Original article

Incidence and factors associated with peripheral intravenous catheter-related phlebitis among inpatients at a district hospital in Vietnam

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Received: 25/05/2026; **Accepted**: 05/10/2026; **Published:** 15/11/2026
DOI:10.34071/jmp.2026.S-3.10

Abstracts

Background: Phlebitis is a frequent complication of peripheral intravenous therapy, yet prospective evidence from district-level hospitals in Vietnam remains limited. This study aimed to determine the incidence of phlebitis and identify associated factors among inpatients at Tan Binh District Hospital.

Materials and Methods: A prospective observational study using convenience sampling was conducted among 511 adult inpatients receiving peripheral intravenous therapy from December 2023 to August 2024. Each participant contributed one PIVC for analysis. Phlebitis was assessed daily for up to 96 hours using the Visual Infusion Phlebitis scale, with a VIP score ≥ 1 considered phlebitis. Associated factors were examined using Firth's penalized logistic regression.

Results: PIVC-associated phlebitis occurred in 58 of 511 evaluated PIVCs (11.35%); 81.0% of cases were Grade 1-2, and no Grade 5 phlebitis was observed. In multivariable analysis, age ≥ 60 years (adjusted odds ratio [aOR] = 3.20, 95% CI: 1.59-6.42, p = 0.001), previous intravenous infusions ≥ 3 times (aOR = 2.04, 95% CI: 1.02 - 4.10, p = 0.045), cubital fossa insertion (aOR = 9.31, 95% CI: 1.14 - 76.34, p = 0.038), and vasoactive drug infusion (aOR = 6.98, 95% CI: 1.23-39.59, p = 0.028) were associated with phlebitis.

Conclusion: The incidence of PIVC-related phlebitis at Tan Binh District Hospital was 11.35%, with most cases being mild. Among patient-related factors, older age and repeated previous intravenous infusions were independently associated with phlebitis. These findings may help identify patients who require closer PIVC monitoring.

Keywords: *phlebitis; peripheral intravenous catheter; associated factors; VIP scale.*

1. INTRODUCTION

Peripheral intravenous catheters (PIVCs) are routinely used in hospitalized patients for the administration of fluids, medications, blood products, and nutritional therapy [1, 2]. Among these complications, phlebitis is the most common adverse event, causing patient discomfort, prolonged hospital stays, interrupted treatments, and increased healthcare costs [3, 4]. While the Infusion Nurses Society recommends a phlebitis rate of 5% or less, reported incidences vary widely, reaching up to 44% globally [5, 6]. In Vietnam, reported rates of PIVC-related phlebitis have varied across hospital settings, ranging from 16.5% to 29.2% in previous studies [7-10]. Previous studies have identified patient-, catheter-, and treatment-related factors associated with phlebitis, including older age, repeated intravenous exposure, catheter insertion site, and the type of infused medication [11-15]. Data from district-level hospitals, however, remain limited. This study therefore aimed to estimate the incidence of PIVC-related phlebitis and examine associated factors among inpatients at a district hospital.

2. MATERIALS AND METHODS

2.1. Study design and sample: A prospective observational design was used.

The study was conducted at Tan Binh District Hospital (currently Tan Binh General Hospital), an urban district-level hospital in Ho Chi Minh City, Vietnam. Participants came from three inpatient units: Internal Medicine, Surgery, and the intensive care unit (ICU). The study was conducted from December 2023 to August 2024.

Inclusion criteria were adult patients aged ≥18 years who were receiving inpatient treatment and had a prescription for peripheral intravenous infusion at Tan Binh District Hospital (currently Tan Binh General Hospital).

Exclusion criteria included coma or unstable neurological or psychiatric conditions that could preclude reliable assessment of pain or discomfort at the catheter site, as well as incomplete medical

records that prevented ascertainment of key study variables.

The required sample was estimated using the formula for a single proportion:

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

N: the desired sample size from a large population size.

α: level of significance, choose α = 0.05.

$Z_{(1-\alpha/2)}$ = two-tailed Z-score confidence level (1.96).

d: absolute error (0.04)

p: the anticipated proportion was set at 0.28 based on the study by Dang Duy Quang et al. (2020), which reported a 28.0% incidence of phlebitis using the VIP scale and diagnostic criteria consistent with those used in the present study [7].

Therefore, our study's sample size was calculated to be at least 485 patients. Consequently, we recruited 511 participants for the research.

2.2. Study measurements:

A convenience sampling method was employed. Each participant contributed only one PIVC to the analysis, with one catheter insertion evaluated per patient during the hospitalization; therefore, the 511 participants corresponded to 511 evaluated PIVCs. Data collection was conducted by trained research staff, including head nurses. The research team received standardized training on PIVC and VIP assessment before data collection.

Previous intravenous infusion history was obtained from the patient or caregiver and categorized as none, once, twice, or ≥ 3 previous intravenous infusions.

The Visual Infusion Phlebitis (VIP) scale, validated by Gallant and Schultz [5], was used to assess phlebitis. VIP scores ranged from 0, indicating no phlebitis, to 5, indicating the most severe grade. For this study, phlebitis was defined as a VIP score ≥ 1. PIVCs were first assessed within 24 hours after insertion and then assessed daily for up to 96 hours. Time to onset was grouped into four intervals: ≤ 24 hours, > 24 - 48 hours, > 48 - 72 hours, and > 72 - 96 hours after catheter insertion. During each assessment, researchers interviewed patients regarding pain or discomfort, visually inspected the insertion site for color changes or edema, and gently palpated the vein above the insertion site to detect any palpable cords. If the PIVC was removed before 96 hours for reasons other than phlebitis, including completion of intravenous therapy, discharge, or transfer, follow-up ended at the time of catheter removal. When phlebitis was identified, the affected PIVC was removed. If continued intravenous therapy was required, a new PIVC was inserted at another site as part of routine clinical care. Follow-up of the study PIVC ended when phlebitis was detected and the catheter was removed; replacement catheters were not included in the analysis.

2.3. Statistical analysis:

Data were analyzed using R version 4.4.2. Continuous variables are presented as mean ± standard deviation (SD) and categorical variables as frequency (%). Pearson's chi-square test or Fisher's exact test was used for categorical variables, as appropriate. Univariable logistic regression was used to estimate crude odds ratios (ORs) with 95% confidence intervals (CIs). Variables considered clinically relevant and supported by the univariable findings were subsequently examined in a multivariable model using Firth penalization. aORs and 95% CIs were reported. Statistical significance was defined as $p < 0.05$.

2.4. Ethical approval

Ethical approval was granted by the Ethics Committee of Hong Bang International University on December 18, 2023 (No. 109/PCT-HDDD-SDH). Participants provided consent before enrolment, and their information was kept confidential throughout the study.

3. RESULTS

Table 1. Patients' characteristics (N = 511)

Characteristics		n	%
Age, years (mean ± SD)		54.0 ± 18.9 (18 - 95)	
Sex	Male	216	42.27
	Female	295	57.73
Age categories, years	18 - 59	296	57.93
	≥ 60	215	42.07

Body mass index (kg/m^2)	< 18.5	51	9.98
	18.5 - 24.9	331	64.77
	≥ 25.0	129	25.25
Smoking habits	Yes	32	6.26
	No	479	93.74
Comorbidities	None	179	35.03
	1	146	28.57
	2	111	21.72
	≥ 3	75	14.68
Diabetes mellitus	Yes	65	12.72
	No	446	87.28
Place of admission	Medical ward	355	69.48
	Surgical ward	85	16.63
	Intensive Care Unit (ICU)	71	13.89
Previous intravenous infusions	None	206	40.32
	1	57	11.15
	2	50	9.78
	≥ 3	198	38.75

The mean age of participants was 54.0 ± 18.9 years, and 42.1% were aged ≥ 60 years. Women accounted for 57.7% of the sample, and most patients were admitted to the medical ward (69.5%). Nearly two-thirds had at least one comorbidity, while 38.8% reported three or more previous intravenous infusions.

Table 2. Characteristics of peripheral intravenous catheters and phlebitis outcomes (N = 511)

Characteristics		n	%
PIVC size	24 gauge	18	3.52
	22 gauge	492	96.28
	20 gauge	1	0.20
Insertion site	Dorsum of the hand	207	40.51
	Forearm	186	36.40
	Wrist	108	21.14
	Cubital fossa	4	0.78
	Other	6	1.17
Insertion attempts	1	466	91.19
	2	29	5.68
	≥ 3	16	3.13
Incidence of PIVC phlebitis	Yes	58	11.35
	No	453	88.65
VIP score severity (n = 58)	Grade 1	29	50.00
	Grade 2	18	31.03
	Grade 3	10	17.24
	Grade 4	1	1.72
	Grade 5	0	0.00

Time to phlebitis onset after catheter insertion (hours) (n = 58)	≤ 24	3	5.17
	> 24 - 48	34	58.62
	> 48 - 72	20	34.48
	> 72 - 96	1	1.72

The 22G catheter was the most commonly used size (96.3%), and most insertions were successful on the first attempt (91.2%). Phlebitis occurred in 58 of 511 patients (11.35%). Among patients with phlebitis, Grade 1 - 2 accounted for 81.0% of cases, no Grade 5 phlebitis was observed, and most events developed between > 24 and 48 hours after catheter insertion.

Table 3. Factors associated with PIVC-related phlebitis

Variable	Phlebitis		OR (95% CI)	p-value
	Yes (n = 58)	No (n = 453)		
Age categories, years				
< 60	14 (4.73)	282 (95.27)	1	**< 0.001**
≥ 60	44 (20.47)	171 (79.53)	**5.18 (2.68 - 10.52)**	
Sex				
Female	39 (13.22)	256 (86.78)	1	0.119
Male	19 (8.80)	197 (91.20)	0.63 (0.33 - 1.16)	
Place of admission				
Medical ward	32 (9.01)	323 (90.99)	1	
Surgical ward	3 (3.53)	82 (96.47)	0.37 (0.11 - 1.23)	0.103
ICU	23 (32.39)	48 (67.61)	**4.83 (2.61 - 8.95)**	**< 0.001**
Previous IV infusions				
None	8 (3.88)	198 (96.12)	1	
1 time	2 (3.51)	55 (96.49)	0.90 (0.19 - 4.36)	0.896
2 times	6 (12.00)	44 (88.00)	**3.37 (1.11 - 10.21)**	**0.031**
≥ 3 times	42 (21.21)	156 (78.79)	**6.66 (3.04 - 14.60)**	**< 0.001**
Insertion attempts				
1 time	45 (9.66)	421 (90.34)	1	
2 times	6 (20.69)	23 (79.31)	2.44 (0.94 - 6.31)	0.066
≥ 3 times	7 (43.75)	9 (56.25)	**7.27 (2.59 - 20.47)**	**< 0.001**
Site of insertion (n = 505)				
Dorsum of the hand	19 (9.18)	188 (90.82)	1	
Forearm	16 (8.60)	170 (91.40)	0.93 (0.47 - 1.86)	0.841
Wrist	17 (15.74)	91 (84.26)	1.84 (0.92 - 3.72)	0.086
Cubital fossa	3 (75.00)	1 (25.00)	**29.68 (2.99 - 294.21)**	**0.004***
Catheter gauge (n = 510)				
22 gauge	49 (9.96)	443 (90.04)	1	**<0.001***
24 gauge	9 (50.0)	9 (50.0)	**9.04 (3.42 - 23.84)**	
Types of infusates				
Antibiotics	27 (17.76)	125 (82.24)	**2.28 (1.25 - 4.12)**	**0.002**
Vasoactive drugs	5 (62.50)	3 (37.50)	**15.15 (2.64 - 92.70)**	**0.001**
Hypertonic solutions	5 (50.00)	5 (50.00)	**8.45 (1.86-37.72)**	**0.003**

*Fisher's exact test; Six observations classified as 'Other' insertion sites and the single 20G catheter were excluded from category-specific OR estimation because of sparse data

In univariable analyses, several patient-, catheter-, and infusion-related characteristics were associated with phlebitis. Significant associations were observed for age ≥ 60 years, ICU admission, previous intravenous infusions, ≥ 3 insertion attempts, cubital fossa insertion, 24 G catheter use, and infusion of antibiotics, vasoactive drugs, or hypertonic solutions. Estimates for cubital fossa insertion and vasoactive drug infusion were imprecise because these exposures were uncommon in the study sample.

Table 4. Multivariable logistic regression analysis of factors associated with PIVC-related phlebitis

Variable	aOR	95% CI	p-value
Age ≥ 60 years	3.20	1.59 - 6.42	**0.001**
ICU admission	1.76	0.81 - 3.82	0.150
Previous IV infusions ≥ 3 times	2.04	1.02 - 4.10	**0.045**
Insertion attempts ≥ 3 times	1.24	0.34 - 4.48	0.745
Cubital fossa insertion site	9.31	1.14 - 76.34	**0.038**
24G catheter	2.12	0.61 - 7.30	0.236
Antibiotic infusion	1.81	0.94 - 3.48	0.076
Vasoactive drug infusion	6.98	1.23 - 39.59	**0.028**
Hypertonic solution infusion	2.55	0.55 - 11.83	0.230

aOR, adjusted odds ratio; CI, confidence interval. Firth penalization was applied to address bias related to sparse observations. Statistically significant p-values (< 0.05) are shown in bold.

In multivariable analysis, age ≥ 60 years remained associated with higher odds of phlebitis (aOR = 3.20, 95% CI: 1.59-6.42; p = 0.001). A history of ≥ 3 previous intravenous infusions was also associated with phlebitis (aOR = 2.04, 95% CI: 1.02 - 4.10; p = 0.045). Cubital fossa insertion (aOR = 9.31, 95% CI: 1.14-76.34; p = 0.038) and vasoactive drug infusion (aOR = 6.98, 95% CI: 1.23-39.59; p = 0.028) remained significant, although both estimates had wide confidence intervals. ICU admission, ≥ 3 insertion attempts, 24 G catheter use, antibiotic infusion, and hypertonic solution infusion were no longer statistically significant after adjustment.

4. DISCUSSION

4.1. Incidence of PIVC-related phlebitis: Phlebitis occurred in 11.35% of the study PIVCs, and most cases were Grade 1 or 2. This proportion was above the 5% benchmark recommended by the Infusion Nurses Society [16], but below rates reported at Hue Central Hospital (28.0%), Viet Duc Hospital (29.2%), Can Tho University of Medicine and Pharmacy Hospital (27.4%), and 108 Military Central Hospital (16.5%) [7-10]. Our incidence of phlebitis (11.35%) was lower than that reported in several international studies. Akyüz et al. observed a substantially higher incidence (29.2%), whereas Ozger et al. found that phlebitis commonly occurred early after catheter insertion, supporting our observation that most cases developed within the first 48 hours [12, 13]. The lower incidence observed in our study may partly reflect differences in case mix and referral patterns across hospital levels in Vietnam [17]. However, disease severity was not directly compared across studies.

4.2. Patient-related factors: Participants aged ≥ 60 years had higher odds of phlebitis after adjustment (aOR = 3.20, 95% CI: 1.59- 6.42), which is in line with previous studies [13, 14, 18]. In older adults, reduced subcutaneous tissue and lower venous elasticity may make peripheral veins more susceptible to irritation. Early inflammatory signs may also be less obvious, potentially delaying recognition of phlebitis [14, 19]. A history of ≥ 3 previous intravenous infusions were also independently associated with phlebitis. Repeated intravenous therapy may reflect greater cumulative exposure to peripheral venous access. Because this history was obtained from patients or caregivers, recall error is possible.

4.3. Mechanical and technical factors: Neither 24G catheter use nor ≥ 3 insertion attempts retained statistical significance in the adjusted model, suggesting possible confounding by clinical severity or poor venous condition. In contrast, catheter insertion at the cubital fossa remained independently associated with phlebitis (aOR = 9.31, 95% CI: 1.14 - 76.34, p = 0.038). This may be explained by frequent movement at joint-flexion areas, which can cause catheter displacement and repeated irritation of the venous endothelium [11,

15]. The estimate was imprecise, as reflected by the wide confidence interval and the small number of cubital fossa insertions.

4.4. Chemical factors from infusates: Chemical characteristics of infusates may contribute to the development of phlebitis [20, 21]. Vasoactive drug infusion remained independently associated with higher odds of phlebitis after adjustment (aOR = 6.98, 95% CI: 1.23 - 39.59). This association may partly reflect the local vascular effects of vasoactive agents; however, the underlying mechanism was not directly assessed in this study [12]. Antibiotic and hypertonic solution infusions were associated with phlebitis in univariate analysis but did not remain statistically significant after adjustment. From a nursing perspective, these findings support closer PIVC monitoring in older patients, those with repeated intravenous exposure, catheters inserted at the cubital fossa, and patients receiving vasoactive drugs. Routine VIP assessment and careful site selection may help facilitate earlier recognition of phlebitis.

Several limitations should be considered. Data were obtained from a single hospital using convenience sampling, which restricts the extent to which the findings can be generalized. The relatively small number of phlebitis events and sparse exposure categories resulted in wide confidence intervals and limited precision for some estimates. Variability in VIP assessment between observers cannot be excluded. In addition, follow-up ended at catheter removal or 96 hours after insertion, whichever occurred first; therefore, phlebitis occurring after early catheter removal or after discharge may have been missed.

5. CONCLUSIONS

PIVC-associated phlebitis occurred in 11.35% of participants, with most cases classified as Grade 1-2. Older age, a history of previous intravenous infusions, cubital fossa insertion, and vasoactive drug infusion were independently associated with phlebitis. The estimates for cubital fossa insertion and vasoactive drug infusion were imprecise because of sparse data and should be confirmed in larger studies. These findings may help identify patients requiring closer PIVC monitoring.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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