Research Article

Peripheral Venous Catheter-Related Infection And Its Affecting Factors In Patients With Breast Cancer Under Chemotherapy

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Abstract

Introduction: Peripheral venous catheter placement is a crucial procedure in a number of patients with cancer. Given the high risk of infection during chemotherapy, it is essential to identify the factors affecting it to take preventive measures. This study aimed yo examine peripheral venous catheter-related infection and factors affecting it in patients with breast cancer under chemotherapy.

Methods: This descriptive-analytic study was conductedon 84 patients who entered the study using accessible sampling in Imam Reza Hospital in Tabriz, Iran during 2018-2019. Peripheral venous catheter was inserted in Operating room under sterile conditions. The patients' demographic data and infection symptoms were recorded in their checklist and laboratory tests were conducted to confirm infection in case of presence of symptoms. The data were analyzed in SPSS 20 using t-test, the Cox regression and cumulative incidence ($P<0.05$).

Results: The incidence of peripheral venous catheter-related infection was 11.04% and fever and chills, inflammation and pain were the most common clinical symptoms. There was a significant difference between groups with /without infection in terms of age ($P=0.001$), number of chemotherapy sessions ($P=0.003$) and radiation therapy ($P=0.002$).

Conclusion: The 11% incidence of peripheral venous catheter-related infection in this study was lower than other studies. When primary symptoms (fever and chills, pain and inflammation) are identified in susceptible patients (older patients and those undergoing long courses of chemotherapy and radiotherapy), it could be diagnosed in time.

Keywords: Chemotherapy, Breast Cancer, Infection, Peripheral Catheter

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Introduction

Cancer has been introduced as a global epidemic over the past decade; a tidal wave of cancer is on the way (1) and the most common cancers in women (breast, ovarian and endometrial cancer) are associated with the highest mortality rate (2, 3). In order to reduce mortality and increase survival rate in these

patients, surgery, radiation therapy, chemotherapy, gene therapy and hormone therapy are suggested (4, 5). These treatments in fighting cancer have a wide range of side effects including reduced life expectancy, decreased quality of life, increased economic burden on health systems, cachexia, asthenia and lethargy, and the possibility of systemic infections (6-8).

These patients receive medications intravenously (9, 10). Chemotherapy medicines are among the most widely used medications in the treatment of breast cancer; despite their many advantages, they have a wide range of complications and side effects (11, 12). Since most of these patients continue chemotherapy for a long time and receive related medications, they develop asthenia, cachexia, and vascular fragility (13). Vascular fragility is common in these patients and delays the treatment for a long time. In addition, increased healthcare costs, cessation of treatment by patients or their families, and increased workload for healthcare workers are among negative outcomes of vascular fragility in these patients (14).

As vascular fragility in cancer patients under chemotherapy has many side effects and affects their survival, placement of peripheral and central venous catheters has received much attention in the medical field in recent years. Using these catheters have led to 100% patient satisfaction (15, 16). Placement of peripheral venous catheters is more complicated than the central catheters. However, given the complications of central venous catheters (cardiac problems, hemothorax, the possibility of phlebitis and the inability to keep the catheter), physicians prefer peripheral venous catheter (15, 17).

Despite increasing patient satisfaction and continuation of the treatment process, peripheral venous catheter is not used in all patients due to its high costs and increased risk of infection (18). Infection in cancer patients may increase mortality, the need for hospitalization, hospital expenditures, and drug resistance. As a result, post-insertion have led physicians to use them with great care (18, 19), since cancer patients are more susceptible to various infections compared to normal individuals (20).

Given that it is essential to use peripheral venous catheter in these patients to continue treatment and they are more susceptible to infection than normal individuals, knowledge of peripheral venous catheter-related infections and factors affecting it is crucial to take relevant preventive measures.

Several risk factors including age and the number of chemotherapy and radiation therapy sessions before catheter insertion were considered the assumptions in this study. Accordingly, this study aimed to examine peripheral venous catheter-related infection and factors affecting it in patients with breast cancer under chemotherapy.

Methods

This descriptive-analytic study was conducted in Imam Reza Hospital affiliated to Tabriz

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University of Medical Sciences during 2018-2019. This hospital was selected as it was the only dedicated center for peripheral venous catheter placement by a vascular specialist. Inclusion criteria were lack of access to peripheral veins for catheterization, confirmed diagnosis of breast cancer by oncologist, prohibition of using central venous catheter, consent for peripheral venous catheterization, and undergoing chemotherapy in the hospital. On the other hand, the history of systemic infection, Other cancer , Metastatic cancer , Need too blood transfusion , cardiovascular problems that require treatment, and having dialysis catheter were the exclusion criteria.

Given that during the period leading to the beginning of this study 120 patients underwent peripheral venous catheterization in Imam Reza Hospital, the population increased to 140 with the chance of a 20% raise in sample size and a sample size of 102 patients was determined using Morgan's table. As 18 patients passed away during the study, 84 patients were studied. Patients entered the study using accessible sampling and they signed a written informed consent when the objectives of the study were explained to them (in case of being illiterate, a first degree relative signed the form).

The patients introduced by the oncologist for peripheral catheter placement were examined by a vascular surgeon (member of the research team) and if approved, they were selected for peripheral venous catheterization. After checking with the OR (Operating room) in Imam Reza Hospital, each patient entered the room and underwent prepping and draping with green prvidone-iodine under sterile conditions (two times to prevent infection). All of the patients before surgery, receive antibiotic(cefazoline 4 time in day) for prevent catheter infection. Then, the specialist inserted the catheter after wearing two pairs of gloves (to prevent infection). A supervisor monitored the procedure from the beginning to the end and in case of seeing any measures that may endanger the sterile conditions, he/she pointed out the case to prevent it. After catheterization, an ultrasound was performed by the vascular surgeon to confirm it. In addition, 10 ml heparinized saline solution (5000 IU of heparin diluted in 1000 ml normal saline solution) was injected by the specialist to ensure catheter function. Then, patients with a stable condition were transferred to the related wards.

A checklist was used in this study to collect data. It consisted of two sections; the first section included questions on demographic information such as age, employment, marital status, number of chemotherapy and radiation therapy sessions, history of surgery, and history of diabetes mellitus (which were completed prior to catheterization). The second section included the symptoms of infection and related tests. When the catheter was placed, the patient was examined on a daily basis by the physician assistant and in case of any symptoms of infection (redness and discoloration of the skin, inflammation,

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burning, fever and chills, itching, pain and lethargy), laboratory tests

Table 1: Demographic information of the participants in the study

Variable		N - %
Age	<30	9 - 10.71%
	30-40	16 - 19.04%
	40-50	25 - 29.76%
	>50	34 - 40.47%
Employment status	housewife	46 - 54.76%
	Employee	38 - 45.24%
chemotherapy sessions	No	24 - 10.71%
	<5	8 - 9.52%
	50-10	21 - 25.00%
	10-15	19 - 22.61%
	>50	12 - 14.28%
radiotherapy sessions	No	33 - 39.28%
	<5	15 - 17.85%
	50-10	18 - 21.42%
	10-15	10 - 11.90%
	>50	8 - 9.52%
Breast Surgery	No	24 - 28.85%
	Mastectomy	19 - 22.61%
	Lumpectomy	41 - 48.80%
Diabetes Mellitus	Yes	8 - 9.52%
	No	76 - 90.48%

were performed. To conduct a test, first, 5 ml blood was drawn from the venous catheter and sent to the Imam Reza Hospital lab to be examined for indicators of infection (WBC, ESR and CRP). The use of catheter was discontinued until the laboratory results determined whether there was an infection and other peripheral veins were used to continue the treatment procedure. It is worth mentioning that the catheter was used for patients under chemotherapy not those under radiation therapy. In addition, symptoms of infection in each patient were examined from the day after catheterization to six months thereof.

Ethical considerations were observed in this study similar to other human studies. Some of these considerations include the ethical code obtained from Regional Ethics Committee to the number IR.TBZMED.REC.1398.009, informed written consent obtained from literate patients and first-degree relatives of illiterate patients, the sterile conditions of operating room and confidentiality of patients' data.

Data were analyzed in SPSS 21 by the research assistant (not included in the research team) using t-test, the Cox regression and cumulative incidence. The significance level was considered less than 0.05.

Results

The age mean ± standard deviation of participants was 49.11±5.19; 64 patients (76.19%) were married and 46 women (54.76%) were housewives; 60 patients (71.42%) had a history of chemotherapy; 51

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patients (85%) had a history of radiation therapy; 60 women (71.42%) underwent surgery and 41 women (48.80%) had metastasis to other organs (Table 1).

The study of cumulative incidence indicated that 11 patients had clinical symptoms of infection (following catheterization) and with a confidence interval of 95%, it could be stated that the incidence of infection in this study was 11.04% (13.55-9.035). Blood samples were sent to the lab to confirm infection and the results showed that all participants with symptoms of infection were infected. The frequency of primary symptoms of infection are demonstrated in Table 2. The study of time of infection with 95% confidence indicated that this complication occurred on day 43 on average (the shortest interval was 28 and the longest interval was 58 days).

Table 2. Frequency of infection symptoms in patients with infection

Variable	Yes (N - %)	No (N - %)
Redness	7 - 63.63%	4 - 36.37%
Inflation	9 - 81.81%	2 - 18.19%
Irritation	6 - 54.54%	5 - 45.46%
Ague	10 - 90.90%	1 - 9.10%
Itching	5 - 45.46%	6 - 54.54%
Pain	8 - 72.72%	3 - 27.28%
Lethargy	5 - 45.46%	6 - 54.54%

Based on the results of t-test, a comparison of variables under study indicated a significant difference between patients with and without infection in terms of the number of chemotherapy and radiation therapy sessions and age (P>0.05) (Table 3).

Since the number of chemotherapy and radiation therapy sessions and age were significantly correlated with infection, the Cox regression was conducted to remove their effect on one another which indicated that they were significantly effective in developing infection (Table 4).

Discussion

The purpose of this study was to examine the incidence of peripheral venous catheter-related infection and factors affecting it in patients with breast cancer under chemotherapy. Mastectomy and receiving chemotherapy medication in patients with breast cancer have some complications such as pain, lymphedema, nausea and vomiting, asthenia, cachexia, etc. (21, 22). Some cancer patients who need chemotherapy or radiation therapy develop peripheral vascular fragility after a few sessions and it becomes difficult to access their veins for venous catheterization. Therefore, peripheral venous catheter is used in them (23). Given their weak immune system (due to chemotherapy, radiation therapy and progression of cancer), peripheral venous catheterization in cancer patients can make them more susceptible to infection. Therefore, it is essential to examine the risk factors to prevent infection in them (24).

The incidence of peripheral venous catheter-related infection was 11.04% in this study, which was lower than usual compared to other studies and predictions in other countries.

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Table 3: Comparison of infection risk factors in patients with and without infection

Variable	With Infection	Without Infection	P Value
Number of chemotherapy sessions before catheter placement	12.22±1.41	5.48±1.36	0.003
Number of radiotherapy sessions before catheter placement	19.15±2.02	9.70±1.82	0.002
Age	40.18±7.30	59.90±9.98	0.001

Table 4: Estimation of risk ratio for significant variables

Variable	RR	P	Confidence interval	
			Min	Max
Number of chemotherapy sessions before catheter placement	1.32	0.003	0.703	2.115
Number of radiotherapy sessions before catheter placement	1.023	0.005	0.815	2.225
Age	1.145	0.011	0.901	2.501

In this regard, Franklin et al. (2012) estimated over 15% rate of peripheral venous catheter-related infection, which was slightly higher compared with this study (25). It appears that a weak immune system as a result of chemotherapy is a major cause of developing infection following catheterization and demands further research. In a guideline to prevent peripheral venous catheter-related infection, Naomi et al. (2011) reported that 10% incidence of infection in cancer patients was normal. They stated that peripheral venous catheter in cancer patients should be used in sterile conditions and developing infection depends on conditions of catheterization. They proposed that healthcare workers should follow specific guidelines during catheterization to minimize the risk of infection. The incidence of infection in their study was approximately similar to this study (26). As sterile conditions of catheter placement was observed in this study, it appears this could be the cause of similar results. Boyd et al. (2011) reported the rate of infection following peripheral venous catheterization (about 15%) and stated that cancer patients develop catheter-related infection due to their weak immune system, cachexia, prolonged use of catheters, and lack of proper care. This could be substantially minimized by taking preventive measures. The incidence of infection in their study was higher than this study (24).

After fitting the Cox regression model and examining the proportional hazards in the final model, age and the number of chemotherapy and radiation therapy sessions were identified as significant variables that affect the incidence of catheter-related infection. This was congruent with the results

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of our study and are further discussed in the following.

Results also suggested that aging and having more chemotherapy and radiation therapy sessions have made patients susceptible to infection. In other words, aging and increased number of chemotherapy and radiation therapy sessions were proved as risk factors contributing to infection following peripheral venous catheterization in cancer patients undergoing chemotherapy. In their study, Capdevila et al. (2017) listed the risk factors contributing to peripheral venous catheter-related infection: prolonged chemotherapy and radiation therapy, history of surgery in the last three months, being metastatic, aging and hospitalization (27). In this study, similar risk factors were reported that were associated with infection. The authors believe that besides eliminating cancer cells, radiation therapy and chemotherapy lower immunity and eliminate immune cells and therefore, make patients prone to infection. Cotogni et al. (2014) examined peripheral venous catheters in patients who need special measures and stated that aging, receiving medications that weaken the immune system, having advanced cancer, and hospitalization were among the major risk factors that contribute to peripheral venous catheter-related infection. They recommended research centers to prioritize taking interventions in patients prone to infection in order to prevent it. Results of their study were congruent with the results of this study (28).

Some of the limitations in this study were the hospitalization environment and lack of control on antibiotics prescribed by the physician. The authors suggest conducting more accurate studies and interventions to prevent peripheral venous catheter-related infection in future research.

Conclusion

The 11% incidence of peripheral venous catheter-related infection in this study was lower than other studies. Ultimately, it can be diagnosed early with identification of primary symptoms (fever and chills, pain and inflammation) in susceptible patients (older patients and those undergoing long courses of chemotherapy and radiotherapy).

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