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Totally Implantable Venous Access Port Infection in Northwest of Iran

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Abstract

Objective: The totally Implantable Venous Access Ports (TIVAPs) are widely used for chemotherapy, parenteral nutrition, blood sampling, infusion or injection. They are suitable for long-term use and improve the patient's quality of life; however they have some important complications. One of the most common complications is infection. We investigated the port infection rate as well as its risk factors.

Materials and Methods: All patients with TIVAP who were admitted to the academic palliative care clinic for heparin flash, Haber needling or care of TIVAP, were enrolled in study. Patients' demographic, sociodemographic data and clinical signs and symptoms were collected by questionnaire and physical exam. Blood culture was performed from port access of patients. The port removed in any case with positive blood culture or other irresolvable problem. The collected data were compared between patients with or without port infection.

Results: Out of 116 patients, 95 patients (81.9%) were female and 21 patients (18.1%) were male. The rate of infection was 5.2%. In 11 cases the port was removed during the study period. The total complication rate was 15.5%. There were not any correlations between type of malignancy, patients' level of education, previous chemotherapy and radiation therapy and the length of time of port implantation with port infection rate.

Conclusion: The prevalence of the infection and total complication rate was 15.5%. and 5.2% respectively. Infection with *Staphylococcus aureus* was the most common reason.

Keywords: Totally implantable venous access port, Chemotherapy, Infection, Complication, Cancer

Introduction

In modern oncology, the old, temporary and permanent tunneled catheters are increasingly replaced by implantation of central venous port systems. Patients need to have effective and safe systems for long-term intravenous treatments such as chemotherapy, parenteral nutrition, trans-fusion, blood sampling, infusion or injection of drugs or serum. The development of totally implantable venous access devices (TIVADs) happened in the early 1980s (1,2). Port systems reduce the pain of intravenous therapies significantly and improve the quality of life and even treatment with no external components and less visibility. They are easily accepted by patients and do not restrict daily activities. Local care for them is easier and they are suitable for long-term applications. Design, preparation and performance of ports require meticulous attention to details of their implantation and great care for it. Complications arising during their implantation by skilled people are very rare and only about 0.2%, but generally the reported complications are variable from 4.3% to 46% (1,3-5).

Immediate, perioperative and early complications such as hematoma, cardiac arrhythmias, perforation of the right atrium, and the primary infection of the port site can occur (6-9). It is difficult to make a distinction between long-term and early complications (10). Complications which arise during the application of the port systems and in daily routine care of port can be considered as long-term complications. The results of various studies showed that the main and most important complications of TIVAD include infection, catheter blockage, thrombosis, catheter sclerosing, pinch-off syndrome, obstruction, catheter leakage and displacement (10-14). However, infection following the use of port systems can be regarded as the most common complication of TIVAD (12,15-20). In various literatures risk factors such as age, gender, hematologic disorders, type of malignancy, hospitalization, the interval between implantation and

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the first use of port, site of implantation, and palliative versus curative chemotherapy have been involved in the infection of TIVAD (3,11,15,17,21).

Due to improvement in the quality of treatment, increased satisfaction of the medical team and improved patient's quality of life, there is an increased demand for port implantation to achieve better therapeutic goals. Infection is the main complication that usually leads to catheter expulsion and treatment discontinuation, especially in obese patients or those whose veins that are hard to find. This study is designed to determine the incidence of the infection of TIVAD in cancer patients and the related risk factors in patients receiving chemotherapy.

Methods and Materials

All patients with POLYSITE® Standard – 4000 port who were admitted to our palliative care clinic in Imam Reza hospital for Huber needle insertions, heparin flashing or care of TIVAD from March to December 2016 were enrolled to this study. Patients with systemic infections caused by other known origins or who had implanted ports other than POLYSITE® Standard – 4000 were excluded from the study. The clinic is connected to the Tabriz University of Medical Sciences and serves for the palliative cares, as the only outpatient academic center in the northwest of Iran. Every patient was under study for 1 week.

Initially the patients were asked to fill a pre-designed questionnaire; then, the required date were extracted from patients' registry and a complete physical exam was performed. The collected data were as follows: demographic data, type of malignancy, time of port implantation, history of port occlusion, thrombosis or rotation, number of chemotherapy and radiation therapy, history of Huber needling and heparin flash numbers, existence of metastasis, the use of antibiotics and any sign or symptom of infection. For all patients, the blood sample was taken from the port using Huber needle in a sterile method and the sample was sent to the laboratory for microbiological study; then, the port was washed out using 1000 units of heparin and normal saline. If there was any sign or symptom of infection in the port or around of it, or any non-soluble port malfunction, the port was removed and the port/ catheter was sent for microbiological assessment. At the end of the study all collected data from patients with positive or negative blood cultures was analyzed using SPSS software.

Statistical Analysis

The quantitative data were presented as mean ± standard deviation (SD) and the categorical data were presented using frequency and percentage. Independent *t* test was used to compare the mean of the quantitative data and chi-square or Fisher exact tests were applied to compare the categorical data. The correlation between port infection rate and other parameters was assessed using Pearson correlation. P value < 0.05 was considered statistically significant.

Results

In this investigation, 116 patients with TIVAD, who were admitted to our outpatient palliative care clinic, were studied for probable port infection. Table 1 shows demographic, socio-demographic and physical findings of patients with or without port infection. Most of patients (82.8%) were female. The mean ± SD for age, weight and height was 55.8 ± 10.7 years, 58.0 ± 11.4 kg and 159.3 ± 6.5 cm, respectively. The most common type of the malignancy was breast cancer (71.6%). In 57.8% of the patients there was a documented metastasis. Except for 1 patient, for all of the patients the port was inserted trough subclavian vein. The time from first cancer diagnosis, the time from port implantation and number of chemotherapy or radiotherapy cycles were similar in infected and non-infected ports. The minimum time length of port placement was 61 days. Totally, in 11 cases the port was removed during the study period. The reason was positive blood culture (6 cases), port complete occlusion (2 cases), catheter rotation (1 case) and local port infection (3 cases). In 6 patients the blood culture was positive for *Staphylococcus aureus*; in 1 case it was positive for both *S. aureus* and *Klebsiella pneumoniae.* The rate of infection was 5.2% (0.045 for 1000 days of its use). In 7 cases the port was partially occluded, that was easily opened with heparin contained solution. In these patients there was a history of irregular flash heparin and the number of heparin flashes was lower than others (3.43±.787 vs. 7.80±.2.751 times). The total complication rate was 15.5%.

There was not any case of extravasation. Other complications were fever, chills, tachycardia, local pain, induration, redness and local pyorrhea. The local pain, swelling and redness at port site as the tachycardia, fever, chills, shortness of breath, cough and chill in injection, all were more common in patients with port infection. The infectious patients had more history of antibiotic therapy (Table 1). The patients' level of education had no significant difference in patients with or without port infection. Mean arterial blood pressure was similar; however the heart rate was more rapid in patients with port infection. There were not any correlations between numbers of previous chemotherapy and radiation therapy, the time from first cancer diagnosis or the time from port implantation with port infection rate. There was not any correlation between type of malignancy and rate of metastasis with the rate of port infection. The rate of the need for port heparin flash or Huber needling did not have any correlation with the rate of port infection.

Discussion

In this study, we compared the clinical findings in patients with and without port infection. The results showed that clinical signs, including fever, chills, tachycardia, local pain, swelling, redness and local pyorrhea, shortness of breath, cough and chill in injection all were more common in patients with port infection. Teichgräber et al conducted a study on 3160 port insertions in a period

Table 1. Demographic, Sociodemographic and Physical Data of the Patients With or Without Port Infection

Variable	Patients With Port Infection, n = 6	Patients Without Port Infection, n = 110	Total, N = 116	*P* Value
Gender, male/female	2/4	19/91	21/95	1.0
Age (y), mean ± SD	57.2 ± 10.9	55.8 ± 10.7	55.8 ± 10.7	0.776
Weight (kg), mean ± SD	58.6 ± 14.9	58.0 ± 11.3	58.0 ± 11.4	0.912
Height (cm), mean ± SD	156.2 ± 5.1	159.4 ± 6.5	159.3 ± 6.5	0.281
Mean arterial blood pressure (mm Hg), mean ± SD	88.8 ± 9.9	84.9 ± 10.1	84.4 ± 10.1	0.321
Heart rate (bpm), mean ± SD	101.8 ± 16.1	87.6 ± 9.8	88.2 ± 10.5	0.003
Port site (N)				
Internal jugular vein	0	1	1	
Subclavian vein	6	109	115	
Time from first cancer diagnosis (mon), mean ± SD	30.4 ± 7.6	32.3 ± 11.3	32.2 ± 11.2	0.714
No. of chemotherapy and or radiation therapy cycles (N), mean ± SD	4.8 ± 1.6	4.7 ± 1.6	4.7 ± 1.6	0.945
Metastasis, Yes/No	3/3	64/46	67/49	0.649
Type of malignancy (N)				
Breast	4	79	83	
Leukemia	2	15	17	
Colon	-	12	12	
Cervix	-	1	1	
Ewing's sarcoma	-	1	1	
Ovarian cancer	-	2	2	
Educational level				0.732
Below high school diploma	2	42	44	
High school diploma	3	44	47	
Bachelor	1	18	19	
Master	-	3	3	
PhD	-	3	3	
The time from port implantation (days)	161.0 ± 84.5	185.8 ± 82.9	184.7 ± 82.8	0.865
Port site pain, Yes/No	4/2	6/104	10/106	0.001
Port site swelling, Yes/No	4/2	10/100	14/102	0.002
Port site redness, Yes/No	5/1	5/105	10/106	0.001
Fever, Yes/No	3/3	0/110	3/113	0.001
Chills, Yes/No	2/4	1/109	3/113	0.006
Hematoma, Yes/No	1/5	1/109	2/114	0.12
Short of breath, Yes/No	2/4	2/108	4/112	0.013
Coughing, Yes/No	4/2	12/98	16/100	0.003
The use of antibiotic drugs, Yes/No	4/2	5/105	9/107	0.001
Chills after injection, Yes/No	3/3	5/105	8/108	0.004
Port heparin flash numbers (N), mean ± SD	6.4 ± 3.2	7.6 ± 2.8	7.5 ± 2.9	0.368
Huber needling (N), mean ± SD	5.6 ± 1.5	5.7 ± 1.8	5.7 ± 1.8	0.865

of 8 years (2000-2008), and reported an infection rate of 5.1%, that was similar to our finding (22). In our study, the overall incidence of complications related to the use of port systems was 15.5%, the incidence of port infection was 5.2%, and the need to replace port was 9.5%. These rates were similar to previous studies (22). Yildizeli et al performed a study on the implanted ports and use of the prolonged venous access devices. Long-term complications were observed in 6.6% and port infections were reported in 2.2% of patients (23). Similar to our study, the most common responsible micro-organisms were staphylococcal strains (23).

In the study conducted by Fischer et al, for 46.2% of the patients, the main reason for port removal was infection, which has been significantly regarded as the main factor for removing the port of the patients under study (15). In our study, from 11 patients with removed port, the port infection had led to the removal of the venous port in 6 patients (54.4%); it was similar to the study of Fischer et al (15). Ahn et al conducted a study in South Korea on the intravenous port systems implanted in 1254 patients with various malignancies, and reported the rate of complications to be 4.47%, with an infection rate of the 0.6% (0.018 of 10 000 catheter days), that was clearly lower

than ours (5.2% or 0.045 for 1000 days of its use) and other similar studies (24). However, in our study, the rate of infection and port removal (5.2% and 9.5%, respectively) was in accordance with most of the previous studies. Differences between the results of these studies can be due to the differences in the study population.

Samaras et al investigated the effect of the patients' malignancy type on the port infection rates. They concluded that the infection rate, resulting from the use of intravenous port systems, are significantly more common in young patients with hematological disorders (17). In our study, there was not any correlation between type of malignancy and the rate of infection; in addition, the numbers of other malignancies in comparison with breast cancer were significantly low. However, another study showed that patients with breast cancer have lower rates of port infection (15). Breast cancer is one of the most common cancer in women. In our study, most of patients (82.8%) were female; the most common malignancy was breast cancer, which it had no impact on the incidence of infection (25). Moreover, our results showed that differences in age, weight, height and gender of patients with or without port infection caused no significant difference in port infection rate. Shim et al conducted a similar study and showed that hematologic malignancies, as well as hospitalization for receiving chemotherapy, lead to an increased risk of infection of TIVAD (11). On the other hand, researchers reported that *S. aureus* is the most common cause of infections in patients (11). Our study, also, showed that patients' educational level did not have significant effects on risk of port site infection. However, lack of relationship between the patient's educational level and port infection can be due to the nurses who do everything related to injections; port system maintenance is performed by health providers; nurses who work in oncologic and palliative care wards; and patients actually have a minor role in the process of using the TIVAD. So, nurses have a significant role in the management and care of port and reduction of its related infections. Therefore, apart from patients, nurses and healthcare providers involved in the insertion and maintenance of catheters, Haber needles, parenteral nutrition, transfusion, blood sampling, infusion or injection of drugs or serum, should be educated and participated in training programs. Even, considering developments in using port, it is suggested to include guidelines for use of venous catheters in educational curriculum of nursing students in order to help reducing the infection rate (11,26).

Among other factors in port infection, the interval between implantation and the first use of port, site of implantation, and palliative versus curative chemotherapy can be pointed at; however this needs more future investigations (3,21).

The limitations of our study were that it was a single-centered study, with small size and additionally, because of undetected catheter-related bloodstream infection, the incidence of infection could have been underestimated.

Conclusion

This study, on the whole, showed that the incidence of clinical signs and symptoms of infection were more common in patients with port infection, than those without infection. The type of malignancy as well as educational level had no significant effect on the rate of port infection. The rate of port use for injection and the time elapsed from its insertion did not have any effect on port infection rate. It was also shown that *S. aureus* was the most common micro-organism causing infections in patients with malignant diseases.

Conflict of Interests

The authors declare no conflict of interest.

Ethical Issues

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethical code number: 94.1-3.8) and Iranian Registry of Clinical Trials. Written informed consent was obtained from all of the patients.

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