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LOCAL INFLAMMATION AND ASSOCIATED FACTORS IN PATIENTS WITH PERIPHERAL VEIN CATHETERS AT TAM ANH GENERAL HOSPITAL HANOI IN 2024

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ABSTRACT

Objective: To determine the rate of local inflammation in patients with peripheral venous catheters and to analyze some related factors.

Research method: A cross-sectional descriptive study with analysis was conducted on 240 patients and 545 peripheral venous catheters observed.

Results: The rate of phlebitis in patients with peripheral venous catheters assessed by the Visual Infusion Phlebitis scale was 27.5% for patients and 25.9% for peripheral venous catheters. The most common levels of inflammation were grade 1 (37.2%) and grade 2 (24.2%); a small number had grade 3 inflammation (1.7%); no grade 4 or grade 5 inflammation was detected. Factors related to the increased rate of phlebitis include: age ≥ 60, low body mass index (BMI < 18.5); treatment duration ≥ 5 days; medication use > 2 times/day, use of more than 2 types of antibiotics and use of antibiotics from the Cephalosporin, Quinolones groups; catheter insertions ≥ 3 times. The risk of developing phlebitis when the peripheral venous catheter is placed at the elbow/leg is 3 times higher than the back of the hand.

Conclusion: The rate of local inflammation in patients with peripheral venous catheters was 25.9%. Early monitoring and detection of localized phlebitis are essential to improve the quality of patient care.

Keywords: Phlebitis, peripheral venous catheter, VIP score.

1. INTRODUCTION

Peripheral venous catheters (PVCs) are among the most common clinical procedures used for fluid and medication administration. Phlebitis is a frequent complication of PVCs, increasing hospital stay duration, healthcare costs, and patient dissatisfaction, and potentially leading to complications like sepsis, pain, discomfort, thrombosis, and venous occlusion. The Infusion Nurses Society (INS) [1] recommends an acceptable phlebitis rate of ≤5%. However, phlebitis rates vary widely from 0.5% to 59.1%, with an incidence of 20–80% in patients receiving intravenous therapy [2] .

At Tam Anh General Hospital Hanoi, about 75% of inpatients have peripheral venous catheters inserted and maintained, making it a routine procedure to enhance patient comfort and facilitate nursing care and emergency treatment. Despite recognizing the presence of phlebitis at catheter sites, no previous studies have quantified its incidence or severity. Therefore, this study aims to:

1. Determine the rate of local inflammation in patients with peripheral venous catheters at the Respiratory Medicine and General Surgery departments of Tam Anh General Hospital Hanoi in 2024.

2. Analyze factors associated with local inflammation in patients with peripheral venous catheters.

2. METHODS

2.1. Study population

- *Inclusion criteria:* Patients ≥ 16 years old with Peripheral venous catheters placed and maintained for at least 24 hours in the study departments.

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- Exclusion criteria:

+ The patient had a peripheral intravenous catheter transferred from another department.

+ The patient lost sensation, the patient was in a coma.

2.2. Study location and duration: The Respiratory Medicine and General Surgery departments of Tam Anh General Hospital Hanoi, April–August 2024.

2.3. Study design: Cross-sectional descriptive study.

2.4. Sample size and selection: Convenience sampling of 240 patients with 545 Peripheral venous catheters meeting the inclusion criteria.

2.4. Data processing and analysis

Data collection tools: Pre-designed patient records, including demographics (age, gender, comorbidities, BMI), Peripheral venous catheter details (type, size, location), and drug use. Phlebitis was assessed using the Visual Infusion Phlebitis (VIP) scale.

Data analysis: Statistical analysis was performed using SPSS 20.0. Descriptive statistics were reported as frequencies and percentages. Chi-square and t-tests were used to evaluate associations between phlebitis and patient/clinical factors.

2.5. Ethics approval

The study was approved by the Institutional Review Board under decision number 32/QĐ-BVTA. Written informed consent was obtained, and patient confidentiality was maintained. Observational data collection posed no harm to patients.

3. RESEARCH RESULTS

3.1. General information of the research subjects

After the data collection period, a total of 240 patients were monitored, and 545 instances of peripheral venous catheterization (PVC) were assessed for the presence of venous inflammation at the insertion sites. The peripheral venous catheters were placed in patients with an average age of 54.3 ± 20.3 years (range: 16 to 93 years), with an equal gender distribution, each accounting for 50%. Among patients, 43.8% were overweight (BMI ≥ 23), and 48.3% had ≥ 2 comorbidities, including hypertension (19.6%) and diabetes (10.8%).

3.2. Rate of phlebitis in patients with peripheral venous catheters

The incidence of phlebitis in patients with peripheral venous catheters (PVCs), assessed by the Visual Infusion Phlebitis (VIP) score, was 27.5% per patient and 25.9% per peripheral venous catheter.

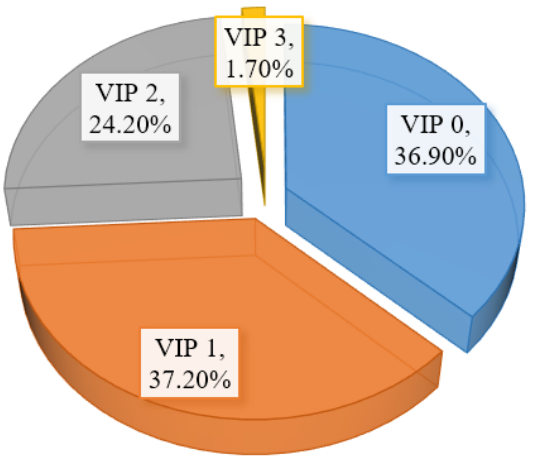

Figure 1. VIP Score inflammation level according to catheter needle (n=545)

Comments: the most common levels of inflammation were grade 1 (37.2%) and grade 2 (24.2%); a small number had grade 3 (1.7%); no grade 4 or grade 5 inflammation was detected.

3.3. Some factors related to phlebitis

Table 1. Patient factors and treatment time for phlebitis (n = 545)

Element	Phlebitis		OR , 95%CI	P Chi-square
	Have (n; %)	No (n; %)		
Sex				
Male	75 (27.4%)	199 (72.6%)	1.17 (0.8 - 1.72)	0.42
Female	66 (24.4%)	205 (75.6%)		
Age				
< 60 years old	56 (20.7%)	214 (79.3%)	0.59 (0.4 - 0.87)	0.007
≥ 60 years old	85 (30.9%)	190 (69.1%)		
Body mass index				
Under-weight (<18.5)	25 (30.5%)	57 (69.5%)	1.04 (0.6 – 1.8)	0.041
Normal (18.5-22.9)	70 (29.7%)	166 (70.3%)		
Overweight (≥23)	46 (20.3%)	181 (79.7%)	1.66 (1.1 – 2.5)	
Treatment time				
≤ 5 days	9 (9.9%)	82 (90.1%)	0.2 (0.1 - 0.4)	< 0.001
> 5 days	57 (38.3%)	92 (61.7%)		

Comments : Men, patients ≥ 60 years old, patients with BMI <18.5, and treatment durations > 5 days have a higher rate of phlebitis than women, patients < 60

years old, those with normal or overweight BMI, and treatment durations of ≤ 5 days. Statistically significant differences were observed between age, BMI, treatment duration, and the risk of phlebitis.

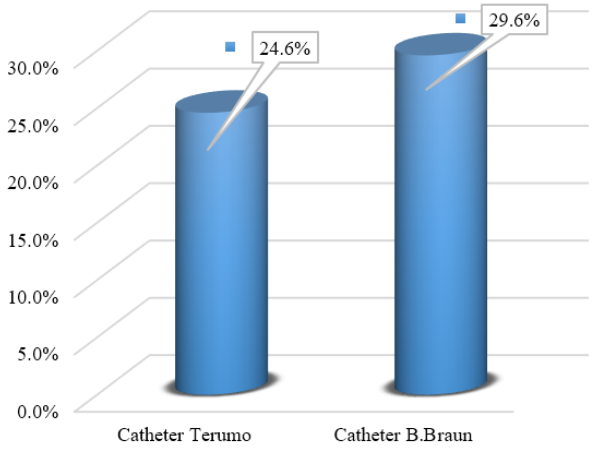

Figure 2. Phlebitis rate by catheter type (n= 545)

Comment: For the same 22G needle size, patients using B.Braun catheter needles had a higher rate of phlebitis than those using Terumo (29.6% vs. 24.6%).

Table 2. Needle retention time catheter with phlebitis

Phlebitis	Catheter retention time			t and p
	Quantity	Mean	SD	
With Inflammation	141	50.8	21.0	t= -1.84 p=0.066
No Inflammation	404	54.5	20.5	
Total	545	53.5	20.7	

Comment: The average catheter retention time for phlebitis was 50.8 ± 21 hours. No significant difference was found between catheter retention time and phlebitis (p > 0.05).

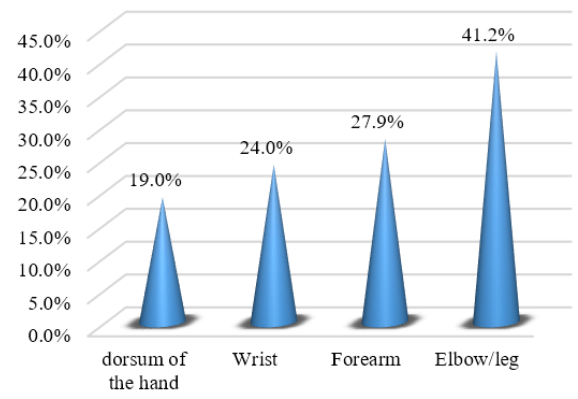

Figure 3. Phlebitis rate according to catheter placement site (n=545)

Comment: The location of the catheter in the elbow/leg had the highest rate of phlebitis (41.2%), while the back of the hand had the lowest (19%).

Table 3. Characteristics of drug use in phlebitis

Characteristics of drug use	Phlebitis		OR , 95%CI	p Chi-square
	Yes (n; %)	No (n; %)		
Number of Drugs per PVC				
≤ 2 types	100 (23.6%)	324 (76.4%)	0.6 (0.4-0.9)	0.022
> 2 types	41 (33.9%)	80 (66.1%)		
Number of Uses per Day				
≤ 2 times	85 (23%)	285 (77%)	0.6 (0.4-0.9)	0.025
> 2 times	56 (32%)	119 (68%)		
Total Number of PVCs during Treatment				
< 3 times	16 (12.5%)	112 (87.5%)	0.2 (0.1-0.3)	< 0.001
≥ 3 times	50 (44.6%)	62 (55.4%)		
Cephalosporin				
Yes	83 (22.3%)	289 (77.7%)	0.6 (0.4-0.8)	0.005
No	58 (33.5%)	115 (66.5%)		
Carbapenems				
Yes	22 (32.4%)	46 (67.6%)	1.4 (0.8-2.5)	0.19
No	119 (24.9%)	358 (75.1%)		
Quinolones				
Yes	44 (32.6%)	91 (67.4%)	1.6 (1.0-2.4)	0.04
No	97 (23.7%)	313 (76.3%)		
5-nitroimidazole				
Yes	22 (24.4%)	68 (75.6%)	0.9 (0.5-1.5)	0.74
No	119 (26.2%)	336 (73.8%)		

Comments: There was a statistically significant difference between the use of more than two types of antibiotics, daily use of drugs (>2 times), and the number of catheters placed during treatment (≥3) with the incidence of phlebitis. The Cephalosporin group had a lower risk of phlebitis, while the Quinolones group had a higher risk compared to the non-users (OR = 1.6, CI 1.0 – 2.4).

Table 4. Multivariate Regression Model Between Peripheral Phlebitis and Related Factors

Variable	B	OR, 95%CI	p
Age ≥ 60	0.53	1.7 (1.2 – 2.6)	0.008
elbow/leg	1.1	3.0 (1.0 – 9.0)	0.049
48 < Needle retention time ≤ 72 hours	0.47	1.6 (1.0 – 2.5)	0.03
Constant	-0.14	0.87	0.78

Comment: The regression model showed that related factors had a positive impact on phlebitis: patients aged ≥ 60 years have a higher risk of phlebitis than those aged < 60 years (OR = 1.7; CI 1.2–2.6), 48 < needle retention time ≤ 72 hours has a higher risk of phlebitis than needle retention time ≤ 48 hours (OR = 1.6; CI 1.0–2.5). Elbow/leg location has a higher risk of phlebitis than dorsum of hand location (OR = 3, CI 1.0–9.0).

4. DISCUSSION

4.1. Local inflammation in patients with peripheral venous catheters

The rate of phlebitis in the study was 25.9%, higher than the 5% rate which is the acceptable threshold according to INS [1] and the rate of 12% in Australia; 11.5% in Portugal; 7.6% in Germany; 5.6% in Spain in a systematic review by Leonor et al. (2022) [3] ; higher than the study by Nguyen Viet Tu (2023) with an inflammation rate of 22.7% [4] ; close to the study rate In the country of Bui Van Thang (2020) is 26% [5] ; lower than the study of Lam Thi Nhung (2021) [6] phlebitis is 30.4%.

Phlebitis according to grade 1 accounted for the highest rate of 37.1%; grade 2 accounted for 24.2%; grade 3 accounted for the lowest rate of 1.7% and there was no grade 4 or 5 phlebitis. This result is higher than the study of Lam Thi Nhung [6] peripheral venous catheters with grade 1 phlebitis accounting for 21.3%; grade 2 accounted for 8.5%; grade 3 accounted for 0.6%. Lower than the study of Dang Duy Quang (2020) [7] with grade 1 phlebitis accounting for 45.5%; grade 2 accounted for 35%; grades 3 and 4 accounted for 11.9% and the study of Vo Thi Phuong Anh (2023) [8] with grade 1 phlebitis accounting for 70.4%; grade 2 accounted for 19.5%; grade 3 accounted for 7.4% and grade 4 accounted for 3.7%. The variation in research results on the rate and severity of phlebitis could be due to differences in disease characteristics, comorbidities, sample sizes, and scales used at different research sites.

4.2. Some factors related to peripheral phlebitis

Regarding gender, phlebitis was higher in men than in women 27.4% vs 24.4%, the difference was not statistically significant. Similar findings were reported by Salma et al. [9] showing a higher rate of phlebitis in men. In contrast, studies by Tran Thi Ly [10] and Vo Thi Phuong Anh [8] showed that female sex was associated with a higher risk of developing phlebitis after peripheral venous catheter placement.

The older you are, the lower your resistance will be. At the same time, old age is a favorable condition for venous thrombosis. In our study, the rate of patients ≥ 60 years old had a higher rate of local inflammation than the group of patients < 60 years old (30.9% vs. 20.7%, p = 0.007). This result is similar to the studies of Lam Thi Nhung [6] , Dang Duy Quang [7] and Tran Thi Ly [10], all of which showed that the group ≥ 60 years old had a higher risk of phlebitis than the group < 60 years old.

The rate of phlebitis in patients with BMI <18.5 was 30.5%, normal BMI was 29.7% and overweight (BMI ≥ 23) was 20.3%, the difference was statistically significant between BMI groups. Lam Thi Nhung's study [6] also gave similar results. On the contrary, the results of Vu Ba Quynh's study [11] showed that overweight and normal patients had higher phlebitis than underweight patients. This may explain that underweight patients may have inadequate nutrition or lack of nutrients necessary for maintaining the health of veins and vessel walls, which can make veins more susceptible to inflammation.

Patients hospitalized for ≤ 5 days had a rate of phlebitis of 9.9%; patients hospitalized for > 5 days had a rate of phlebitis of 38.3%. The study results were similar to the study by Dang Duy Quang [7] which also showed that the longer the hospital stay, the higher the risks such as hospital infection, severity of the disease and catheter retention time. These are also factors that increase the risk of local inflammation after catheter placement.

There are two types of catheters mainly used in the hospital and monitored in this study: Braun 22G safety catheter with an inflammation rate of 29.6%; higher than Terumo 22G catheter with an inflammation rate of 24.6%. This result is similar to the study of Tran Thi Ly [10] . This difference can be explained by the fact that the two types of catheters are made of different materials and have different designs.

The rate of phlebitis was highest in the elbow/leg at 41.2%; forearm 27.9%; wrist 24% and dorsum of hand 19%. This result is similar to the study of Tran Thi Ly [10] with the rate of phlebitis in the forearm at 53.3%, higher than dorsum of hand 37.5%; wrist 43.9%. Some studies by Dang Duy Quang [7] , Vo Thi Phuong Anh [8] . Lam Thi Nhung's study [6] showed that phlebitis when placed in the arm was 1.7 times higher than in the elbow. The forearm is a favorable location with large, long, straight veins and has little impact on the patient's daily life, so it is often chosen for catheter placement.

The average retention time for phlebitis in peripheral venous catheters was 50.8 ± 21 hours. When the catheter is retained for a short time, there may not be enough time for the body to adapt and the immune response may be stronger, leading to phlebitis. Some patients may react strongly to the catheter material, causing phlebitis shortly after placement. The study results showed that patients who had to have the needle inserted 3 times or

more had a high rate of phlebitis of 44.6%, similar to the studies of Tran Thi Ly [10] and Vo Thi Phuong Anh [8] . The reason for such results may be that patients who are hospitalized for a long time have weaker immune systems than other patients, and the amount of medication and the number of times the medication is used are higher, leading to a higher risk of inflammation.

The Quinolones and Carbapenems antibiotic group had a risk of inflammation of 32%; the Cephalosporin group had a risk of inflammation of 22.3%; the 5-nitroimidazole group had a risk of inflammation of 24.4%; the difference was statistically significant between the group that used Cephalosporin antibiotics and the Quinolones group. Tran Thi Ly's study [10] showed that the highest rate of inflammation was in the 5-nitroimidazole group and the difference was statistically significant between the group that used aminoglycosides and the group that did not. The PH level in antibiotics can increase the risk of phlebitis. In addition, the material, needle size, treatment time, infusion rate and the number of antibiotics used, and the number of times used per day were related to the rate of phlebitis. In the study, the use of > 2 drugs per KLTMNV showed the highest risk of phlebitis at 33.9%; Use frequency more than 2 times/day has a higher risk of phlebitis than ≤ 2 times/day (32% vs 23%), the difference is statistically significant p = 0.025.

The differences in the rates of phlebitis and associated factors across studies can be attributed to variations in sample size, study locations, and the specific characteristics of drug use in different medical facilities. These factors likely influenced the study results, causing variations in the rates of phlebitis and related risk factors across patient groups and research environments.

5. CONCLUSION

The incidence of phlebitis in patients with peripheral intravenous catheters remains high. The main risk factors for phlebitis include advanced age (≥ 60 years), thin body condition, use of multiple antibiotics, especially quinolones, as well as needle placement in the elbow or leg and needle retention time exceeding 48 hours. These factors are important in deciding the choice of needle placement site and the time of phlebitis monitoring by nurses. Monitoring and early detection of local phlebitis is necessary to improve the quality of patient care, minimize complications and improve the quality of care.

The incidence of phlebitis in patients with peripheral intravenous catheters (PVCs) remains high. The main risk factors for phlebitis include advanced age (≥ 60 years), low body weight, the use of multiple antibiotics, especially quinolones, as well as catheter placement in the elbow or leg and needle retention time exceeding 48 hours. These factors are crucial for determining catheter placement sites and the timing of phlebitis monitoring by healthcare providers. Early monitoring and detection of local phlebitis are essential to improve the quality of patient care, minimize complications, and enhance overall healthcare outcomes.

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