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Frequency of Phlebitis Development and Associated Factors in Hospitalised Adult Patients: A Descriptive and Correlational Study

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Abstract

Objective: The aim of this study was to determine the incidence and associated factors of peripheral venous catheter-related (PVC-related) phlebitis in hospitalised patients.

Methods: In this study, 315 catheters inserted in 247 patients hospitalised in the clinic were examined. Data were collected using the "patient identification form", the "peripheral catheter characteristics table", the "visual infusion phlebitis diagnosis scale" recommended by the Infusion Nurses Society (INS), and "intravenous drugs administered to the patient form". Data analysis performed using Statistical Package for Social Sciences 25.

Results: The frequency of PVC-related phlebitis was 15.6%. When phlebitis development at the peripheral venous catheter site was compared according to the individual and medical characteristics of the patients, no statistically significant difference was observed between phlebitis development and age, gender, body mass index, smoking status, chronic disease, anatomical location, catheter placement, and catheter size ($p>0.05$). However, there was a significant difference between the development of phlebitis and repeated catheter use, duration of catheter stay, type of medication used, and type and frequency of medication administration ($p<0.05$).

Conclusion: The frequency of PVC-related phlebitis is higher than the acceptable rate defined by the INS. It is essential for nurses to be aware of phlebitis risk factors, and it is recommended that they monitor the catheterised site at an appropriate frequency.

Keywords: Phlebitis, peripheral venous catheterization, incidence, complication

INTRODUCTION

Peripheral venous catheter (PVC) insertion is an intervention used in most hospitalised patients (1). PVC insertion is used to administer intermittent or continuous medication to the patient, to provide fluid support, to administer blood and blood products, to provide total parenteral nutrition of the patient, or to take blood samples (2). Although PVCs are a vital tool when administered correctly and effectively, they can cause many complications because of patient-related factors and incorrect practice. These complications include ecchymosis, hematoma, extravasation, occlusion, phlebitis, and catheter-related infections (3-5). Phlebitis is one of the common complications associated with PVC (6).

Phlebitis is defined as inflammation of the tunica intima layer of the vein using PVC (7). Phlebitis is a complication of bacterial phlebitis with symptoms of redness, pain, edema, a red line along the vein, palpation as a straight tube, and purulent discharge (8). Phlebitis causes significant pain and disruption of the peripheral vascular line. It may also require the placement of a new PVC. In addition, making a new diagnosis and requiring new treatments related to this new diagnosis prolongs the hospital stay of the patients and causes adverse effects such as

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increased workload for the nursing staff, stress for the patient/relatives, and additional costs (9-12). The Infusion Nurses Society (INS) states that the acceptable incidence of phlebitis should not exceed 5% in any population (13). However, when the literature is examined, it is seen that the incidence of phlebitis varies between 6.1% and 44% in studies on the development of phlebitis related to PVC conducted between 2010 and 2020 in the world and our country (13-18). In a study conducted in Serbia in 2018 to determine the incidence, severity, and risk factors of complications caused by PVCs, 1428 PVCs applied to 368 adult patients were analysed, and it was reported that phlebitis development with 44% ranked first among the complications that developed after PVC insertions (16).

When the risk factors affecting the frequency of phlebitis development are evaluated, the material from which the catheter is made (19,20), the length and diameter of the catheter (19), the duration of catheter stay in the vein (15,21,22), the anatomical region used (14,17,21), aseptic technique (8,17), immobility (17), and the properties of the drugs and fluids used (17,22) are considered. Individual characteristics such as age, gender (23), chronic diseases (17) and decreased mobility, family history of deep vein thrombosis, catheterisation of veins above the hand, pain, and use of certain drugs are also effective factors in phlebitis formation (17).

Along with the wide range of reported incidences of phlebitis and various risk factors, a detailed and recent analysis is missing. Therefore, the purpose of this study was to investigate the frequency of peripheral venous catheter-related (PVC-related) phlebitis and related factors in hospitalised adult patients. This study will reveal the development of phlebitis and the factors affecting the development of phlebitis in patients undergoing PVC and thus will guide nursing practice. Our aims were twofold. First, we attempted to determine the frequency of PVC-related phlebitis. Second, we tried to identify the risk factors for developing PVC-related phlebitis.

METHODS

This descriptive and correlational study was conducted in the adult inpatient clinic of a training and research hospital in İstanbul province between October 2020 and March 2021. The sample size of the study was calculated as 270 catheters because of G*Power (3.1.9.4) analysis (power: 0.8, β:0.20, α:0.05) based on the data of a previous similar study (24). Considering the possibility of patients dropping out, 315 catheters applied to 247 patients who met the sampling criteria and were accepted to participate were included in this study, which was slightly above 10% of the calculated sample size. Inclusion criteria: catheters inserted for the first time during hospitalisation and patients aged 18 and over. Exclusion criteria: receiving any immunosuppressive treatment, undergoing chemotherapy treatment, and existing phlebitis in the same extremity. The primary outcome of this study was the development of phlebitis. The variables analysed in the study were the patient's age, gender, body mass index, presence of chronic disease, smoking, PVC size, duration of catheter stay in the vein, extremity and anatomical region where the catheter was inserted, repeated use of the catheter site, intravenous (IV) treatment, frequency and method of treatment. The data of the study were collected from the "patient identification form", "visual infusion phlebitis diagnosis scale (VIPDS)", "peripheral catheter characteristics table," and "IV drugs administered to the patient form" which were created by the researcher as a result of the literature review. The patient identification form was created by the investigator because of a literature review (8,14-17). The patient identification form included characteristics such as age, gender, height, weight, history of chronic disease, smoking, number of IV catheters used, extremity used, and anatomical region used. The VIPDS was developed by Alyce Schultze and Paulette Gallant and published by the INS. The VIPDS comprises five stages. The VIPDS includes the steps of observing the catheter in terms of possible risks and/or grading phlebitis with the symptoms of phlebitis seen at each stage in case of phlebitis development while treatment is administered through a PVC (18,24). IV drugs administered to the patient form was created by the investigator to check whether the drugs administered to the patient through the IV catheter had a direct relationship with phlebitis. In this form, the names of the drugs initiated by the physician, starting times, doses, method of administration, frequency of administration, and the development of phlebitis during or after treatment were included.

In this study, data were collected using data collection forms in collaboration with the researcher and the primary nurses. Service nurses were previously trained on the documents for data collection. The process started with catheter insertion and subsequent catheter monitoring by the patient's primary nurse using the VIPDS. It continued until the patient was discharged or referred. As per the hospital policy, catheter site asepsis was provided in the wards using 2% chlorhexidine solutions. Semipermeable dressings/plasters supplied by the institution were used for fixation. In the case of phlebitis findings, the patient's PVC was removed. Catheters inserted in the ward were routinely changed every 72 h, except for complications. Because the patient was followed up only until discharge, phlebitis findings that may develop after discharge could not be reached.

Statistical Analysis

Data analysis was performed using Statistical Package for Social Sciences 25 (IBM SPSS Statistics Version 25, USA). Descriptive statistical methods (number, percentage, mean, standard deviation) were used to evaluate the demographic and disease-related characteristics of the patients, PVCs, phlebitis development, and medications. The chi-square test was used to compare the development of phlebitis in PVCs with demographic and disease-related, PVC-related, and drug-related characteristics. Post-hoc chi-square analyses were performed to determine the group causing significance in more than two groups. Because of chi-square analyses, a significant difference was observed between the groups according to five variables (repeated use of the catheter insertion site, duration of catheter stay in the vein, antiarrhythmic treatment, method of drug administration, and frequency of drug administration). In the evaluation of the data, p-values below 0.05 were considered statistically significant in all comparisons.

The study's ethics approval was obtained from the Üsküdar University Non-Interventional Clinical Ethics Committee (approval number: 61351342/2020-31, date: 29.01.2020). Written permission were obtained from the institution where the research was conducted. The purpose of the study was explained to the patients and their relatives, and written consent was obtained.

RESULTS

When the demographic characteristics of the patients who participated in the study were analysed, it was found that the mean age was 60.00±16.81 years, 59.9% were male, 42.9% were overweight, 83.8% had never smoked or quit smoking, 66% had chronic diseases, and 50.2% had a diagnosis of hypertension (Table 1). It was found that 60% of the PVCs were applied to the left arm of the patients, 35.2% of all catheters were applied to the antecubital fossa, and 71.4% of the catheters were not 20 G catheters. It was determined that 92.7% of the patients used the catheter for the first time, 75.2% of the catheters stayed in the vein for 49-72 h, and 90.8% were inserted in the ward. The frequency of PVC-related phlebitis was 15.6%. According to the VIPDS, 84.4%, 7.3%, 4.8%, 4.8%, 3.5%, and 3.5% of the sites where PVC was performed were found to be at level 1, level 2, level 3, and level 4, respectively. IV treatment was administered in 124 of 315 PVCs administered to the patients included in the study, and 21.3% of the IV treatments were in the antibiotic group. It was determined that 54.0% of the drugs administered to the patients were administered as bolus and 52.4% were administered twice or more daily (Table 2).

When phlebitis development at the site of PVC was compared according to the individual and medical characteristics of the patients, no statistically significant difference was observed between phlebitis development and age, gender, body mass index, smoking status, chronic disease, anatomical site of catheter insertion, and catheter size ($p>0.05$). When phlebitis development was compared according to the frequency of intervention at the site of PVC insertion, it was determined that the frequency of phlebitis development was significantly higher at the catheter sites repeated after intervention than at the catheter sites used for the first time ($p=0.041$). When phlebitis development was compared according to the duration of stay in the vein after PVC insertion, it was determined that phlebitis development was higher at the site of catheter insertion between 0-24 h and 25-48 h ($p<0.001$). In the post-hoc chi-square advanced statistical analyses performed to determine the group causing the significance, it was determined that there was no significant difference between the rate of phlebitis development in catheters left in the vein between 0-24 hours and 25-48 hours ($\chi^2=0.053$, $p=0.819$), 0-24 and 49-72 hours ($\chi^2=71.995$, $p<0.000$) and 25-48 and 49-72 hours ($\chi^2=75.014$, $p<0.001$).

Table 1. Demographic and disease-related characteristics of patients (n=247)

Variables	Mean	SD
Age (years)	60	16.81
BMI	27.86	5.35
	n	**%**
Age (years)		
18-40	53	19.92
41-64	116	43.60
65+	146	54.88
Gender		
Female	99	40.1
Male	148	59.9
BMI		
18.5-24.9	74	30.0
25-29.9	106	42.9
30=>	67	27.1
Smoking		
Yes	40	16.2
No	207	83.8
Chronic disease		
Yes	163	66.0
No	84	34.0
Chronic diseases		
Diabetes mellitus	64	25.9
Hypertension	124	50.2
Heart failure	86	34.8
Chronic renal failure	9	3.6
Chronic obstructive pulmonary disease	13	5.3

SD: Standard deviation, BMI: Body mass index

Tablo 2. Characteristics related to peripheral venous catheters and drugs administered through peripheral venous catheters (n=315)		
Variables	**n**	**%**
Extremity where the PVC is inserted		
Left arm	126	40
Right arm	189	60
PVC insertion site		
Dorsum of the hand	51	16.2
Forearm	89	28.3
Antecubital fossa	111	35.2
Upper arm	64	20.3
PVC size		
20 Fr	225	71.4
22 Fr	90	28.6
Frequency of use of the PVC site		
First time	292	92.7
Repeated use	23	7.3
Time of PVC		
0-24 hours	33	10.5
25-48 hours	45	14.3
49-72 hours	237	75.2
Phlebitis development		
Yes	49	15.6
No	286	84.4
Level of phlebitis		
Level 1	266	84.4
Level 2	23	7.3
Level 3	15	4.8
Level 4	11	3.5
IV drug use		
Yes	124	39.3
No	191	60.6
Antibiotic drug use		
Yes	67	21.3
No	248	78.7
Antiarrhythmic drug use		
Yes	22	6.9
No	293	93.1
Other drug use		
Yes	35	11.5
No	280	88.6
Development of phlebitis during the drug administration period		
Yes	38	30.6
No	86	69.3
Method of administration of the drug		
Bolus	67	54.0
Infusion	57	46.0
Frequency of drug administration		
One time	59	47.5
Two and more	65	52.4
PVC: Peripheral venous catheter, IV: Intravenous		

A statistically significant difference was found between the groups when phlebitis developed at the catheter site where antibiotics, antiarrhythmics, and other drugs were administered ($p<0.001$). Among these groups, the highest rate of phlebitis development was observed in patients receiving antiarrhythmic treatment, with 54.5% (n=12). Post-hoc chi-square advanced statistical analyses performed to determine the group causing the significance showed a highly significant difference between the development of phlebitis in catheters receiving antibiotics and those receiving antiarrhythmic therapy ($\chi^2=13.904$, $p<0.001$). There was a highly significant difference between the rates of phlebitis development at the catheter site in the antiarrhythmic and other drug groups ($\chi^2=10.697$, $p=0.001$). A statistically significant difference was observed between the groups when phlebitis development at the PVC site was compared according to the way the drugs were administered ($p=0.001$). Phlebitis developed in 38.6% of the infused catheter sites. According to the frequency of administration of the drugs, 46.7% of the drugs caused phlebitis at the catheter site in the first administration, and there was a highly significant difference between the groups ($p=0.014$) (Table 3).

DISCUSSION

The most important finding of this study was that the incidence of phlebitis in peripheral IV catheter use was 15.6%. This descriptive study determined the incidence of phlebitis and related factors in hospitalised patients by analysing 315 catheters used in 247 patients. The limitations of this study include the fact that the study was conducted in a single clinic, catheters were inserted by different nurses, and phlebitis development was evaluated by different nurses. In recent years, studies on this subject in Turkey have been limited. This study contributes to the national literature in terms of giving an incidence.

The INS recommends an acceptable phlebitis incidence of 5% or less (13). When the literature is analysed, it is seen that the phlebitis rates reported in other studies vary between 6.1% and 44% (13-18). The wide range of results in the literature may be due to the difference in phlebitis assessment tools and the different experiences of nurses evaluating phlebitis. The results of this study are compatible with the literature, but both the results and other results are above the acceptable values recommended by the INS. In this study, according to the findings determined by VIPDS, 84.4% of the catheters had phlebitis symptoms at level 1 and 7.3% had phlebitis symptoms at level 2. Unlike other phlebitis scales, level 1 phlebitis was defined as the stage in which phlebitis symptoms were not observed. In the study, 4.8% had level 3 phlebitis, 3.5% had level 4 phlebitis, and level 5 phlebitis was not detected. In this direction, in the study of Paşalıoğlu (24), similar to this study, it was reported that

Table 3. Comparisons of phlebitis development at PVC sites, drugs, and individual characteristics of patients (n=315)

Variables	Phlebitis development				χ^2	p-value
	Yes		No			
	n	%	n	%		
Age						
18-40	12	22.6	41	77.4	3.104	0.212
41-64	14	12.1	102	87.9		
>65	23	15.8	123	84.2		
Gender						
Female	18	14.8	104	85.2	0.097	0.755
Male	31	16.1	162	83.9		
BMI						
18.5-24.9	9	10.3	78	89.7	3.022	0.221
25-29.9	26	19.0	111	81.0		
30=>	14	15.4	77	84.6		
Smoking						
Yes	9	18.8	39	81.3	0.440	0.507
No	40	15.0	227	85.0		
Extremity where the PVC is inserted						
Left arm	18	14.3	108	85.7	0.258	0.612
Right arm	31	16.4	158	83.6		
PVC insertion site						
Overhand	9	17.6	42	82.4	1.401	0.705
Forearm	14	15.7	75	84.3		
Antecubital fossa	14	12.6	97	87.4		
Upper arm	12	18.8	52	81.3		
PVC size						
20 G	34	15.1	191	84.9	0.118	0.731
22 G	15	16.7	75	83.3		
Time of PVC						
0-24 hours	17	51.5	16	48.5	93.735	<0.001
25-48 hours	22	48.9	23	51.1		
49-72 hours	10	4.2	227	95.8		
Drugs						
Antibiotics	10	14.9	57	85.1	15.834	<0.001
Antiarrhythmics	12	54.5	10	45.5		
Other	4	11.4	31	88.6		
Method of administration of drugs						
Bolus	9	13.4	58	86.6	10.401	0.001
Infusion	22	38.6	35	61.4		
Frequency of drug administration						
One time	28	46.7	32	53.3	5.985	0.014
Two and more	17	25.8	49	74.2		
Chronic disease						
Yes	29	13.5	186	86.5	2.203	0.138
No	20	20.0	80	80.0		
Diabetes mellitus						
Yes	9	10.8	74	89.2	1.905	0.168
No	40	17.2	192	82.8		
Hypertension						
Yes	21	12.7	145	87.3	1.285	0.526
No	28	18.8	121	81.2		
Heart failure						
Yes	22	18.2	99	81.8	1.285	0.526
No	27	13.9	167	86.0		
Chronic renal failure						
Yes	0	0.00	12	100.0	1.232	0.267
No	49	16.2	254	83.8		
Chronic obsrtuctive pulmonary disease						
Yes	2	13.3	13	86.7	0.026	0.873
No	47	15.7	253	84.3		

χ^2: Chi-square, PVC: Peripheral venous catheter

90.1% of patients developed level 2 phlebitis. However, Berşe et al. (15), Braga et al. (25), and Atay et al. (14) reported that the most common level 1 phlebitis (the stage in which the first stages of phlebitis are seen) was observed in their studies using the phlebitis scale recommended by the INS. This was thought to be due to the withdrawal of catheters in patients with early signs of phlebitis at level 2.

When the development of phlebitis was compared according to the duration of stay in the vein after PVC application, it was observed that phlebitis was higher in catheters that stayed in the vein between 0-24 h and 25-48 h. The results of this study are similar to those of Paşalıoğlu (24) and Saini et al. (26). However, Berşe et al. (15) found that the incidence of phlebitis was higher in patients whose catheters remained for 72-96 h, and Lulie et al. (27) found that the incidence of phlebitis was higher in catheters that remained for more than 96 h. PVCs removed due to complications remain in the vein for a shorter time than those removed due to completion of treatment. Therefore, it is thought that the phlebitis rates were higher in catheters that remained in the vein for a shorter time in this study. The fact that phlebitis was observed with a rate of 51.5% in the first 24 h in this study is thought to be because antiarrhythmic and antibiotic group drugs administered in the clinic were started in the first hospitalisation of the patient and these drugs caused phlebitis in the first 24 h (20,28).

When the development of phlebitis was analysed according to the drugs administered through the catheter, a statistically significant difference was found between the districts and the development of phlebitis ($p<0.001$). The highest rate of

phlebitis development among these groups was found in patients receiving antiarrhythmic treatment (54.5%). In this study, the increased risk of phlebitis with antiarrhythmic treatment was interpreted as a result of using antiarrhythmic drugs with the active ingredient amiodarone, which has been reported to cause phlebitis in different studies. In a study performed to determine the incidence of IV amiodarone-induced phlebitis, the incidence of amiodarone-related phlebitis was found to be 44% (28). In a systematic review in which 20 studies were analysed to determine the incidence of amiodarone-related phlebitis, phlebitis was found to be between 0% and 85% (29). It is thought that the effect of pH and osmolarity of antiarrhythmic therapies on the vessel wall and the fact that they are continued in long-term infusions from the same PVC due to treatment procedures increase the incidence of phlebitis (8).

When the results of the study were analysed, it was observed that there was a statistically significant difference between the two groups according to the way the drugs were administered ($p=0.001$). The rate of phlebitis at the PVC sites of drugs administered by infusion was 38.6%. When the frequency of drug administration through the catheter was compared with the development of phlebitis, it was observed that phlebitis developed more frequently in catheters where the drug was applied twice or more times ($p<0.05$). It is thought that this result occurs because of repeated administration and primarily by infusion of drug groups such as antibiotics and antiarrhythmics with high phlebitis rates (20,29).

Study Limitations

The limitations of this study include the fact that the study was conducted in a single clinic, catheters were inserted by different nurses, and phlebitis development was evaluated by different nurses. In recent years, studies on this subject in Turkey have been limited. This study contributes to the national literature in terms of giving an incidence.

CONCLUSION

In conclusion, the rate of phlebitis due to PVCs in hospitalised adult patients was 15.6%. This study found a statistically significant difference between the duration of catheter stay in the vein, antiarrhythmic drugs, type and frequency of drug administration through the PVC, and the development of drug phlebitis. The results of this study expand our knowledge about the risk factors and frequency of phlebitis in adult patients using PVCs. In addition, feedback on the results to the healthcare team provides awareness of phlebitis and risk factors. In the future, multicenter, large-sample, prospective studies are recommended to clarify phlebitis development risks and develop strategies to reduce them.

Ethics

Ethics Committee Approval: The study's ethics approval was obtained from the Üsküdar University Non-Interventional Clinical Ethics Committee (approval number: 61351342/2020-31, date: 29.01.2020).

Informed Consent: Informed written consent was obtained from all participants.

Authorship Contributions

Surgical and Medical Practices: M.Ç., M.A., Concept: M.Ç., M.A., Design: M.Ç., M.A., H.D., Data Collection or Processing: M.Ç., M.A., Analysis or Interpretation: M.Ç., M.A., Literature Search: M.Ç., M.A., H.D., Writing: M.Ç., M.A., H.D.

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