczelnego układu i prawidłowego położenia cewnika port może być używany.

Przy całkowitej niedrożności (nie można podawać przez port i niemożliwa aspiracja krwi) – cewnik należy wymienić.

Niekiedy proces zakrzepowy może rozszerzyć się na sąsiednie naczynia żylne powodując zakrzepicę żylną. Objawy zakrzepicy powodowane utrudnionym odpływem żylnym z okolicy portu występują u ok. 6% pacjentów i objawiają się obrzękiem, zaczerwienieniem lub zasinieniem, bólem kończyny górnej po stronie założonego wkłucia, poszerzeniem żył powierzchownych tej okolicy (w rzadkich przypadkach nawet szyi, twarzy, górnej połowy ciała). Leczeniem z wyboru jest podawanie heparyny drobnocząsteczkowej — np. Fragmin, Fraxiparine, Clexane w iniekcjach podskórnych. W wybranych przypadkach, przebiegających z pogarszającym się stanem ogólnym pacjenta, konieczna jest hospitalizacja.

W przebiegu użytkowania portu należy liczyć się również z ryzykiem wystąpienia powikłań na tle infekcyjnym. Z reguły rozpoznanie ich nie nastręcza trudności, a objawy polegają na pojawieniu się bolesnego zaczerwienienia z wzmożonym ucieplieniem. Gdy proces ogranicza się do okolicy wkłucia, to z reguły wystarczającym postępowaniem jest zastosowanie antybiotyku (doustnie i / lub miejscowo). Natomiast objawy takie jak gorączka z dreszczami, wzmożona potliwość, złe ogólne samopoczucie, osłabienie, mogą nasuwać podejrzenie zakażenia uogólnionego (wówczas konieczna jest niezwłoczna kontrola lekarska).

Do **rzadkich problemów** z którymi mogą spotkać się pacjenci posiadający port dożylny należą:
a. przemieszczenie cewnika do góry (np. wskutek nasilonego, długotrwałego kaszlu, znacznego wysiłku fizycznego),
b. zaburzenia rytmu serca (drażnienie przez końcówkę cewnika),
c. uszkodzenia mechaniczne zestawu (np. nieszczelność, oderwanie).
W tych przypadkach wdrożone postępowanie zależy od indywidualnej sytuacji. Możliwa jest korekta położenia cewnika lub wymiana nieprawidłowego elementu. Jednak najskuteczniejszą metodą jest usunięcie lub ewentualnie wymiana całego układu.

W razie jakichkolwiek wątpliwości i pytań związanych z implantacją i użytkowaniem portu dożylnego, należy zgłosić się do lekarza bądź pielęgniarki w Klinice Diagnostyki Onkologicznej i Kardioonkologii lub Poradni Leczenia Bólu i Medycyny Paliatywnej.

USUWANIE PORTU

1. W razie wystąpienia powikłań zakrzepowych, infekcyjnych lub innych.
2. Ostateczne zakończenie terapii.
3. Na życzenie pacjenta.

INFORMACJE DLA PACJENTA
JAK SIĘ PRZYGOTOWAĆ DO ZABIEGU WSZCZEPIENIA PORTU DOŻYLNEGO?

1. Pacjent jest zgłaszany do zabiegu, przez lekarza prowadzącego, telefonicznie pod numer: 22 546 22 42, lekarz wystawia skierowanie do Kliniki Diagnostyki Onkologicznej i Kardioonkologii w celu implantacji portu dożylnego w ramach hospitalizacji jednodniowej.
2. Pacjent powinien:
a. uzyskać od lekarza prowadzącego skierowanie na badania krwi: morfologia, APTT, INR, D-dimery,
b. omówić z lekarzem prowadzącym konieczność odstawienia, zmiany dawkowania lub zastąpienia innym niektórych leków wpływających na krzepnięcie nawet do 2 tygodni od planowego zabiegu (aspiryna, tiklopidyna, klopidogrel, heparyna drobnocząsteczkowa, acenokumarol itp.).
c. wykonać zlecone badania nie wcześniej niż w ciągu 2 tygodni poprzedzających zabieg założenia portu dożylnego.
d. w dniu planowanego zabiegu zgłosić się około godziny 7.00 do Kliniki Diagnostyki Onkologicznej i Kardioonkologii na 7 piętrze, następnie zarejestrować się w Ruchu Chorych i ponownie zgłosić się do punktu pielęgniarskiego kliniki.
e. powstrzymać się od jedzenia, należy wypić co najmniej pół litra wody.
f. przynieść ze sobą wyniki badań, szlafrok, kapcie, bieliznę bawełnianą nową (z metką sklepową).

UWAGA: Po wszczepieniu portu dożylnego pacjent otrzymuje wypis około godziny 15.00. Powrót do domu koniecznie w asyście osoby towarzyszącej.

STANDARD POSTĘPOWANIA MEDYCZNEGO PR10.15_ST2_W1

POSTĘPOWANIE PO ZABIEGU WSZCZEPIENIA PORTU DOŻYLNEGO

1. W dniu wszczepienia portu dożylnego, po ustąpieniu znieczulenia miejscowego, może pojawić się ból w okolicy założonego portu. W takim przypadku zalecamy: Paracetamol 1000 mg co 6–8 godzin lub Pyralgin 1000 mg co 8 godzin (jeżeli nie ma uczulenia) lub Ibuprofen 400 mg co 8 godzin. Leki te są dostępne w aptekach bez recepty.
2. W nielicznych przypadkach może pojawić się duży krwiak schodzący poniżej piersi lub na plecy — w tej sytuacji należy niezwłocznie skontaktować się z lekarzem lub pielęgniarką z Kliniki Diagnostyki Onkologicznej i Kardioonkologii.
3. Od drugiego dnia od założenia portu należy codziennie, do czasu zdjęcia szwów, zmieniać opatrunek — myć się pod prysznicem mydłem hipoalergicznym, osuszać miejsce rany jałową gazą, następnie stosować Octenisept w sprayu i przyklejać jałowy opatrunek na suchą skórę (wymienione preparaty i opatrunki są dostępne w aptekach bez recepty).
4. Zdjęcie szwów odbywa się 12–14 dni po założeniu portu dożylnego w Poradni Chirurgicznej w miejscu zamieszkania chorego (wystawiamy skierowanie) lub w Poradni Leczenia Bólu i Medycyny Paliatywnej w Centrum Onkologii w Warszawie (również ze skierowaniem).

TELEFONY KONTAKTOWE
W PRZYPADKU WYSTĄPIENIA PROBLEMÓW DOTYCZĄCYCH PORTÓW DOŻYLNYCH ZAKŁADANYCH W KLINICE DIAGNOSTYKI ONKOLOGICZNEJ I KARDIOONKOLOGII:

22 546 21 10
CAŁODOBOWO
22 546 26 09
OD GODZINY 8.00–15.00 OD PONIEDZIAŁKU DO PIĄTKU

Figure 4. Information booklet for patients and their families

— information about whether the MRI test may be done;
— information about whether it is possible to infuse the contrast material (power port-violet colour).

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Appendix

A cannulation of a superior vena cava from the peripheral access (PICC) [1]

The central catheters of PICC (peripherally inserted central catheter) type have become more and more popular, especially because the procedure is less expensive than implantation of a port-chamber catheter. The procedure may be done at the patient's bed, but usually it is done in the operating theatre. The method of the peripheral cannulation of a central vein is considered less invasive and burdened with lower risk of periprocedural complications [1, 2].

The PICC catheters may be placed by qualified nurses [3].

If we plan to use this method in patients with neoplastic diseases, we should remember to qualify the patient before the peripheral veins become weakened by chemotherapy.

Indications and contraindications

PICCs are recommended by the guidelines about using a venous access device (VAD) for infusions planned for 14 or more days (I, A), which includes:

— administration of the cycles of chemotherapy;
— cyclic administration of hyperosmotic or irritating fluids;
— administration of fluids in palliative patients;
— use of intravenous palliative therapy (e.g. antibiotics therapy, pain management);
— short-term administration of the parenteral nutrition;
— repeated blood products transfusions;
— need of frequent taking of blood samples (e.g. every 8 hours);
— use of kidney replacement therapy under the insufficiency stage 3b [4–6].

Special indications

Clinical situations when placement of a PICC catheter is safer than attempts to implant a port-chamber catheter include:

— treating patients with coagulation disorders;
— presence of anatomic anomalies that are inherited or acquired during the disease course (e.g. post-radiation changes or infiltrations at the typical sites of port-chamber catheter implantation);
— difficulties laying a patient in an appropriate position, e.g. Trendelenburg (dyspnoea, vomiting, etc.) (II, B);
— presence of tracheotomy (placement of the catheter tip on the upper limb permits avoidance of any contact with mouth or trachea secretions and decreases the risk of infection) [5].

The main indication concern patients who require a central line for a relatively short period of time (up to three months) [5].

Contraindications

Contraindications include:

— prior episodes of upper limb thrombosis or surgical operations at the site of a potential insertion;
— presence or suspicion of an infection attributable to previous vein catheters;
— presence of skin changes at the insertion site [6–8].

Technique of cannulation

PICCs may be placed in aseptic conditions at the patient's bed, under ultrasound control, or in the operating theatre. A procedure is done in a local anaesthesia. The rules of asepsis are the same as during the implantation of a port-chamber catheter.

An indirect method to confirm the location of the catheter tip is the occurrence of transient changes of the morphology of ECG waves (increase of a P wave amplitude) and its characteristic shape contingent to the location of the guideway (I, B) [3, 5].

In the case of this method not being authoritative, a postprocedural location of the catheter tip should be radiologically controlled. The optimal location of the

catheter tip is a junction of the superior central vein and of the right atrium; for PICCs the location in the right atrium is acceptable (I, B) [5].

A procedure is technically easier and less painful than the implantation of a port-chamber catheter (no incision of the tissues). A lower number of early complications.

Correct fixation and dressing guaranty long use. Regular changes of dressing and control of whether the catheter tip remains dry are required.

Patients require help in changing the dressing (which excludes people living alone). It is not recommended to cannulate the only upper limb [9].

The veins above the elbow-bow may be cannulated: cephalic, basilic, and brachial vein.

Complications

Similar complication as in the case of port-chamber catheters are reported. Their incidence is changeable:
— displacement of the catheter tip;
— occlusion;
— thrombosis — statistically it is more frequent than in port-chamber catheters;
— catheter-related infections;
— accidental removal (II, B) [3, 5, 7, 8, 10].

It is important to evaluate properly the proportion of the vein diameter to the catheter diameter. In order to minimise the risk of thrombosis, the size of a catheter should be well adjusted to the vein diameter so that it would fill not more than 33–50% of its inside. 45% is considered an optimal value [3, 4, 8].

Flushing and care

The general rules of flushing the PICCs are similar to the recommendations developed for port-chamber catheters flushing. Flushing with saline is recommended (III, C) [1, 3, 5, 6]. Flushing with heparin remains controversial. The immediate use of heparin lock is recommended [12, 13] if only they are compatible with the administered infusions. Exception — the central lines of PCC type should be flushed once a week (III, C) [1, 4, 11].

PICCs should always be flushed:
— after placement;
— before and after infusion of fluids;
— before and after taking a blood sample [1, 3, 11].

The PICC type catheters should not be left in a vessel when they are no longer regularly used. In theory, the access may be safely left in a vessel for a much longer period of time. One-year observations are reported. However, in order to minimise the risk of thrombosis a PICC that is not used should be quickly removed by trained personnel [5].

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