

Port-a-Cath-related complications in 252 patients with solid tissue tumours and the first report of heparin-induced delayed hypersensitivity after Port-a-Cath heparinisation

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The use of the subcutaneous Port-a-Catheters (Port-a-Caths) provides an important mean of venous access for oncological patients. The aim of our retrospective consecutive single-centre study was to investigate Port-a-Cath-related complications in 252 cancer patients. Overall period of Port-a-Caths maintenance was 25 months. The strategy of our centre is to keep Port-a-Caths *in situ* up to the end of follow-up in adjuvant cancer patients. A total of 22 complications were recorded (8.73%). Interventional complications occurred in four patients. The main complications during Port-a-Cath use included thrombosis (4 patients, 1.58%), infections (4 patients, 1.58%), persistent pain or discomfort (3 patients, 1.19%) and dislocations (2 patients, 0.79%). Median time to the occurrence of any type of complications was 4.5 months. Eleven Port-a-Caths were removed due to complications (4.36%). Similar rate of Port-a-Cath-related thrombosis/infection was seen in adjuvant and advanced cancer patients (no statistical significance). Continuous infusion of anticancer therapy via a Port-a-Cath system is a relatively safe procedure, although major complications might occur. We are first to describe heparin-induced delayed hypersensitivity after heparinisation of Port-a-Cath. This fact should influence the preference to keep the Port-a-Cath after completion of adjuvant anticancer treatment.

Keywords: Port-a-Cath, venous port system, complications, heparin hypersensitivity, delayed-type hypersensitivity reaction.

INTRODUCTION

Implanted Port-a-Catheters (Port-a-Caths) are totally implantable vascular access devices designed to provide

repeated access to the vascular system. They are indicated for the withdrawal of blood samples, delivery of medications, intravenous fluid, parenteral nutrition solutions and blood products (Bard Access Systems 2003). The use of the subcutaneous Port-a-Caths provides an important mean of venous access for critically ill patients. Its use started in early 1980 in oncological patients (Dal Molin *et al.* 2011).

However, serious complications can occur, both perioperatively and during Port-a-Cath use. These

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complications include (Bard Access Systems 2003; Subramaniam *et al.* 2011): pneumothorax, malposition, bleeding from venepuncture point, arterial puncture, hydropneumothorax, lesion of phrenic nerve or brachial plexus, AV fistula, pocket haematoma, arrhythmia from cardiac perforation, cardiac tamponade, haemothorax, catheter embolism, thoracic duct injury, air embolism. Other complications include catheter or Port-related sepsis, endocarditis, pocket infection, catheter or Port occlusion, catheter disconnection/fracture, malfunction, difficulty to take blood, catheter fracture with embolisation, thrombosis of Ports, vascular thrombosis. Well documented in medical literature are also difficulty to localise Port, catheter or Port erosion through the skin, extravasation of fluids/leakage, catheter occlusion, damage or breakage due to compression between the clavicle and first rib (pinch-off syndrome, Lin *et al.* 2010), device rotation or extrusion, fibrin sheath formation, intolerance reaction to implanted device, inflammation, necrosis, or scarring of skin over implant area, laceration or perforation of vessels or viscus, spontaneous catheter tip malposition or retraction, vessel erosion, mediastinal infusion with tracheal necrosis (Renaud *et al.* 2011). Finally, risks normally associated with local and general anaesthesia, surgery and post-operative recovery should be mentioned.

This retrospective study analyses Port-a-Cath-related complications in 252 consecutive cancer patients at a single institution. The following data were collected: age, primary tumour, cause of Port-a-Cath implantation, related complications and the necessity for device removal, reason for removal, period of Port-a-Cath maintenance, time to occurrence of complications and type of complication. Moreover, we specified if Port-a-Cath-related complications occurred in patients who received just adjuvant anticancer treatment ('adjuvant patients') or in patients treated with palliative chemotherapy ('advanced cancer patients'). It was a spontaneous observational retrospective research; no ethical approval was needed. Any specific fund was obtained for the study.

PATIENTS AND METHODS

General characteristics of the patients are summarised in Table 1. Of the 252 cancer patients 144 were men (57.1%) and 108 (42.9%) were women. All patients underwent Port-a-Cath placement between January 1997 and September 2011. Reasons for implantation included type of chemotherapy and/or difficult venous access. Preoperative evaluation included history and physical examination (clavicle fracture, cervical or mediastinal adenopathy, chest wall tumours, pneumothorax history, body habitus,

Table 1. General characteristics of 252 cancer patients

Age at the time of the Port-a-Cath placement	
Median	62 years
Range	19–84 years
Sex	
Male	144 patients (57.1%)
Female	108 patients (42.9%)
Cause of Port-a-Cath implantation	
Rectal cancer	121 patients (48.02%)
Colon cancer	116 patients (46.03%)
Mammary cancer	8 patients (3.17%)
Sarcoma	2 patients (0.79%)
Anal cancer	1 patient (0.396%)
Hepatocellular carcinoma	1 patient (0.396%)
Pancreatic cancer	1 patient (0.396%)
Gastric cancer	1 patient (0.396%)
Ampulla of Vater cancer	1 patient (0.396%)
Sites of metastases	
Liver	115 patients (45.63%)
Lung	60 patients (23.81%)
Peritoneum	14 patients (5.55%)
Lymphonodes	9 patients (3.57%)
Bone	9 patients (3.57%)
Anastomosis	6 patients (2.38%)
Locoregional recurrence	5 patients (1.98%)
Abdominal mass	2 patients (0.79%)
Spleen	2 patients (0.79%)
Kidney	2 patients (0.79%)
Adrenal gland	2 patients (0.79%)
Ileum	1 patient (0.39%)
Duodenum	1 patient (0.39%)
Colostomy	1 patient (0.39%)
Skin	1 patient (0.39%)
Soft tissue	1 patient (0.39%)
Bladder	1 patient (0.39%)
Mesenterium	1 patient (0.39%)
Pleura	1 patient (0.39%)
Central nervous system	1 patient (0.39%)
Retroperitoneum	1 patient (0.39%)
Overall period of Port-a-Cath <i>in situ</i>	
Median	25 months
Range	6 days to 111 months

pulmonary disease). The other important clinical notes were: unilateral breast carcinoma, ulcerations on the chest wall, previously implanted pacemakers and Port-a-Caths (Teichgräber *et al.* 2011). A history of venous thromboembolism was not considered an exclusion criterion for Port-a-Cath placement. All patients had chest radiographs for preoperative identification of mass lesions or anatomic anomalies (Barbetakis *et al.* 2011). A Titanium Implanted Port (BardPort®) with Polyurethane 8.0 French Single-Lumen venous catheter was used from 2001 on, whereas an MRI Implanted Low-Profile Port (BardPort®) with Attachable Open-Ended Silicone 6.6 French Single-Lumen venous catheter was used in 14 patients up to 2000. BardPort® catheters were implanted under sterile conditions in the right subclavian vein by infraclavicular surgical approach

using the blind Seldinger technique in Day Surgery Department. After the device implantation, all patients had a chest radiographs to evaluate the correct position and perioperative complications of Port-a-Cath. To help prevent clot formation and catheter blockage, Port-a-Cath was filled with sterile heparinised saline (50 UI/5 ml) after each use. If the device remained unused for long periods of time, the heparin lock was changed every 30–40 days, according to our internal guidelines. The catheter-indwelling-time was calculated from the date of insertion to one of the following observation end points including: 30 September 2011, date of the patient's death, date of catheter failure or date of last visit.

The association of Port-a-Cath-related complications in adjuvant/advanced cancer patients was evaluated using a Fisher's exact test. Statistical analyses were performed using XLSTAT, version 2009.3.02 (Addinsoft, New York, NY, USA). Only *P*-values <0.05 were considered statistically significant.

RESULTS

General characteristics of cancer patients

The patients' demographic and baseline characteristics are presented in Table 1. In two patients, Port-a-Cath was not placed due to pre-existing thrombosis of right internal jugular vein and ventricular extrasystole during the implant procedure. Median age at the time of the Port-a-Cath implantation was 62 years. Of 252 patients 144 were men (57.1%) and 108 (42.9%) were women. The most common pathology which required Port-a-Cath implantation was rectal cancer (121 patients, 48.02%), colon cancer (116 patients, 46.03%) and mammary cancer (8 patients, 3.17%). The predominant sites of metastases were liver (115 patients, 45.63%) and lung (60 patients, 23.81%). Overall period of Port-a-Caths *in situ* was 25 months, range 6 days to 111 months.

General Port-a-Cath-related complications

Overall Port-a-Cath-related complications in our study were 8.73% (22 complications). We divided these complications into two groups: perioperative and complications during Port-a-Cath use. Interventional complications occurred in four patients and included accidental arterial puncture (1 patient, 0.39%), ventricular extrasystole (1 patient, 0.39%), pre-existing thrombosis of right internal jugular vein (1 patient, 0.39%) and pneumothorax (1 patient, 0.39%). Complications during Port-a-Cath use included thrombosis (4 patients, 1.58%), infections (local

Table 2. Port-a-Cath-related complications

Port-a-Cath-related complications	
Overall complications	22 (8.73%)
Perioperative complications	
Accidental arterial puncture	1 (0.39%)
Ventricular extrasystole	1 (0.39%)
Pre-existing thrombosis of right internal jugular vein	1 (0.39%)
Pneumothorax	1 (0.39%)
Complications during Port-a-Cath use	
Thrombosis	4 (1.58%)
Infection – local	3 (1.19%)
Infection – systemic	1 (0.39%)
Persistent pain/discomfort	3 (1.19%)
Dislocation	2 (0.79%)
Malfunction	1 (0.39%)
Difficulty to localise Port	1 (0.39%)
Accidental trauma	1 (0.39%)
Extravasation	1 (0.39%)
Hypersensitivity reaction to heparin	1 (0.39%)
Time to occurrence of complication	
Median	4.5 months
Range	0–52 months

and systemic, 4 patients, 1.58%), persistent pain or discomfort in the site of Port-a-Cath (3 patients, 1.19%), dislocations (2 patients, 0.79%), malfunction (1 patient, 0.39%), difficulty to localise Port-a-Cath (1 patient, 0.39%), accidental trauma of Port-a-Cath (1 patient, 0.39%), extravasation (1 patient, 0.39%) and hypersensitivity reaction after heparin administration (1 patient, 0.39%). Median time to the occurrence of any type of complications was 4.5 months (range 0–52 months). See Table 2. Eleven Port-a-Caths were removed due to complications (4.36%) until September 2011. The main reason for the device removal was infection (3 patients), thrombosis (2 patients), persistent pain/discomfort (2 patients), other reasons including malfunction (1 patient), accidental trauma in the site of Port-a-Cath (1 patient), extravasation (1 patient), hypersensitivity reaction to heparin (1 patient). There is another device removal programmed due to difficulty to localise Port-a-Cath. Overall duration from Port-a-Cath implantation to its removal was 20 months (range 6 days to 60 months). In one patient the device was removed after 6 days due to persistent neck and shoulder pain. See Table 3.

Comparison of Port-a-Cath-related complications in adjuvant/advanced cancer patients

Seventy-four patients received just adjuvant anticancer therapy ('adjuvant cancer patients', 29.37%). Overall Port-a-Cath-related complications in this group of patients were 14.86% (11 patients). Namely, we saw perioperative

Table 3. Necessity for Port-a-Cath removal due to complication

Necessity for Port-a-Cath removal due to complication	
Overall	11 patients (4.36%)
Infection	3 patients
Thrombosis	2 patients
Persistent pain/discomfort	2 patients
Malfunction	1 patient
Accidental trauma	1 patient
Extravasation	1 patient
Hypersensitivity reaction to heparin	1 patient
Difficulty to localise Port	1 patient: removal planned
Period from Port-a-Cath implantation to its removal due to complication	
Median	20 months
Range	6 days to 60 months

complications which include accidental arterial puncture (1 patient, 1.35%), ventricular extrasystole (1 patient, 1.35%), pre-existing thrombosis of the right internal jugular vein (1 patient, 1.35%) and pneumothorax (1 patient, 1.35%). Complications during the use of Port-a-Caths included thrombosis (1 patient, 1.35%), systemic infection (1 patient, 1.35%), persistent pain or discomfort (3 patients, 4.05%), difficulty to localise Port-a-Cath (1 patient, 1.35%) and hypersensitivity reaction to heparin (1 patient, 1.35%). One hundred and seventy-eight patients received adjuvant and/or at least one line of palliative chemotherapy ('advanced cancer patients', 70.63%). Overall Port-a-Cath-related complications were 6.1% (11 patients). We did not see any perioperative complications. Complications during the use of Port-a-Caths included thrombosis (3 patients, 1.68%), local infection (3 patients, 1.68%), malfunction (1 patient, 0.56%), dislocation (2 patients, 1.12%), accidental trauma in the site of the Port-a-Cath (1 patient, 0.56%), extravasation (1 patient, 0.56%). Port-a-Cath removal due to complication was necessary in 5.4% of adjuvant cancer patients and 3.9% advanced cancer patients.

A statistical significant difference was seen comparing the occurrence of any type of complications in adjuvant vs. advanced cancer patients ($P = 0.04$). On the contrary, no statistical significant difference was seen comparing infection complication in adjuvant vs. advanced cancer patients ($P = 1.0$), the same for thrombosis complications. Finally, no statistically significant difference was seen in the necessity for Port-a-Cath removal due to complications in adjuvant vs. advanced cancer patients ($P = 0.73$). See Table 4.

DISCUSSION

The Port-a-Caths are well accepted by most cancer patients (Ignatov *et al.* 2009). According to study of

Ignatov *et al.*, only 9.0% of the cancer patients were dissatisfied with the devices. The main reasons of their dissatisfaction included poor cosmetic results and limitation of movement. Other reasons were pain, feeling of a foreign body under the skin, anxiety and encumbrance on daily activity. Ninety-six per cent of the cancer patients would further recommend a Port-a-Cath to other patients. Only 18% patients desired its removal after completion of treatment. The decision to keep the Port-a-Cath after completion of treatment is also related to the physician's advice (Ignatov *et al.* 2009). Port-a-Caths are preferred to percutaneous tunnelled catheters because of several advantages. Generally, subcutaneous devices interfere less with patient daily activities because of no need of external dressing. Moreover, Port-a-Caths have relatively low incidence of infections and malfunctions and require only monthly flushes of heparinised saline (Gallieni *et al.* 2008). According to Gallieni *et al.* (2008), the global cost for each device per patient, treated for a 6-month period, was \$US1.971. The strategy of our centre is to maintain Port-a-Caths *in situ*, in accordance with the patient and in the absence of any complication, up to the end of the oncological follow-up in adjuvant cancer patients. The technical success concerning the Port-a-Cath implantation in our study was 98.8% (249 of 252), comparable with literature (99.3% in the study Goltz *et al.* 2010). Complications were observed in a total of 22 patients (8.73%) of 252. We did not observe any Port-a-Cath-related death in our study.

Port-a-Cath-related perioperative complications

We observed four perioperative complications: accidental arterial puncture, ventricular extrasystole, pneumothorax and pre-existing thrombosis of right internal jugular vein. An accidental arterial puncture did not cause any further significant complication in our study. This complication is rare, with the rate 0.26% (Biffi *et al.* 2004). A ventricular extrasystole as a consequence of the Port-a-Cath implantation was successfully treated with device removal. Atrial fibrillation as a complication of Port-a-Cath implantation was reported in literature with rate 0.1–0.9% (Barbetakis *et al.* 2011). A small asymptomatic pneumothorax was seen in chest radiograph, obtained immediately after procedure, in one of our patients. It required just observation. Pneumothorax rate in literature is low, comprised between 0.5% and 6% of cases (Barbetakis *et al.* 2011). Its prevalence depends on differences in clinical features, access site and operator experience (Gallieni *et al.* 2008). Finally, one patient had a pre-existing thrombosis of right internal jugular vein.

Table 4. Comparison of Port-a-Cath-related complications in adjuvant/advanced cancer patients

	Adjuvant cancer patients	Advanced cancer patients
Number of patients	74 patients (29.37%)	178 patients (70.63%)
Time to occurrence of complication		
Median	0 months	7 months
Range	0–52 months	28 days to 24 months
Port-a-Cath-related complications		
Overall complications	11 (14.86%)	11 (6.1%)
Perioperative complications		
Accidental arterial puncture	1 (1.35%)	0
Ventricular extrasystole	1 (1.35%)	0
Pre-existing thrombosis of right internal jugular vein	1 (1.35%)	0
Pneumothorax	1 (1.35%)	0
Complications during Port-a-Cath use		
Thrombosis	1 (1.35%)	3 (1.68%)
Infections – local	0	3 (1.68%)
Infections – systemic	1 (1.35%)	0
Malfunction	0	1 (0.56%)
Dislocation	0	2 (1.12%)
Persistent pain/discomfort	3 (4.05%)	0
Difficulty to localise Port	1 (1.35%)	0
Accidental trauma	0	1 (0.56%)
Extravasation	0	1 (0.56%)
Hypersensitivity reaction to heparin	1 (1.35%)	0
Necessity for Port-a-Cath removal due to complication	4 patients (5.4%)	7 patients (3.9%)

Port-a-Cath-related complications during its use

In the oncology setting, complications occurring after the first chemotherapy course given through the device can be considered in this group (Gallieni *et al.* 2008).

Thrombosis

Cancer and chemotherapy are recognised risk factors for development of central venous thrombosis in patients with a central venous catheter. This is because of direct release of thrombotic factors by neoplastic cells, decrease of antithrombotic natural factors induced by the tumour, and the procoagulant activity of many anticancer drugs (Gallieni *et al.* 2008). We suspect a Port-a-Cath-related thrombosis if following symptoms occur: impaired catheter flow, swelling or oedema of the arm or the development of collateral veins in the shoulder/chest area. Our suspicion was always confirmed by ultrasound or phlebography. Factor V Leiden was not determined in our series of patients. We did not use thromboprophylaxis to prevent catheter-related thrombotic complications. After the thrombosis diagnosis, the treatment with low-molecular-weight heparin was initiated subcutaneously and no further thrombosis was seen in any of them. In our study, it was described the incidence of Port-a-Cath-related thrombosis of 1.58%. Median time to the occurrence of complication was 8 months (range 2–31 months). In very

recently published studies (Biffi *et al.* 2009; Ignatov *et al.* 2009; Heibl *et al.* 2010; Subramaniam *et al.* 2011), the rate of Port-a-Cath-related thrombosis was 2.1–12.8%. In another study (Nobili *et al.* 2010), no statistical significance between thromboembolic events and the location or the extent of metastatic lesions was found. The statistical significance did not reach either other risk factors such as prior venous thromboembolism, age, treatment with antiangiogenetic agents, granulocyte-stimulating growth factors, erythropoietin, hormonal therapy. Goltz *et al.* described a trend towards less thrombotic complications if the Port-a-Cath was placed on the left side ($P = 0.06$) (Goltz *et al.* 2010). Laboratory results at the time of implantation had no predictive value for bleeding complication (Goltz *et al.* 2010). A literature search on prophylactic treatment in cancer patients with Port-a-Cath or receiving chemotherapy did not present evidence to support the use of routine prophylactic anticoagulation for these patients (Voog *et al.* 2007). The Italian Study Group for Long Term Central Venous Access suggests considering prophylaxis with a single daily dose of low-molecular-weight heparin (e.g. enoxaparin 100 UI/kg) in high-risk patients, including those who have a family history of thrombotic events or previously suffered from idiopathic venous thrombotic events (Campisi *et al.* 2007). In conclusion, the rate of Port-a-Cath-related thrombotic events in our series of cancer patients was low in the absence of antithrombotic prophylaxis.

Infections

In the literature, it has been shown an association of central venous catheter-related infections with thrombosis. After an episode of central venous catheter-related infection, the risk of developing the thrombosis increases (van Rooden *et al.* 2005). We consider highly clinically suspicious for this diagnosis if local pain, redness and fever appear. In all patients with these symptoms, bacterial culture of the catheter tip and peripheral blood was obtained. Antibiotic treatment was required in all these cases. In our study, overall rate of Port-a-Cath-related infection was 1.58% (total 4 patients, 3 patients had local pocket infection, 1 patient systemic infection). Port-a-Cath removal due to infection complication was necessary in three patients. In one patient with Port-a-Cath, related systemic infection was detected in blood cultures *Staphylococcus aureus* from the catheter tip, and *S. aureus* and *Staphylococcus epidermidis* from peripheral blood. This patient did not necessitate the Port-a-Cath removal. Median time to the occurrence of complication was 12 months (range 3–24 months). In literature, Port-a-Cath-related infections vary from 0.8% up to 9.1%. *S. aureus* and *S. epidermidis* are the most frequent organisms found also in another study (Heibl *et al.* 2010). There is conflicting evidence on the value of prophylactic antibiotics given prior to insertion of Port-a-Caths. In a recent study, there was no statistical difference between those patients without and those who had an antibiotic prophylaxis (Goltz *et al.* 2010). From antibiotic prophylaxis might benefit specific patient groups (e.g. neutropenic). The negative role of neutropenia in promoting Port-a-Cath-related infections was demonstrated by a study of nosocomial septic events in cancer patients: 61% of septic episodes occurred when the patients were neutropenic (Morrison *et al.* 1990).

Other rare complications

In our study, shoulder and neck pain occurred in three patients (1.19%). This complication necessitated the removal of two Port-a-Caths. In all patients complaining of pain, radiological and microbiological investigations are necessary to exclude thrombosis and infections (Nightingale *et al.* 1997). Other complications include malfunction (impossibility to flush fluids and/or draw blood), Port-a-Cath dislocation or difficulty to localise Port-a-Cath. Finally, one case of extravasation occurred in our study, requiring Port-a-Cath removal and local medical care. Extravasation injury has been reported to occur in 0.1% to 6.5% of cases (Ener *et al.* 2004).

Hypersensitivity to heparin

This complication was observed in one 79-year-old female patient. The patient completed adjuvant therapy for colon cancer in August 2007. Intravenous heparin solution (50 UI/5 ml) was administered every 30–40 days to prevent clotting of her BardPort® access, according to our internal guidelines, without any problems. The patient had no history of previous hypersensitivity reactions. After 52 months of Port-a-Cath maintenance, during administration of intravenous heparin solution, within a few minutes, generalised hypersensitivity reaction was seen, with pruriginous erythema on the plantar side of the hand and face, rhinitis, lacrimation, nausea and vomiting. No thrombocytopenia but leucocytosis ($13.48 \times 10^3/\text{mmc}$) was seen after 6 h. Treatment with hydrocortisone and antihistamines gradually led to a complete recovery. At the time, the aetiology of this event was not further investigated. No further attempts of heparin administration were proved, and the patient successfully removed the Port-a-Cath. Finally, the patient referred the same type of reaction of milder intensity after previous Port-a-Cath heparinisation 40 days ago, without consulting any physician.

Allergic reactions from heparines are very rare (Bircher *et al.* 2006). Literature describes that heparin may cause all types of allergic reactions, particularly cell-mediated type IV and antibody-mediated type II reactions.

Cell-mediated hypersensitivity to heparines In sensitised individuals, maculopapular exanthemas may be observed after a sensitisation period of at least 7–10 days, but more often after weeks to months (Jappe & Gollnick 1999; Wütschert *et al.* 1999). Risk factors appear to be female gender, obesity and repetitive or long-lasting treatment (Bircher *et al.* 2006).

Immediate hypersensitivity to heparines Palmoplantar pruritus after subcutaneous and intravenous application of heparines has been described. Reported symptoms include pruritus, urticaria, conjunctivitis, rhinitis, bronchial asthma (Jappe & Gollnick 1999; Bottio *et al.* 2003) and anaphylaxis (Bottio *et al.* 2003).

In conclusion, we report the first case of heparin-induced delayed hypersensitivity after heparinisation of Port-a-Cath in a cancer patient. The prolonged heparinisation of Port-a-Cath in cancer patients may lead to possible dangerous hypersensitivity reactions to heparins (Berkun *et al.* 2004).

Comparison of Port-a-Cath-related complications in adjuvant vs. advanced cancer patients

We observed higher rate of complication in adjuvant cancer patients (14.86%) compared to advanced cancer patients (6.1%); this difference was statistically significant ($P = 0.04$). This fact can be explained by accidental more perioperative complications in the adjuvant group of patients. The rate of thrombosis-related Port-a-Cath complication was similar in both adjuvant and advanced cancer patients (1.35% vs. 1.68% respectively, $P = 1.0$), as well as the rate of infection complication (1.35% vs. 1.68% respectively, $P = 1.0$) and the necessity of device removal (5.4% vs. 3.9% respectively, $P = 0.73$). The median time to occurrence of complication in advanced cancer patients was 7 months. In conclusion, similar, statistically non-significant rate of Port-a-Cath-related thrombosis/infection was seen in adjuvant and advanced cancer patients. See Table 4.

CONCLUSION

It can be concluded that continuous infusion of anticancer therapy via a Port-a-Cath system is a relatively safe

procedure. It can be used for long periods with a low rate of complications, although major complications might occur. We observed higher rate of complication in adjuvant cancer patients compared to advanced cancer patients ($P = 0.04$). This fact can be explained by accidental more perioperative complications in the adjuvant group of patients. Similar rate of Port-a-Cath-related thrombosis/infection was seen in adjuvant and advanced cancer patients (no statistical significance). To the best of our knowledge this is the first report describing heparin-induced delayed hypersensitivity after heparinisation of the Port-a-Cath in a cancer patient who completed adjuvant therapy. The prolonged heparinisation of Port-a-Cath in cancer patients may lead to possible dangerous life-threatening heparin-induced delayed hypersensitivity. This fact should influence the preference to keep the Port-a-Cath after completion of adjuvant anticancer treatment.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The authors indicated no potential conflicts of interest. All authors gave final approval.

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