Original Article

Knowledge Level on Administration of Chemotherapy through Peripheral and Central Venous Catheter among Oncology Nurses

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ABSTRACT

Objective: The aim of this study is to determine the knowledge levels of oncology nurses about peripheral and central venous catheter during their chemotherapy administration. **Methods:** Data collection of this descriptive study was started on April 15, 2015–July 15, 2015. The data presented in this summary belong to 165 nurses. Data were collected with data collection form including questions related to sociodemographic qualifications and knowledge levels of nurses. Data collection forms were E-mailed to the members of Turkish Oncology Nursing Society. Data presented with numbers, percentages, and mean ± standard deviation. **Results:** The mean age of nurses was 33.60 ± 7.34 years and mean duration for oncology nursing experience was 2.65 ± 0.91 years. Nurses had correct information about the importance of selecting peripheral venous catheter and choosing the placement area for chemotherapy administration (63.6%), control of catheter before the administration (93.9%), influence of chemotherapeutic agent on length of catheter (40.6%), and management of extravasation (75.7%). Nurses also had correct information about the first use of port catheter (67.3%) and checking the catheter whether it is working properly or not (75.8%). **Conclusions:** In General, nurses' level of knowledge related to catheter is 50% and higher. It is recommended to increase the knowledge of nurses about evidence-based information for catheter care as a step to safe chemotherapy practice.

Key words: catheter, chemotherapy, nursing, oncology

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Introduction

Intravenous (IV) catheterizations are frequently applied in cancer therapy for hydration, nutrition, drug administration, and transfusion of blood and blood products.[1-7] Oncology nurses are responsible for the safe and timely administration of IV treatments to the patients through peripheral and central venous catheter (CVC) and management of any possible complication.[8-12]

In recent years, an increased high-dose chemotherapy administration has led to increased use of peripheral venous catheter (PVC) and CVC in the oncology patients.[13] Although several factors such as catheter site, characteristics of the material used, characteristics of the drugs and fluids used, duration, frequency and modality of the treatment, and aseptic techniques employed affect the success of IV chemotherapy, the knowledge level and capability of the nurse play a crucial role.[9,12,14,15]

Although interventions performed through venous catheterization in oncology clinics provide many advantages for the patient and health professionals, they may cause problems such as phlebitis, extravasation, thrombophlebitis, air embolism, circulatory overload, bleeding, hematoma, and infection, unless they are performed and monitored properly.[7,16-22] Therefore, to achieve a successful management of IV chemotherapy administration, to prevent complications, and to extend the life of catheters, nurses should have adequate knowledge on the field and should refer to evidence-based recommendations and guidelines in their practices.[23-26] Although studies assessing the knowledge level and attitudes of nurses on the administration of chemotherapy are available in Turkey and worldwide, the number of studies addressing the knowledge levels of oncology nurses on chemotherapy applications with PVC and CVC in Turkey is limited.[27] This study aims to evaluate the knowledge level on chemotherapy administration through PVC and CVCs among Turkish nurses.

Methods

Study design and sample

This study is a descriptive type of study. The study population included 568 nurses employed in oncology services/outpatient clinics, whose E-mail addresses were registered in the Turkish Oncology Nursing Society. Data were collected from 165 (29%) nurses who agreed to participate in the study.

Measures

In this study, data were collected through a web-based and in-print questionnaire. The first of the two-part questionnaire contained six questions of sociodemographic characteristics and 11 questions of chemotherapy applications. The second questionnaire, in turn, included twenty questions of chemotherapy applications performed with peripheral and central venous catheterization. Each question had a single correct answer and the answer choice "I do not know" was given in each question to avoid speculation. Internal consistency coefficient of the questionnaire was 0.654.

Having received the expert opinion of two oncology nurses and five academicians on items and answer formats included in the questionnaire, which was developed according to the literature data, questionnaires were designed in a manner which allowed participants to fill them on a webpage.[4,14,15,17,25,28-30] Five nurses filled out the questionnaires as part of the preliminary survey of the study. During the preliminary survey, the cognitive penetrability and the convenience of filling out the questionnaire were evaluated. Data obtained from preliminary survey were excluded from the study. The web-based questionnaire was printed out and used as hard copy.

Procedures

This study was conducted between April 15, 2015, and July 15, 2015 through E-mail and face-to-face interview method. Researchers sent information forms and web-based questionnaires to the participants through E-mail. The nurses who read the information form and agreed to participate in the study filled out the web-based questionnaires and sent them back to researchers through E-mail (100 questionnaires). Printed questionnaires were handed out to the oncology nurses directly and filled out during face-to-face interviews (65 questionnaires). The study protocol was approved by the local Ethics Committee of the Association of Oncology Nurses (No: 604.01.02) and written informed consent was obtained from each participant.

Statistical analysis

Statistical analysis was performed using the SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were given in percentage and mean values. One of the answer choices given in questions in the questionnaire on chemotherapy administration through peripheral and CVC was correct, two choices were incorrect, and the other choice was "I do not know". While evaluating nurses' answers to questions in the questionnaire, frequencies and percentage values of correct, incorrect, and "I do not know" answers were calculated. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as numbers and percentages. Pearson's Chi-square (χ^2) test was performed to analyze the differences among categorical variables (answers of the

nurses regarding administration of chemotherapy through peripheral/CVC and characteristics of the nurses). $P < 0.05$ was considered statistically significant.

Results

The descriptive characteristics of nurses who participated in the study are presented in Table 1. A total of 70.9% of nurses reported that a safety chemotherapy protocol existed in the institutions which they worked, while 56.1% reported that extravasation record forms were available. The mean number of insertion of peripheral catheters and port needles was 12.28 ± 18.81 and 4.64 ± 6.95 on a daily practice of nurses, respectively. They also carried out the maintenance of 3.70 ± 4.45 port catheters and 1.75 ± 2.15 central catheters on average per day.

The responses of nurses who participated in the study on chemotherapy administration through PVC are shown in Table 2. Of the nurses, 57.6% answered the questions on PVC selection correctly, 63.6% answered the questions on the selection of the region where catheter should be inserted correctly, 93.9% answered the questions on catheter control correctly, 53.3% answered the questions on the properties of liquids administered through PVC correctly, 59.4% answered the questions on the administration ways of chemotherapy medication to be infused for more than 6 days correctly, and 75.8% answered the questions on actions to be taken in case extravasation occurs correctly. Nearly 69.1% of nurses gave incorrect answers to questions on the frequency of changing infusion sets [Table 2].

The distribution of nurses' responses who participated in the study to chemotherapy administration through CVC and port catheter is presented in Table 3. Of them, 67.3% responded correctly to questions on administration of first chemotherapy following the insertion of port catheter, 75.8% responded correctly to questions on the necessity to control catheters before administration of chemotherapy through port/central catheters, 61.2% responded correctly to questions on the termination of the procedure after chemotherapy through port catheters, 69.1% responded correctly to questions on the frequency of heparin administration through port catheters besides chemotherapy application, 70.3% responded correctly to questions on actions to be taken in case extravasation develops during administration of chemotherapy through CVC, and 80.6% responded correctly to questions on the content of the training to be provided to patients who received treatment through port catheterization. On the other hand, 76.4% of nurses responded correctly to questions on the application of antiseptic hand sanitation procedure before and after the administration of chemotherapy through CVC, and 89.6% of nurses responded incorrectly to questions on the selection of port needle gauge according to the treatment to be administered saying that the port needle gauge should not be changed according to treatment; 89.7% of nurses responded incorrectly to questions on the adjustment and monitoring of infusion rate during chemotherapy infusion saying that the infusion rate was set by the pump device [Table 2 and 3].

Although not shown in Table 3, it was found that giving the correct answer regarding frequency of changing infusion sets during administration ($\chi^2 = 6.597$, $P = 0.010$) and single/multiple chemotherapy administration through CVC was more within the nurses who had prior training on safety chemotherapy administration ($\chi^2 = 8.319$, $P = 0.004$)

Table 1: Descriptive characteristics of nurses who participated in the study ($n = 165$)

Characteristics	*n* (%)
Educational status	
Vocational high school	15 (9.1)
Associate degree	31 (18.8)
Bachelor's degree	105 (63.6)
Graduate	14 (8.5)
Institution	
Public hospital	52 (31.5)
University hospital	92 (55.8)
Private hospital	18 (10.9)
Other*	3 (1.8)
Years at work	
<1	6 (3.6)
1-5	42 (25.5)
6-10	45 (27.3)
11 or more	72 (43.6)
Years at work as oncology major	
<1	16 (9.7)
1-5	78 (47.3)
6-10	38 (23.0)
11 or more	33 (20.0)
Department	
Chemotherapy unit	61 (37.0)
Medical oncology service	46 (27.9)
Hematology service	27 (16.4)
Pediatric oncology service	13 (7.9)
Radiation oncology unit	18 (10.9)
Prior training on safety chemotherapy administration	
Yes	110 (66.7)
No	55 (33.7)
Time of safety chemotherapy administration training ($n = 110$)	
0-6 months ago	36 (32.7)
7-12 months ago	13 (11.8)
13-18 months ago	13 (11.8)
2 years ago or more	48 (43.6)
Source of safety chemotherapy administration training ($n = 110$)	
On-the-job training	66 (60.0)
Course/congress	33 (30.0)
School	3 (2.7)
Other**	8 (7.3)

*Foundation for Children with Leukemia, **Graduate education

Table 2: Distribution of nurses' responses on chemotherapy administration through peripheral intravenous catheter ($n = 165$)

Questions about application of chemotherapy through peripheral intravenous catheter	Percentage
Which of the following is not included in the selection of peripheral venous catheters during chemotherapy?	
The patient's activity status	57.6
Catherine diameter and ven diameter compatibility	6.7
The concentration of drug to be delivered, pH, and osmolarity	20.6
I do not know	15.2
Is the recommended side/region for placement of peripheral venous catheter during chemotherapy important?	
Yes, the hand on the dominant side is recommended	13.9
Yes, the forearm on the dominant side is recommended	12.7
Yes, the forearm on the nondominant side is recommended	63.6
I do not know	9.7
How should be the catheter controlled whether it works or not before the start of chemotherapy from the peripheral venous catheter?	
Check whether the blood is coming back or not; then infiltration should be checked by giving 0.09% sodium chloride	93.9
Check whether the blood is coming back or not; then infiltration should be checked by giving 5% dextrose	1.3
Check whether the blood is coming back or not	3.0
I do not know	1.8
How to apply chemotherapy infusion with peripheral intravenous catheter?	
Calculate the number of drops per minute and use the pump device	89.7
Calculate the number of drops per minute and use the dosimeter	3.0
Calculate the number of drops per minute and make infusion according to gravity	3.0
I do not know	4.2
Does the type of chemotherapy drug affect the duration of catheterization during peripheral intravenous chemotherapy?	
Yes, the duration of the infusion should not exceed 12-24 h in the administration of vesicant drugs, otherwise the catheter must be replaced	40.6
Yes, the duration of infusion of vesicant drugs during administration should not exceed 12-24 h, otherwise the drug should be diluted as much as possible	16.4
No, catheter should be changed daily on chemotherapy drug applications	17.6
I do not know	25.5
Should I pay attention to the characteristics of fluids applied from short peripheral venous catheters?	
Yes, only hypotonic and isotonic fluids should be sent	53.3
Yes, only hypertonic fluids should be sent	3.0
No, any kind of liquid can be sent	27.3
I do not know	16.4
In which way should the chemotherapy drugs be given in infusion for a longer period of time than 6 days?	
Short intravenous peripheral catheter	59.4
Central peripheral venous catheter	11.5
Port catheter	22.4
I do not know	6.7
How often should infusion sets be changed during peripheral intravenous chemotherapy?	
Every 24 h	69.1
Every 48 h	15.7
Every 96 h	8.5
I do not know	6.7
In the case of vascular leakage of intravenously applied chemotherapy drugs, do the unwanted changes in the tissue vary according to the nature of the drug?	
Yes, vascular leakage of vesicant drugs such as epirubicin causes necrosis of the tissue	64.2
Yes, vascular leakage of neutralizing drugs such as ifosfamide causes necrosis of the tissue	9.1
No, all drugs cause damage similarly	14.5
I do not know	12.1
In the case of vascular leakage of chemotherapy drugs administered through the peripheral route, which of the following is true?	
The chemotherapy drug is drained from the infiltration site, the catheter is left in place and the extremity area is immobilized	11.4
The chemotherapy drug is drained from the infiltration site, the catheter is removed, if possible antidote is applied, depending on the nature of the medicine; hot or cool application is made for 20 min × four times in the first 2 days	75.8
The catheter area is elevated, the catheter is removed, the pressure is applied to the site	6.1
I do not know	6.7

than who did not. Giving the correct answer regarding points to consider in PVC selection during administration was less among the nurses who have bachelor's degree than others ($\chi^2 = 8.075$, $P = 0.044$), and giving the correct

answer regarding whether chemotherapy medications have any impact on the changes that occur in the tissue in case of extravasation was more within the nurses who have bachelor's degree than others ($\chi^2 = 7.885$, $P = 0.048$). And

Table 3: Distribution of nurses' responses on chemotherapy administration through central venous or port catheters ($n = 165$)

Questions about application of chemotherapy with central venous catheter and port catheter	Percentage
When the first chemotherapy should be done after the port catheter is inserted?	
As soon as possible after port insertion	67.3
2 days after the port is installed	15.2
5 days after the port is installed	11.5
I do not know	6.1
How should be the catheter controlled whether it works or not before the start of chemotherapy from the port/central catheter?	
Check whether the blood is coming back or not from port catheter; then infiltration should be checked by giving 0.09% sodium chloride	75.8
Check whether the blood is coming back or not from port catheter; then infiltration should be checked by giving heparinized SF	14.1
Check whether the blood is coming back or not from port catheter	9.5
I do not know	0.6
Should port pin number be changed according to the treatment?	
Yes, large diameter needles should be preferred if blood products and dense liquids are going to be applied	61.6
Yes, as small as possible needles should be preferred. Because large diameter needles shorten the use life of port	10.4
No, the nature of fluids/treatment does not affect the needle number	22.6
I do not know	5.4
When the chemotherapy treatment from the port catheter is finished, does the procedure should be terminated?	
The needle is removed from the port catheter after application of 15 ml of saline, the dressing is closed	7.3
The needle is removed from the port catheter after application of 15 ml of saline and in children/adults 1 ml of heparinized SF/3 ml heparinized SF respectively, then the dressing is closed	29.7
The needle is removed from the port catheter after application of 15 ml of saline and in children/adults 3 ml of heparinized SF/5 ml heparinized SF respectively, then the dressing is closed	61.2
I do not know	1.8
If the port needle is not inserted, what should be your heparin application frequency to prevent complications?	
Every 48 h	9.7
Every 7 days	13.3
Every 4-6 weeks	69.1
I do not know	7.9
Which of the following is not included in the content of the education given to a patient with a port?	
It should be emphasized that the activity of the arm at the area where the port catheter is placed must be restricted	80.6
It should be emphasized that the patients should not rub the area where the port is located while bathing, the pressure of the women's brassiere to the port area should be checked	3.9
Patients who received chemotherapy at home with a port catheter should emphasize that the catheter should be applied to the health care facility if the catheter area develops swelling, pain, redness	11.9
I do not know	3.6
Is it advisable to use an antiseptic hand wash procedure before and after administration of chemotherapy from the CVC?	
Yes, always	76.4
No, hand-washing with antimicrobial solution/soap is sufficient	7.2
No, this is only necessary for invasive procedures	8.5
I do not know	7.9
Which of the following is true about chemotherapy application from the CVC?	
Washing with saline solution is recommended between different chemotherapy infusions	73.9
There is no inconvenience in applying chemotherapy infusion with other drugs	6.1
Central vein should be preferred if vesicant drugs will be sent more than 12-24 h	7.9
I do not know	12.1
In cases where central venous medication chemotherapy drugs are infiltrated out of the vein, which of the following are among the applications to be performed?	
Stop the infusion. The chemotherapy agent is drained from the area where it is infiltrated, the catheter area is covered with dressing	9.7
Stop the infusion. The chemotherapy agent is drained from the area where it is infiltrated, antidote of the drug should be applied, region should be monitored	70.3
Stop the infusion. Rapid wash infusions start with saline	7.3
I do not know	12.7
Which of the following can be made after chemotherapy treatment via CVC?	
At least 10 ml of saline is given from the CVC, then the catheter entry site is closed with dressing	18.3

Contd...

Table 3: Contd...

Questions about application of chemotherapy with central venous catheter and port catheter	Percentage
At least 10 ml of saline is given from the CVC, then heparinized fluid is given, the catheter entrance is covered with transparent cover, it is recommended to change dressing every 7 days	47.3
At least 10 ml of saline is given from the CVC, then heparinized fluid is administered, the catheter entry site is closed with a gauze, and a dressing change is recommended every 7 days	24.7
I do not know	9.7

SF: Serum physiologic , CVC: Central venous catheter

also, giving the correct answer regarding termination of the procedure when chemotherapy administered through port catheter is finished was more within the nurses who had the training on safety chemotherapy administration 2 years ago or more than others ($\chi^2 = 9.076$, $P = 0.028$).

Discussion

In this study, we found that 65.5% of oncology nurses had already trained about safety chemotherapy administration. The literature on the field also reveals that not all oncology nurses participate in chemotherapy training programs.[31,32] The national and international oncology organizations recommend that the treatment of patients who receive chemotherapy due to cancer diagnosis should be provided by expert oncology nurses in a patient-centered, safety, timely, and reliable manner using accurate methods.[31,33] Several studies have shown that the proportion of nurses who trained about safety chemotherapy administration before starting to work in the field where they will administer chemotherapy is low, whereas most of them complete these trainings while working at the chemotherapy centers. It has also been demonstrated that nurses experience distress, irritability, and fear during chemotherapy application, which is due to lack of prior training on the subject.[31,32] It was reported that untrained oncology nurses did not adopt a positive attitude toward preparation and administration of chemotherapy and adverse effect and emergency management, implying the necessity of training seminars to improve nurses' knowledge level and attitudes.[34] It was also addressed in the literature that seemingly insignificant negligence and errors during IV administration of chemotherapy might cause adverse outcomes such as extravasation, thrombophlebitis, bleeding, hematoma, and infection, suggesting that nurses with inadequate level of knowledge posed a risk to patients' well-being.[17,19,25,26,28,35] Therefore, to provide more comfort to patients and to minimize potential complications, it is of utmost importance that all nurses who administer chemotherapy should complete training programs based on the current clinical guidelines and evidence-based studies and improve their clinical skills through these trainings.

The majority of the nurses who participated in this study responded incorrectly to the questions on the frequency of changing infusion sets and antiseptic hand sanitation procedures. According to the conducted studies and guidelines, types of catheters used in chemotherapy, infusion times, and changing and maintenance of catheters not only reduce the risk of complications but also have a considerable effect on the success of treatment.[2,14,15,35-38] While Alkubati *et al*.[30] showed that 10% of nurses were aware of the correct frequency of changing the clothing on the catheter, 31.3% were aware of accurate skin antisepsis and 54% implemented CVC care accurately. Cicolini *et al*.[25] also found that nurses most frequently responded incorrectly to the question on antiseptic hand sanitation before inserting PVC (73.7%), 54.6% were aware that PVC should be changed every 96 h, while 55.2% were aware that antiseptic techniques should be used while changing the infusion sets. In another study, Maki *et al*. reported that the ratio of catheter-related infections was 3% in CVC and 0.1% in peripheral venous catheterizations. Vidal *et al*. also reported the ratio of total implant venous port-related infections to be 84.5% whereas Shah *et al*. reported the same ratio to be 3.6%.[38-40] The guidelines developed by O'Grady *et al*., on the other hand, highlighted the importance of antiseptic technique in preventing IV catheter-borne infections.[15] Based on these results, it can be suggested that oncology nurses should update their information by following the developments in current guidelines and evidence-based practices on the prevention of infections occurring during the IV catheterization procedures.

In this study, while most of the nurses responded correctly to questions on catheter control before chemotherapy administration, a majority of nurses responded incorrectly to questions on the selection of needle gauge to be inserted in the port catheter according to the treatment to be administered and the adjustment of the rate of liquids to be infused with peripheral IV catheters. Furthermore, the ratio of correct answers regarding PVC selection, designation of the region where PVC will be inserted, and the duration of PVC was low. This outcome might be a result of the fact that not all nurses received training. Moreover, it was an interesting finding of our study that most of the nurses who were aware of the actions to be taken in case of extravasation did not know the procedures to prevent extravasation. In the prevention of extravasation, which

is defined as "a terrible complication" and "an avoidable disaster," risks aggravate unless necessary precautions are taken.[35] Therefore, the patient's veins should be assessed; veins at flexion point should be avoided during applications; pH value and osmolarity of the medication administered, drug infusion rate, duration of the treatment, and appropriate catheter diameter for the width of the vein should be known; and catheter aperture should be checked.[2,14,35-37] In their study, Verity *et al*.[31] showed that oncology nurses were well informed on the development of extravasation, which a similar finding is found in this study. Another study revealed that almost half of the oncology nurses, who had a mean chemotherapy knowledge level score of 79.4 ± 9.82 over 100, were preparing and administering chemotherapeutics four or more times a day.[41] We believe that on-the-job training programs and courses on catheters and their maintenance would be helpful to raise the awareness of oncology nurses.

Furthermore, this study showed that 47.3% and 61.2% of participant nurses washed CVC and implanted venous port catheter, respectively, with 10 ml 0.09% NaCl and heparinized solution before closing the catheters. Similarly, Keogh *et al*.[42] reported that 61% and 57% of nurses and midwives washed CVC and PIVC, respectively, with 10 ml 0.09% NaCl.[43] On the other hand, Hadaway suggested that catheters should be washed with at least 10 ml 0.09% NaCl to reduce vein damage and to extend the catheter's life, while Infusion Nurses Society stated that 1–3 ml and 5–10 ml of 0.09% NaCl would be sufficient to wash PVC and CVC, respectively.[4,14]

Previous studies showed nurses' knowledge influenced by professional education and training.[43,44] Our study nurses who had prior training on safety chemotherapy administration more correct answer chemotherapy administration. Gibson *et al*.[32] showed that there were significant correlations between time working in oncology and the number of years administering chemotherapy and the worry domains and attitude to chemotherapy. Our study giving the correct answer regarding termination of the procedure when chemotherapy administered through port catheter is finished was more within the nurses who had the training on safety chemotherapy administration 2 years ago or more than others.

Conclusion

This study found that more than half of oncology nurses were accurately informed on the peripheral and CVC and chemotherapy administration. However, believing in a "zero-error" practice in patient care, this observation may be considered unfavorable for oncology nurses. To provide the necessary benefit on behalf of the patient and to carry out the practice effectively, institutions should regularly develop chemotherapy training programs and ensure oncology nurses to participate in these programs, which would not only improve the knowledge levels of nurses but also induce positive changes in their attitudes and behaviors. Based on the results of this study, we recommend nurses working in this field to be supported with relevant on-the-job training programs and courses to improve the knowledge level concerning catheter care.

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Conflicts of interest

There are no conflicts of interest.

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