CURRENT STATUS OF CATHETER-RELATED PERIPHERAL PHLEBITIS IN INPATIENTS AT MILITARY HOSPITAL 175 IN 2024

Dinh Thi Thuy[1*], Cam Ngoc Thuy[1], Tran Kim Quyen[1], Nguyen Thi Ngoc Huong[1], Nguyen Thai Ngoc Phong[1], Bui Thi Ngoc[1], Hoang Vu Hien[1], Ngo Quoc Anh[1], Dao Minh Tan[1], Lo Thi Ngoc Nu[1]

ABSTRACT

Objective: *To evaluate the prevalence and characteristics of peripheral intravenous catheter (PIVC)-related phlebitis at catheter insertion sites among inpatients across selected clinical departments of Military Hospital 175.*

Subjects and Methods: *A cross-sectional descriptive study described the prevalence of peripheral phlebitis at catheter insertion sites among inpatients in several clinical departments of Military Hospital 175, conducted from June to November 2024. Phlebitis was identified and graded using the Visual Infusion Phlebitis (VIP) score.*

Results: *The prevalence of peripheral intravenous phlebitis at catheter insertion sites among inpatients in selected clinical departments was 13.5%. Phlebitis at VIP grade 1 accounted for the highest proportion (10.1%), followed by VIP grade 2 (2.4%). The lowest proportion was VIP grade 3 (1%). No cases of VIP grade 4 or VIP grade 5 phlebitis were observed. Independent risk factors associated with phlebitis included catheter dwell time and catheter patency status.*

Conclusion: *The prevalence of peripheral intravenous phlebitis at catheter insertion sites (13.5%) was relatively high compared with the recommendation of the Infusion Nurses Society (INS) (approximately 5%). Nurses should pay close attention to related risk factors and strictly adhere to protocols for the management and care of peripheral intravenous catheters in order to reduce the incidence of phlebitis.*

Keywords: *Peripheral phlebitis; peripheral intravenous catheter; Visual Infusion Phlebitis (VIP) score.*

---

[1] Military Hospital 175
Corresponding author: Dinh Thi Thuy, email: dinhthithuy04@gmail.com
Recieved: August 5, 2025
Revised: December 10, 2025.

1. INTRODUCTION

Peripheral intravenous catheter (PIVC) insertion is a common invasive procedure among hospitalized patients worldwide [1]. It is estimated that 80% of inpatients receive at least one PIVC. Each year, approximately 1.2 billion PIVCs are used globally [1]. PIVCs are widely used for therapeutic, diagnostic, monitoring, and nutritional purposes (administration of medications, intravenous fluids, nutritional solutions, blood products, and for diagnostic testing, etc.).

Phlebitis is a common complication associated with PIVC use, characterized by an inflammatory response of the vessel wall and endothelial injury at the catheter insertion site [2]. Patients may present with pain, swelling, and erythema at the insertion site; in more severe cases, inflammation may spread along the vein, causing venous induration and fever [3], [4]. Mechanical, chemical, and infectious factors may all contribute to the development of phlebitis. This complication not only affects the maintenance of intravenous access but also poses a potential risk of progression to systemic infection. If not managed promptly, phlebitis can prolong treatment duration, increase healthcare costs, and negatively impact the patient care experience [4].

Studies worldwide report phlebitis rates following PIVC insertion ranging from 3% to 70% [4]. Although recent systematic reviews and meta-analyses indicate that catheter-related infection rates per catheter are relatively low, catheter failure remains common. As a result, catheter-related peripheral phlebitis continues to be a clinically significant issue that warrants specific investigation at individual healthcare facilities [2]. In Vietnam, reported phlebitis rates range from 7.9% to 43.4% [5], [6], [7].

Military Hospital 175 is a general, tertiary, and specialized hospital serving as the final referral center of the Vietnamese military in the southern region. The hospital provides medical care for senior leaders of the Party, the State, the Military, military personnel, and civilians. With an inpatient population of 1,600–1,800 patients per day and nearly 500,000 PIVCs used annually, catheter management and care play a crucial role in treatment and nursing practice.

Although numerous domestic and international studies have examined PIVC-related phlebitis rates and associated factors, Military Hospital 175 has not yet conducted a comprehensive assessment of the current situation. Consequently, intervention measures have not been implemented in a coordinated manner or fully aligned with the hospital's actual conditions. Therefore, this study was conducted to provide an overall assessment of PIVC-related phlebitis at catheter insertion sites, thereby guiding appropriate intervention strategies to reduce phlebitis

and improve the effectiveness and quality of patient care, with the following objectives:

- To determine the prevalence of PIVC-related phlebitis among inpatients in selected clinical departments of Military Hospital 175.

- To identify factors associated with PIVC-related phlebitis among inpatients in selected clinical departments of Military Hospital 175.

2. SUBJECTS AND METHODS

Study Subjects:

All inpatients receiving treatment in 11 clinical departments of Military Hospital 175 during the period from June 2024 to November 2024.

Study Site and Duration:

The study was conducted from June 2024 to November 2024 in 11 clinical departments of Military Hospital 175, including:

- **Four internal medicine departments:** Cardiology–Rheumatology–Endocrinology, Gastroenterology, Tuberculosis and Pulmonary Diseases, Neurology–Stroke

- **Four surgical departments:** Lower Limb Surgery, Gastrointestinal Surgery, Thoracic Surgery, Neurosurgery

- **Three departments under the Institute of Oncology and Nuclear Medicine:** Radiotherapy, Chemotherapy, Palliative Care

Inclusion Criteria:

- Inpatients with one PIVC in place at the time of data collection who agreed to participate in the study.

Exclusion Criteria:

- Patients with impaired consciousness

- Catheters inserted in paralyzed or insensate limbs

- Patients undergoing hemodialysis

- Patients with sepsis

Research Methods

Study Design: Cross-sectional descriptive study.

Sample Size

The sample size was calculated using the formula for estimating a population proportion:

$$n \geqslant \frac{Z^2_{1-\alpha/2}(1-p)p}{d^2}$$

Where:

- p = 0.165 (PIVC-related phlebitis rate of 16.5% [8])

- Z = 1.96, corresponding to a 95% confidence level

- d = 5%, acceptable margin of error

The minimum required sample size was n = 212. Accounting for a 10% attrition rate, the final required sample size was 235.

Sampling Method:

Convenience sampling was used, including all patients who met the inclusion and exclusion criteria across the 11 clinical departments.

Data Collection Instrument:

The data collection tool was adapted and revised based on the instrument developed by Vu Ba Quynh [8]. A pilot test was conducted with 30 samples, yielding a Cronbach's alpha coefficient of 0.72.

- **Part 1 – Patient Information (6 items):** age, gender, diagnosis, comorbidities.

- **Part 2 – PIVC Information (18 items):** date and time of catheter insertion, number of insertion attempts, catheter size, type of fixation dressing, condition of the dressing, dressing change interval, connection devices, condition of catheter hub/needleless connector, catheter patency, local condition at the insertion site, Visual Infusion Phlebitis (VIP) score, antibiotic use, types of medications, intravenous fluids, blood products, and the patient's level of cooperation in caring for and maintaining the catheter site.

Data Collection Procedure:

Investigators were trained to ensure consistency in data collection procedures. Investigators compiled a list of inpatients in each department, approached eligible patients, explained the study purpose, provided study information, and invited participation. Data were collected on weekdays, with one department surveyed per day, including all eligible patients.

Investigators collected demographic information, clinical data, and PIVC-related information through a combination of patient interviews and medical record review.

Observation and assessment of phlebitis at the PIVC insertion site were conducted using the Visual Infusion Phlebitis Score (VIP Score), 2016 version, which has been translated into Vietnamese and implemented according to the guideline *"Safe Intravenous Therapy"* issued under Decision No. 62/QĐ-K2ĐT dated June 16, 2023, by the Department of Science, Technology and Training – Ministry of Health. The validity and reliability of the VIP score have been established in previous studies and are recommended by the Infusion Nurses Society (INS) for clinical use [4].

Table 1. VIP Scale

VIP Score	Signs
VIP 0	No signs
VIP 1	Mild pain or slight redness at the cannula insertion site
VIP 2	Presence of 2 out of 3 signs: pain at the cannula insertion site, erythema, swelling
VIP 3	Presence of 3 signs: pain along the path of the cannula, erythema, induration around the cannula site
VIP 4	Presence of 4 signs: pain along the path of the cannula, erythema, induration around the cannula site, palpable cord-like vein
VIP 5	Presence of 5 widespread signs: pain along the path of the cannula, erythema, induration around the cannula site, palpable cord-like vein, fever

Control of Bias

Selection bias control:

Strict adherence to the inclusion criteria for study participants.

Information bias control:

Investigators clearly explained the purpose, requirements, and significance of the study to encourage voluntary participation and reduce refusal rates. Participants were encouraged to take part voluntarily.

Data Management and Analysis:

Data analysis was performed using Stata software 14.2. Categorical variables were described using frequencies and percentages (%). Continuous variables were presented as mean ± standard deviation or median (if not normally distributed).

Associations between categorical variables and binary outcomes (presence/absence of peripheral phlebitis) were assessed using the chi-square test or Fisher's exact test. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each variable. Statistical significance was defined as $p < 0.05$ and a 95% CI that did not include 1.

Multivariable regression models were used to control for potential confounding factors affecting the true association between phlebitis and related variables. Variables associated with phlebitis in univariable analysis with $p < 0.20$ were selected for multivariable analysis.

Ethics: The study was approved by the Biomedical Research Ethics Committee of Military Hospital 175 under Decision No. 2349/GCN-HĐĐĐ, dated June 5, 2024.

3. RESEARCH RESULTS

1.1. Characteristics of the Study Subjects

Table 2. Characteristics of Study Participants

Varialbe		Frequency (n=297)	Percentage (%)
Age group	< 60 years	156	52,5
	≥ 60 years	141	47,5
Gender	Female	114	38,4
	Male	183	61,6
Comorbidities	No comorbidities	149	50,2
	Hypertension	52	17,5
	Diabetes mellitus	14	4,7
	Two or more comorbidities	61	20,5
	Others	21	7,1

The results showed that patients under 60 years of age accounted for 52.5%. The majority were male (61.6%), and the proportion of patients without comorbidities (50.2%) was higher than that of the other groups.

1.2. Characteristics of Peripheral Intravenous Catheters (PIVCs)

Table 3. Characteristics of Peripheral Intravenous Catheters

Variable		Frequency (n=297)	Percentage (%)
Dwell time	≤ 48 hours	210	70.7
	> 48 hours – < 72 hours	62	20.9
	72 hours – 96 hours	25	8.4
Insertion site	Upper extremity	282	94.9
	Lower extremity	15	5.1

Variable		Frequency (n=297)	Percentage (%)
Size	22G	222	74,8
	20G	51	17.2
	18G	19	6.4
	16G	1	0.3
	24G	4	1.3
Catheter patency	Good patency	189	63.6
	Occluded	9	3.0
	Not yet used	99	33.4
Presence of blood at Catheter hub	Yes	84	28.3
	No	213	71.7
Type of dressing	Sterile fabric dressing with gauze	265	89.2
	Silk adhesive bandage	32	10.8
Condition of dressing	Clean, fully covered, secure	259	87.2
	Soiled with fluid/blood, loose	38	12.8
Type of connecting device	None	102	34.3
	Three-way extension set	9	3.0
	IV infusion set	186	62.7
Medications/infusions administered	Electrolyte solutions	127	42.7
	Intravenous antibiotics	35	11.8
	Nutritional solutions	15	5.1
	Chemotherapeutic agents	12	4.0
	Potassium chloride, calcium chloride, etc.	4	1.4
	Others	104	35
Patient cooperation in catheter care and maintenance	Not good	91	30.6
	Good	206	69.4

The results indicate that most PIVCs were observed within the first 48 hours of insertion (70.7%). The majority were placed in the upper extremities (94.9%). Most catheters remained patent (63.6%). Clean, fully covered, and secure dressings accounted for a high proportion (87.2%). Among medications and fluids administered via PIVCs, electrolyte solutions were the most commonly used (42.7%). Patients who demonstrated good cooperation in catheter care and maintenance accounted for 69.4%, which was approximately twice the proportion of patients with poor cooperation.

3.3. Incidence of phlebitis at the catheter insertion site

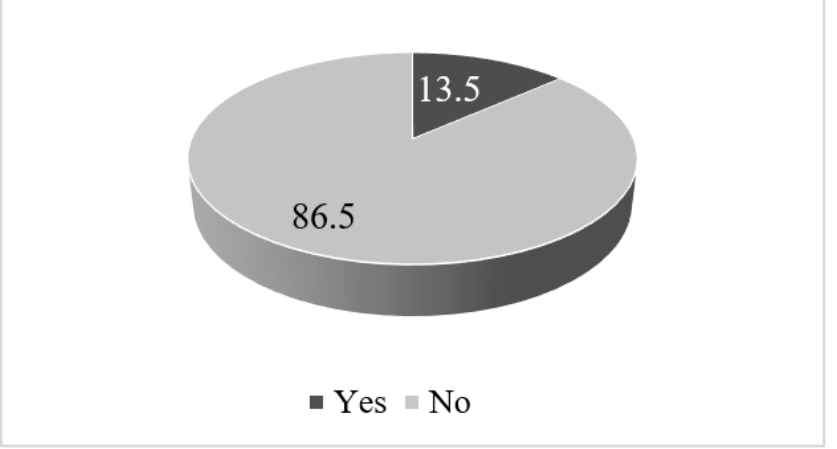

Figure 1. Incidence of phlebitis at the catheter insertion site

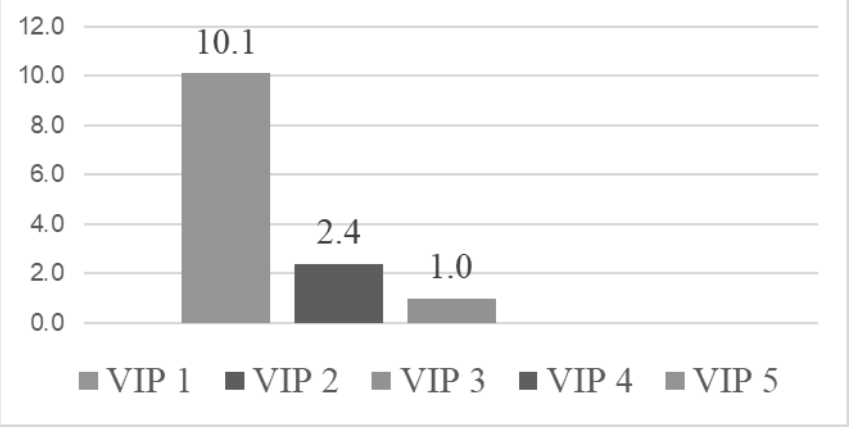

Figure 2. Incidence of phlebitis according to the VIP scale

The results shown in Figures 1 and 2 indicate that the incidence of phlebitis at the catheter insertion site was 13.5%. Among these cases, VIP grade 1 phlebitis accounted for the highest proportion (10.1%), while VIP grade 3 was the lowest (1%). No cases of phlebitis at VIP grades 4 or 5 were observed.

3.4. Association between Factors and Peripheral Intravenous Phlebitis

Table 4. Results of Univariate Analysis and Multivariable Logistic Regression of Factors Associated with Peripheral Intravenous Phlebitis

Variable	Univariate OR* (95% CI)	p (univariate)	Adjusted OR** (95% CI)	p (multivariable)
Duration of PIV catheter indwelling				
≤48 hours	-	-	-	-
> 48 - <72 hours	2.7 (1.8-4.4)	**<0,001**	3.1 (1.8-5.2)	**<0.001**
72 hours - 96 hours	7.3 (3.2-19.4)	**<0,001**	9.6 (3.2-27)	**<0.001**
PIV catheter patency status				
Patent	-	-	-	-
Occluded catheter	18.5 (5.8-62.4)	**<0.001**	19.4 (5.3-73.9)	**<0.001**
Not in use	4.3 (2.4-7.9)	**<0.001**	4.4 (2.3-8.6)	**<0.001**
Condition of catheter fixation dressing				
Clean, fully covered, secure	-	-	-	-
Soiled with fluid/ blood, loose	2.3 (1.8-5.5)	**0.048**	Not significant	Not significant
Medications/infusions administered via PIV catheter				
Electrolyte solutions	-	-	-	-
Antibiotic infusion	4.2 (1.6-11)	**0.003**	Not significant	Not significant
Nutritional solutions	2.6 (0.6-10.8)	0.2	-	-
Chemotherapeutic agents	0.9 (0.1-8.1)	0.9	-	-
Other	1.8 (0.8-4.1)	0.2	-	-
Catheter maintenance practices				
Poor	-	-	-	-
Good	0.48 (0.2-0.9)	**0.03**	Not significant	Not significant

* **Univariate OR**: Odds ratio from univariate analysis, reflecting the crude association between each factor and peripheral intravenous phlebitis.

** **Adjusted OR**: Odds ratio from multivariable logistic regression, adjusted for confounding factors.

Multivariable analysis showed that an indwelling PIV catheter duration exceeding 48 hours was an independent risk factor for phlebitis, with a particularly strong association observed in the 72–96 hour group (OR = 9.6; 95% CI: 3.2–27.0; $p < 0.001$). Catheter occlusion or unused catheters were also strongly associated with an increased risk of phlebitis, with ORs of 19.4 and 4.4, respectively ($p < 0.001$), and were identified as independent risk factors.

In contrast, dressing condition, type of medication/infusion, and the level of patient cooperation were only significant in univariate analysis and did not retain statistical significance after adjustment for confounding variables.

This study did not find any statistically significant associations between personal characteristics (age, sex, and comorbidities) and the following factors: catheter insertion site, catheter size, presence of blood at the catheter hub, type of fixation dressing, type of connector device, or catheter use purpose, with peripheral intravenous phlebitis in either univariate or multivariable analyses.

4. DISCUSSION

4.1. Characteristics of the Study Subjects

In this study, the majority of patients were under 60 years of age (52.5%), which is higher than the proportion reported by Võ Thị Phương Anh (40.9%) [5]. Military Hospital 175 is a military hospital that regularly receives a patient population including active-duty soldiers, retirees, and civilians from southern Vietnam. Patients under 60 years old are typically of working age and often face injuries or work- and training-related conditions associated with the military environment.

Regarding gender, males predominated with a proportion of 61.6%, similar to the findings of Chu Văn Long (62.4%) [6], lower than those reported by Vũ Bá Quỳnh (68.9%) [8], and higher than those of Lâm Thị Nhung (54.1%) [9]. The higher proportion of male inpatients may be related to lifestyle factors such as smoking, alcohol consumption, and unhealthy living habits, which increase the risk of health problems.

Concerning comorbidities, most patients in this study had no concomitant diseases (50.2%), a lower proportion than that reported by Vũ Bá Quỳnh (61.7%) [8]. The prevalence of hypertension was 17.5%, similar to the result reported by Lâm Thị Nhung (18%) [9] and higher than that reported by Vũ Bá Quỳnh (6.2%) [8]. This difference may reflect the increasing trend of chronic diseases, particularly hypertension, occurring at younger ages.

4.2. The prevalence of Phlebitis at the Catheter Insertion Site

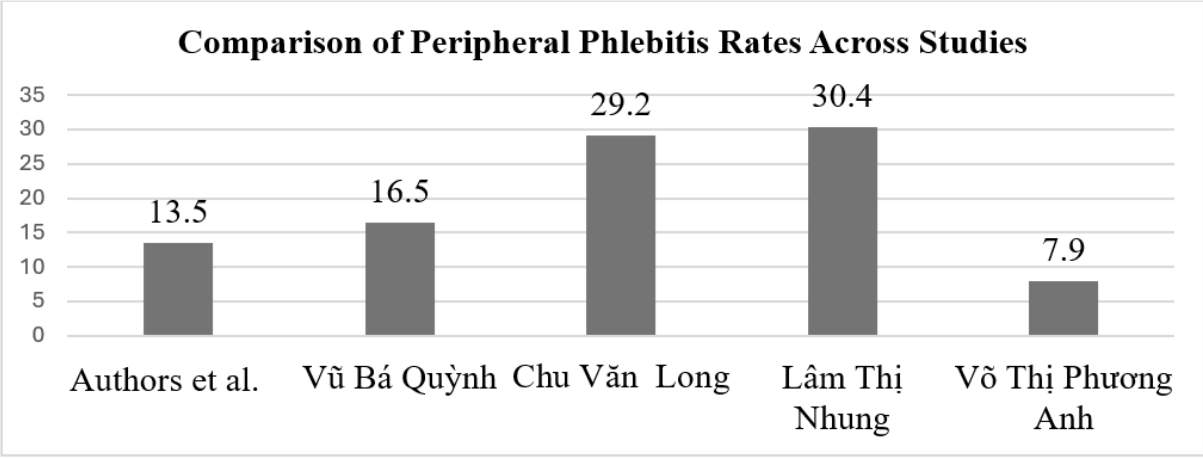

Figure 3. Comparison of peripheral venous phlebitis rates among studies

The prevalence of peripheral venous phlebitis at the catheter insertion site in this study was 13.5%, exceeding the recommended threshold of 5% set by the Infusion Nurses Society (INS) [4]. Compared with domestic studies, this rate was higher than that reported by Vo Thi Phuong Anh [5] but lower than those reported by Chu Van Long [6], Lam Thi Nhung [9], and Vu Ba Quynh [8]. These differences may be related to variations in data collection and reporting methods. Specifically, Chu Van Long and Lam Thi Nhung applied the VIP scale and recorded the progression of phlebitis over time, whereas Vu Ba Quynh used the INS phlebitis scale. The study by Vo Thi Phuong Anh was conducted in five departments, including the Intensive Care and Toxicology Unit, which may have influenced the phlebitis rate. Our results are comparable to some international reports, such as those by Marsh (12%) [10] and Berger (14.4%) [11], but remain much lower than studies conducted in Ethiopia (70%) [12] and by Simin (44%) [13].

Most cases of phlebitis were mild, with VIP grade 1 accounting for 10.1%, while more severe grades were less frequent (VIP 2: 2.4%; VIP 3: 1%). No cases of VIP grade 4 or 5 were recorded, suggesting that current clinical practices are partially effective in preventing severe phlebitis. Nevertheless, the overall phlebitis rate still exceeds the recommended threshold, highlighting the need to enhance nursing competencies and strictly adhere to catheter care protocols to minimize complications.

4.3. Factors Associated with Phlebitis

Regression analysis showed that the duration of peripheral catheterization was positively associated with the risk of phlebitis: catheter dwell time longer than

48 hours significantly increased this risk, particularly during the 72–96 hour period (OR = 9.6; $p < 0.001$). In contrast to the study by Võ Thị Phương Anh [5], which reported the highest risk within 24–48 hours, our findings suggest that effective infection control and technical compliance at the study site may provide a protective effect during the early phase.

Catheter patency status was identified as an important independent risk factor. Occluded catheters had the highest risk of phlebitis (adjusted OR = 19.4), followed by unused catheters (adjusted OR = 4.4). Possible pathophysiological mechanisms include thrombosis, endothelial injury, and increased infection risk due to fluid stasis. These findings reinforce INS recommendations to maintain catheter patency, perform regular flushing, and avoid unnecessary catheter placement [4].

Although loose or soaked dressings were associated with phlebitis in univariate analysis, this factor was no longer significant in the multivariate model. Its effect may have been overshadowed by more influential factors such as catheter dwell time and infused medications. This result differs from the study by Lam Thi Nhung, which focused on fixation materials [9].

Antibiotic infusion through the catheter was associated with an increased risk of phlebitis in univariate analysis (OR = 4.2) but was not an independent factor after adjustment for confounders. A previous study by Chu Van Long demonstrated that antibiotic dilution significantly affected phlebitis severity [6]; however, this aspect was not examined in our study. Thus, the impact of antibiotics may be context-dependent and warrants further investigation by drug type, dosage, and infusion technique.

Patient cooperation in catheter care showed a protective effect in univariate analysis (OR = 0.48) but did not retain significance in multivariate analysis. This finding reflects the complex relationship between patient behavior and technical factors in catheter care. Additional evidence from clinical studies using supportive diagnostic tools is needed to clarify the true role of this factor.

Other factors, including catheter insertion site, catheter size, blood residue at the hub, type of dressing, connector device, and purpose of catheter use, showed no significant association with peripheral venous phlebitis. These findings differ from previous studies by Marsh Larsen [10], Mielke [14], Lam Thi Nhung [9], and Vo Thi Phuong Anh [5], possibly due to limitations in sample size and the low number of phlebitis cases, which reduced statistical power.

4.4. Study Limitations

Convenience sampling was conducted in selected departments, and

patients with severe conditions (sepsis, hemodialysis, impaired consciousness) were excluded; therefore, the results may not be generalizable to all hospitalized patients. This approach was intended to focus on stable patients, ensure safety, control confounding factors, and align with the scope and resources of the study.

5. CONCLUSION

This study found that the incidence of peripheral venous phlebitis at catheter insertion sites was 13.5%, predominantly mild in severity (VIP grade 1 accounted for 10.1%). No cases of severe phlebitis (VIP grades 4 or 5) were recorded. Multivariate logistic regression identified statistically significant associated factors, including catheter dwell times of >48–<72 hours and 72–96 hours, as well as occluded or unused catheters.

These findings indicate that nurses must strictly adhere to protocols for managing and caring for patients with peripheral catheters to reduce the risk of phlebitis. Furthermore, the results may inform future interventional or longitudinal studies to evaluate the effectiveness of intervention bundles aimed at reducing peripheral venous phlebitis and to better characterize the clinical progression of cases with VIP ≥ 2, thereby supporting the development of more optimal prevention and management strategies.

REFERENCES

1. Alexandrou, E., Ray-Barruel, G., Carr, P. J., Frost, S., Inwood, S., Higgins, N., Lin, F., Alberto, L., Mermel, L., & Rickard, C. M. (2015). International prevalence of the use of peripheral intravenous catheters. *Journal of Hospital Medicine*, *10*(8), 530–533. https://doi.org/10.1002/jhm.2389

2. Marsh, N., Larsen, E. N., Ullman, A. J., Mihala, G., Cooke, M., Chopra, V., Ray-Barruel, G., & Rickard, C. M. (2024). Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. *International journal of nursing studies*, *151*, 104673. https://doi.org/10.1016/j.ijnurstu.2023.104673

3. Mihala, G., Ray-Barruel, G., Chopra, V., Webster, J., Wallis, M., Marsh, N., McGrail, M., & Rickard, C. M. (2018). Phlebitis Signs and Symptoms With Peripheral Intravenous Catheters: Incidence and Correlation Study. *Journal of infusion nursing: the official publication of the Infusion Nurses Society*, *41*(4), 260–263. https://doi.org/10.1097/NAN.0000000000000288

4. Nickel, B., Gorski, L., Kleidon, T., Kyes, A., DeVries, M., Keogh, S., Meyer,

B., Sarver, M. J., Crickman, R., Ong, J., Clare, S., & Hagle, M. E. (2024). Infusion Therapy Standards of Practice, 9th Edition. *Journal of infusion nursing: the official publication of the Infusion Nurses Society*, *47*(1S Suppl 1), S1–S285. https://doi.org/10.1097/NAN.0000000000000532.

5. Anh VTP, Hoai TT, Nga TT, Trang NT. (2022). Assessment of local inflammation and related factors in patients with peripheral venous catheters at Quang Tri Provincial General Hospital. Journal of Medical and Pharmaceutical Sciences, 135. DOI: 10.34071/jmp.2022.6.185.

6. Chu, V. L., & Đong, V. H. (2020). Study on the risk of phlebitis after peripheral venous catheter insertion at Viet Duc Friendship Hospital. Journal of Nursing Science, 3(4), 33–42. Retrieved from https://jns.vn/index.php/journal/article/view/258

7. Tran, T. L., Cao, T. H. H., & Le, V. N. (2023). Characteristics of phlebitis after peripheral venous catheter insertion in patients at the National Lung Hospital. Vietnam Medical Journal, 529(2). https://doi.org/10.51298/vmj.v529i2.6453

8. QuynhV. B., Thanh N. N., Yen P. K., LongB. H., Ngoc L. M., Chung T. Đuc, & AnT. T. T. (2022). Survey of the prevalence of local inflammation and related factors after peripheral venous catheter insertion at the 108 Military Central Hospital in 2021. Journal of 108 – Clinical Medicine and Pharmacy, 17(DB8). https://doi.org/10.52389/ydls.v17iDB8.1309

9. Nhung, L. T., Trung, T. Q., & Cuc, L. T. (2021). Phlebitis at the site of peripheral venous catheter placement and associated factors at Hanoi Medical University Hospital. Journal of Medical Research, 145(9), 85–92. https://doi.org/10.52852/tcncyh.v145i9.272

10. Marsh, N., Larsen, E. N., Takashima, M., Kleidon, T., Keogh, S., Ullman, A. J., Mihala, G., Chopra, V., & Rickard, C. M. (2021). Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. *International journal of nursing studies*, *124*, 104095. https://doi.org/10.1016/j.ijnurstu.2021.104095

11. Berger, S., Winchester, K., Principe, R. B., & Culverwell, E. (2022). Prevalence of peripheral intravenous catheters and policy adherence: A point prevalence in a tertiary care university hospital. *Journal of Clinical Nursing*, *31*(15-16), 2324–2330. https://doi.org/10.1111/jocn.16051

12. Lulie, M., Tadesse, A., Tsegaye, T., Yesuf, T., & Silamsaw, M. (2021). Incidence of peripheral intravenous catheter phlebitis and its associated factors among

patients admitted to University of Gondar hospital, Northwest Ethiopia: a prospective, observational study. *Thrombosis journal*, *19*(1), 48. https://doi.org/10.1186/s12959-021-00301-x

13. Simin, D., Milutinović, D., Turkulov, V., & Brkić, S. (2019). Incidence, severity, and risk factors of peripheral intravenous cannula-induced complications: An observational prospective study. *Journal of Clinical Nursing*, *28*(9-10), 1585–1599. https://doi.org/10.1111/jocn.14760.

14. Mielke, N., Johnson, S., Karabon, P., & Bahl, A. (2022). A prospective sonographic evaluation of peripheral intravenous catheter-associated thrombophlebitis. *The journal of vascular access*, *23*(5), 754–763. https://doi.org/10.1177/11297298211009019.