Original Article

Use of port-a-cath in cancer patients: a single-center experience

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Abstract

Introduction: Central venous catheters play an important role in the management of cancer patients. Different types of devices are associated with different patterns of complications. We report on the pattern of use and rate of complications of port-a-caths in patients diagnosed with malignant cancer at a single institution.

Methodology: The data were collected retrospectively from patients who received the treatment for solid tumors or lymphoma through a port-a-cath at the Sultan Qaboos University Hospital (SQUH) between January 2007 and February 2013.

Results: A total of 117 port-a-caths were inserted in 106 patients. The majority (86; 73.5%) were implanted by an interventional radiologist, and the right internal jugular vein was accessed in 79 (67.5%) patients. Mean catheter indwelling time was 354 (range 3–1,876) days for all patients, 252 (3–1,876) and 389 days (13–1,139) for patients with and without complications, respectively. Thirty (25.6%) port-a-caths were removed prematurely, mainly due to infectious complications, while 17 (14.5%) were removed after completion of treatment. *Staphylococcus aureus* was the most frequently isolated organism, found in 8 (6.8%) patients. Underlying diagnosis ($p < 0.001$), chemotherapy regimen ($p < 0.001$), sensitivity to antibiotics ($p = 0.01$), and any complication ($p < 0.001$) were significant factors affecting the duration of port-a-cath use. None of these factors were significant on multivariate cox regression analysis.

Conclusions: The mean duration of port-a-cath use was almost one year. Infection was the most common complication leading to premature removal, followed by port thrombosis.

Key words: port-a-cath; chemotherapy; infection; cancer; Oman.

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Introduction

Central venous catheters play an important role in the management of patients with malignancies. They serve not only for safe administration of chemotherapy, but also for prolonged administration of fluids, blood and blood products, antibiotics, parenteral nutrition, and frequent blood sampling [1-5]. There are different types of venous access devices, but totally implantable venous access ports (TIVAP) are now used most commonly because of their safety, cosmesis, low infection rates, ease of implantation, and use [1,3,6,7]. TIVAP can be implanted in an office setting under local anesthesia. Interventional radiologists can implant the TIVAP in an outpatient setting, offsetting the costs [8]. However, the procedure and its subsequent maintenance are not free of side effects; infections, hematoma, malpositioning, pneumothorax, thrombosis/blockage, embolization, and catheter fracture remain important complications associated with TIVAP [1,2,8,9]. Over the course of the past decade, reports suggest that the complication rate has decreased with improved techniques and material [10].

There are different kinds of devices used for long-term venous access in cancer patients. Earlier, the Hickman line and Broviac catheters were used; more recently, port-a-caths, which are implanted subcutaneously, are being used more commonly due to their ease of access and lower complication rates [11,12]. There are many reports in the literature on the increasing use of port-a-cath devices from developed countries, but scant data have been reported from developing countries on the use of such devices, which may be due to unavailability of the technique, cost, and/or patient unwillingness.

Hence, here we present our experience with the use of port-a-cath in patients with solid tumors at a university hospital in Oman. To the best of our knowledge, this is the largest data set on the port-a-cath-associated side effects reported from this region. Our aim was to determine the total length of stay/indwelling time and reasons for premature removal.

Sultan Qaboos University Hospital (SQUH) is 450-bed tertiary referral center and is one of the two hospitals in the country providing cancer care services. The section of medical oncology consists of three consultants, two senior registrars, two registrars, four rotating interns, and two cancer care nurses. The senior registrars and cancer care nurses are responsible for port-a-cath care and are appropriately trained. The port-a-caths are placed by an interventional radiologist. All the patients receive a detailed explanation of the procedure by a consultant or a senior registrar.

Methodology

The data were collected retrospectively on consecutive adult patients (> 14 years of age) who received a port-a-cath between January 2007 and February 2013 at the SQUH, Muscat, Oman. Information regarding patient's age, gender, BMI, diagnosis, operator, date of insertion and removal, indication for implantation, complications, duration of port in place, and patient's current status (alive or dead) was gathered from electronic patient medical records. The duration of port-a-cath use was calculated from the time of insertion to removal due to any cause (complication, removed after completion of planned chemotherapy), death, or on February 28, 2013, whichever came first.

All the implanted port-a-caths were single lumen. All the devices were implanted under local anesthesia; only two patients received post-procedure prophylactic antibiotics, and none of the patients received anti-coagulation therapy.

Access to the port-a-cath was limited to trained oncology specialist nurses or doctors (senior registrar level) to minimize the chances of infection, and aseptic measures were observed while the port-a-cath was accessed for administration of chemotherapy or other fluids.

Log rank univariate analysis was performed using indwelling time of port-a-cath as the dependent factor. The Kaplan-Meier method was used to calculate the duration of port-a-cath use. The study was approved by the hospital's medical research ethics committee.

Technique

After 2010, all procedures were performed in the radiology department using the Vital Port power injectable system with a 7.5F catheter (Cook Medical, Bloomigton, Indiana, USA). Prior to 2010, the cases were performed sporadically and patients received different ports depending on availability. The standard procedure is here described.

The skin puncture site at the root of the neck is infiltrated using 2% lignocaine. The internal jugular vein is accessed, and a 0.018 guide wire is passed through the needle and its position is confirmed by fluoroscopy. Subsequently, the track is dilated using the Seldinger technique and the peel-away sheath is inserted. A skin incision is made in the lateral part of the anterior chest wall, parallel to the clavicle. The incision is deepened through the fascial layers until subcutaneous fat is reached. A pocket is created in the subcutaneous fat using blunt dissection. A track is created connecting the mid part of the skin incision to the puncture site in the neck using the tunneling device. The port is assembled, connecting the catheter to the port. The catheter is connected to the tunneling device and pulled through the track. The port is inserted in the pocket. The catheter is cut to appropriate length using fluoroscopic guidance. The catheter is inserted into the central vein through the peel-away sheath and the sheath is removed. The pocket created for the port is closed in layers. Waterproof dressing is applied at both sites. The port can be used immediately after the procedure. Routine prophylactic antibiotics are not prescribed [4,8].

Results

Out of 117 port-a-caths, 18 (15.4%) were placed at hospitals abroad, as these patients traveled to seek medical advice outside the country. The remaining 99 (84.6%) port-a-caths were placed at SQUH, 84 (71.8%) by the three interventional radiologists, 12 (10.3%) by anesthetists, and 3 (2.6%) by a general surgeon.

One hundred and six patients (106) had 117 port-a-caths inserted; 11 (9.4%) had it inserted a second time, as the first port-a-cath was removed due to complications. The majority of patients were females (82 patients, 70.1%), with a mean duration of use of 354 days (range 3–1876 days). Median BMI was 27 KG/M^2 (range 12–49); 39 (33.3%) had a BMI between 21 and 25 KG/M^2, while the majority of population were either overweight or obese. Results are shown in Table 1.

Table 1. Patient characteristics and diagnosis

Characteristics	N (%)
Male	35 (29.9)
Female	82 (70.1)
BMI	
Underweight (<18.5)	11 (9.4)
Normal weight (18.5–24.9)	39 (33.3)
Overweight (25–30)	29 (24.8)
Obese (>30)	38 (32.5)
Diagnosis	
Breast cancer	52 (44.2)
Colon cancer	25 (21.4)
Gastric cancer	10 (8.5)
Hodgkin's lymphoma	6 (5.1)
Non-Hodgkin's lymphoma	4 (3.4)
Ovarian cancer	4 (3.4)
Others	20 (17.0)
Interventionist	
Interventional radiologist	86 (73.5)
Abroad	16 (13.7)
Anesthetist	12 (10.3)
Surgeon	3 (2.6)
Treatment intention	
Curative	12 (10.3)
Adjuvant	33 (28.2)
Palliative	72 (61.5)

Table 2. Time port-a-cath in place and reason for removal

Mean time port-a-cath in place (all patients)	354 days, range 3–1,876
Mean time port-a-cath in place (patients with complication)	252 days, range 3–1,876
Reason for removal	
Complication	30 (25.6%)
Infection	19 (16.2%)
Infection + blocked	2 (1.7%)
Blocked	4 (3.4%)
Skin rupture	4 (3.4%)
Catheter fracture	1 (0.9%)
Completed chemotherapy	17 (14.5%)
Organism isolated	
Staphylococcus aureus	8 (6.8%)
Acinetobacter	1 (0.9%)
E. coli	1 (0.9%)
Staphylococcus hemolyticus	1 (0.9%)
No organism isolated	8 (6.8%)
Chemotherapy regimen	
*AC → D±T	25 (21.4%)
Multiple lines (no bevacizumab)	39 (33.3%)
Multiple lines with bevacizumab	18 (15.4%)
**FOLFOX4	2 (1.7%)

*AC: doxorubicin and cyclophosphamide; D: docetaxel; T: trastuzumab; ** FOLFOX-4: folinic acid, 5FU, oxaliplatin (total infusion time 48 hours)

Breast cancer was the most common diagnosis, followed by colon cancer, gastric cancer, and Hodgkin's lymphoma (Table 1). Almost half of the patients (57 patients, 48.7%) received more than one line of chemotherapy through the same port-a-cath, while the remaining patients were treated with only one line of chemotherapy.

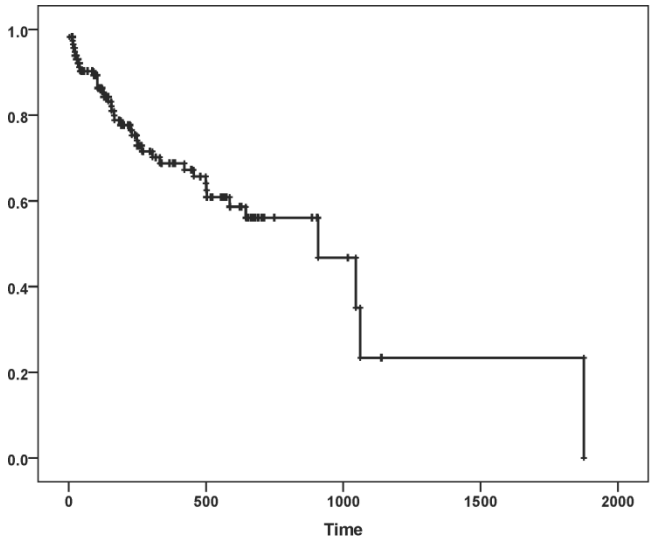
The right internal jugular vein was accessed in 79 (67.5%) patients, while in 38 (32.5%) patients, port-a-caths were was implanted in the left internal jugular vein. Choice of site of port-a-cath implantation was interventionist dependent; however, in 18 patients with breast cancer, the left internal jugular vein was accessed because the right breast was affected. The tip of the port-a-cath was found to be placed in the superior vena cava in 73 (62.3%) patients, while in 36 (30.7%) patients, it was in the right atrium; the data for the remaining 8 (6.8%) patients was missing.

A total of 30 (25.6%) port-a-caths were removed prematurely due to complications, while 17 (14.5%) were removed after completion of planned adjuvant or curative treatment (Table 2). The mean duration of use of port-a-cath was 354.4 days (range 3–1,876); for patients with a complication, it was 253 days (range 3–1,876) for patients with no complications, mean duration of use was 389 days (range 13–1,139) (Figure 1). Of the 30 ports requiring removal secondary to complication, 19 were placed by an interventional radiologist while 6, 2 and 3 were placed by an anesthetist, surgeon or in a different institution respectively. None of the patients died of complications secondary to the port-a-cath.

Infection was the major reason for removal (19 patients, 16.2%) followed by catheter blockage (4 patients, 3.4%) and skin dehiscence (4 patients, 3.4%), infection and catheter block (2 patients each, 1.7%), and catheter fracture (1 patient, 0.6%). *Staphylococcus aureus* was the most common isolated organism (8 patients, 6.8%), while in 8 (6.8%) patients, no organisms could be isolated. Out of 8 *Staphylococcus aureus* isolates, 3 were resistant to methicillin, and hence those patients were treated with vancomycin (Table 2).

None of the patients developed pneumothorax, arterial puncture, or acute bleeding after the procedure. A little less than half of the patients (52, 44.4%) were diagnosed with breast cancer; out of those, 23 patients received adjuvant chemotherapy with doxorubicin + cyclophosphamide (AC) followed by docetaxel + trastuzumab, while patients with metastatic disease were treated with multiple lines of chemotherapy,

Figure 1. Duration of port-a-cath use by the Kaplan-Meier method



including bevacizumab in 4 patients. Of these patients, 7 had complications associated with the port-a-cath.

Almost one-fifth (25 patients, 21.4%) of the patients had colorectal cancers; all of them received oxaliplatin, leucovorin and 5-fluorouracil (FOLFOX4) regimen in the adjuvant setting or the same regimen with bevacizumab in the metastatic setting. Out of 25 patients, 11 developed complications (9 had infections while 1 had catheter thrombosis and 1 had skin dehiscence); 9 of those 11 patients received bevacizumab as part of the chemotherapy regimen. Of the 25 patients, 6 were treated with FOLFOX-4 alone (5 in the adjuvant setting and 1 with metastatic disease), and the remaining 19 patients received bevacizumab along with a backbone of FOLFOX-4 chemotherapy. The most commonly used chemotherapeutic regimens were AC followed by docetaxel + trastuzumab for breast cancer in the adjuvant setting (25 patients, 21.4%), while different chemotherapy regimens were used for patient with stage IV breast cancer (Table 2). Patients with colon cancer received FOLFOX-4 + bevacizumb followed by irinotecan, leucovorin, and 5-fluorouracil (FOLFIRI) + bevacizumab or cetuximb (25 patients, 21.4%), while patients with metastatic gastric cancer were also treated with FOLFOX4-based therapy. Patients with Hodgkin's lymphoma or non-Hodgkin's lymphoma were treated with the standard Adriamycin, bleomycin, vincristine and dacarbazine (ABVD), or rituximab, cyclophosphamide, vincristine and prednisolone (R-CHOP) regimens. A total of 20

(17.1%) patients received the vascular endothelial growth factor receptor (VEGFR) antibody bevacizumab with chemotherapy; 18 of these patients received multiple lines of chemotherapy, while 2 received FOLFOX4 only. In 8 of those 20 patients, the port-a-cath was removed because of infection.

On log rank analysis, underlying diagnosis ($p < 0.001$), complication ($p < 0.001$), chemotherapy regimen ($p < 0.001$), and sensitivity to antibiotics ($p = 0.01$) were significant factors affecting the duration of port-a-cath use, while gender ($p = 0.40$), intention of treatment ($p = 0.16$), site of port-a-cath placement ($p = 0.33$), site of tip ($p = 0.33$), interventionist ($p = 0.17$), BMI ($p = 0.23$), administration of bevacizumab ($p = 0.65$), and single or multiple lines of chemotherapies ($p = 0.24$) were not significantly associated with premature removal of the port-a-cath. None of these factors were significant on multivariate cox regression analysis.

Discussion

Patients with cancer require repeated venous access for blood sampling, administration of drugs (chemotherapeutic agents, antibiotics, and others), and sometimes parenteral nutrition. Some chemotherapeutic agents are notorious for causing thrombophlebitis or extravasations injuries. With a central line, all these complication can be reduced [1,14]. Since the introduction of TIVAPs, many studies have been published regarding their efficacy, cost, and complications [1]. Though port-a-cath use is more common these days, it is also associated with short- and long-term complications, mainly arterial puncture, pneumothorax, infections, malposition, thrombosis/blockage, difficulty of access, and catheter fracture and leakage [1,4,8,9]. Our data indicate that port-a-cath placement is an effective route for the administration of chemotherapy and other agents over several days and over several courses of chemotherapy. The mean duration of use was more than a year (389 days), which is similar to findings of several other studies (range 181–596) [3,10,15-17], though higher than what was reported by an Italian study (168 days) [5]. The mean duration of use was much better in our study compared to a study from Pakistan in which port-a-caths were inserted in 55 patients (153 days *vs*. 354.4 days). However, 20% of the population in that study had acute leukemia and the main reason for premature removal was device failure. The authors did not specify the details of device failure. The infection as a cause of premature removal for the port-a-cath was mentioned for only one patient, which is again much better when compared to our study [11].

Infection (21 port-a-caths, 17.9%) was the most common complication for the premature removal of the port-a-cath, which is much higher than other studies, which ranged from 1.7% to 9.3% [1,3,6,9,10,14,18]. A total of 85 port-a-caths were placed between 2010 and 2013, while only 14 were inserted in the three preceding years, from January 2007 through December 2009. Out of 14 port-a-caths placed before, 5 (35.7%) were removed, while among the 84 implanted during 2010–2013, 22 (26.2%) required removal. The learning curve of the operators might explain the higher rate of infection. In a small study published from our hospital about patients with sickle cell disease, 17/24 (70.83%) port-a-caths were removed due to infective complications in the years 1996–2011 [19]. After the documentation of bloodstream infections associated with port-a-caths, infections were treated with systemic intravenous antibiotics. The port-a-cath was not removed if the infection was treated successfully; the port-a-cath was removed only from patients with repeated infections or continuous fever despite negative blood and urine cultures and despite receiving adequate antibiotic coverage.

In a study by Sticca *et al*. (2009) comparing the outcomes of central venous devices placed by an interventional radiologist and surgeon, there was no difference in complication rates between the two groups, and it was more expensive for the devices to be placed by the radiologist [10]. It is difficult to compare the success rate for the port-a-cath duration implanted by the general surgeon and interventional radiologist in our study, as the vast majority of procedures were done by the radiologist while only three devices were implanted by the surgeon, out of which two were removed. Since the health system in Oman is government supported, direct cost estimates are difficult to assess. The vast majority of port-a-caths were placed in the right internal jugular vein due to ease of implantation; the left jugular vein was accessed in patients with right breast cancer most often, but the site of implantation had no significance on the duration of use or development of complications ($p = 0.33$). This is similar to the study by Stica *et al*. [10]. Catheter thrombosis/blockage was the second most common complication, seen in 6 patients (5.1%), which is higher than what has been reported in other studies (range 0%–1.58%) [4,5,20]; however, the rate is lower than that reported from the Netherlands (9.3%) [16,21]. At our institution, we

observe guidelines for the management of port-a-caths [21,22]; however, prophylactic low-dose anti-coagulation is not used routinely. The use of prophylactic anti-coagulation has been studied extensively in the literature; though two studies demonstrated benefits with mini doses of warfarin, later larger trials showed contradictory results [23-26]. Similarly, only one study showed better results with the use of low molecular weight heparin (LMWH) in a patient with TIVAP, but subsequent studies were negative [25]. Currently, there are no recommendations for the prophylactic use of anti-coagulation therapy for patients with a port-a-cath in place. We used thrombolytic therapy (reteplase 40,000 units) if there was no forward or backflow; if still there was no free flow, then the catheter was considered blocked and was removed.

Conclusions

The trend of port placement is not yet widely accepted in the Omani population due to apprehension of the procedure and maintenance, but with increasing counseling and success rates, more and more patients are now accepting it, as seen from the results. Our complication rate is declining with time due to more vigilant care to prevent infection, but it is still a major concern. With increasing experience and knowledge about port-a-cath care, we hope the associated complications will decrease, resulting in improved patient safety and compliance with the device.

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