Phlebitis in Medical-Surgical Units

A Case-Control Study in a Brazilian Hospital

Isabela Granado Antequera, RN • Amanda Saba, MMS, CRNI®, RN • Maryana da Silva Furlan, MS, RN

ABSTRACT

The most commonly used vascular access is the peripheral intravenous catheter (PIVC). However, it can trigger complications and the occurrence of adverse events, such as phlebitis. This study evaluated the variables that are associated with the occurrence of phlebitis in medical and surgical inpatient units. This is an observational, retrospective, case-control study in medical and surgical hospitalization units of a private general hospital in the city of São Paulo. Participants were an average age of 66.3 years, and 71% were hospitalized in medical units. The risk variables associated with phlebitis were medical hospitalization (odds ratio [OR] = 4.36; $P = .002$), presence of comorbidity (OR = 10.73; $P < .001$), and having 5 or more PIVCs (OR = 53.79; $P = .001$). Regarding intravenous therapy, the use of contrast was a risk variable (OR = 2.23; $P = .072$). On the other hand, patient education regarding PIVCs was a protective measure against the development of phlebitis. The nursing team plays an essential role in the care of patients with PIVCs, inpatient guidance, planning, and device choice, taking into account the risk factors for phlebitis to maintain the preservation of vascular health and reduce adverse events.

Key words: catheterization, inpatients, nursing care, phlebitis

INTRODUCTION

Patients of all ages can receive intravenous therapy in an intensive care unit through adequate vascular access.[1] The most commonly used vascular access is a peripheral intravenous catheter (PIVC).[2] The PIVC has been used for years and is present in patient care; however, the risks related to this device are underestimated or even ignored. Its use may be associated with complications and the occurrence of adverse events (AEs).[2]

The Health Surveillance Notification System (NOTIVISA) is a Brazilian computerized system for recording problems related to the use of technologies and care processes by monitoring the occurrence of technical complaints regarding medicines and health products, incidents, and adverse events to strengthen postuse surveillance of health technologies.[3] According to NOTIVISA, incidents related to the use of catheters in Brazil rank second in notifications.[4] Accordingly, knowing the causes and reasons associated with the occurrence of phlebitis can help in the decision-making processes at the managerial and care levels regarding investments in preventive or risk mitigation strategies.[5]

Several strategies can be used both for the identification and prevention of phlebitis, such as systematic clinical evaluation to verify the early presence of phlebitis, the auditing

Author Affiliations: *Hospital Sírio Libanês, São Paulo, Brazil (Granado Antequera); Graduate Program in Nursing Management, School of Nursing (da Silva Furlan), University of São Paulo (Saba), São Paulo, Brazil.*

Isabela Granado Antequera, RN, *is an RN at Hospital Sírio Libanês, São Paulo. She graduated in Nursing from Federal University of São Paulo, and she is a specialist in intensive care unit and medical-surgical nursing with experience in this area.* **Amanda Saba, MMS, CRNI®, RN,** *is a researcher at University of São Paulo. She graduated in nursing from the University Center São Camilo, and she is also a specialist in cardiology and master in medical sciences. She has 8 years of experience in vascular access in the field of infusion therapy. She also worked as a professor in the critical care discipline and as residency tutor in the medical-surgical nursing program.* **Maryana da Silva Furlan, MS, RN,** *is a doctoral student at the Graduate Program in Nursing Management at the School of Nursing of the University of São Paulo. She graduated in nursing from the State University of Maringá. She is a specialist in medical-surgical nursing and in care for patients with pain and has 9 years of experience, 5 in medical-surgical units and 4 in pain care/management. She worked as a residency tutor/preceptor in a medical-surgical nursing program.*

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Corresponding Author: *Amanda Saba, School of Medicine, University of São Paulo, Av. Dr. Arnaldo, 455, Cerqueira César — São Paulo, CEP 01246-903, Brazil (amanda_saba_@hotmail.com).*

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and follow-up of compliance reports, choosing the device with the smallest gauge according to the patient's therapy, evaluating intravenous therapy (IVT; dilution and administration) based on evidence, and the use of technologies, such as ultrasound, among others.[6]

Clinical manifestations of phlebitis may include pain/tenderness, erythema, swelling, purulence, or palpable venous cords. The etiology may be of chemical, mechanical, infectious, or postinfusion origin. Recognition of phlebitis by the nurse is essential to intervene quickly.[1]

Knowing and reducing the number of harmful AEs, as well as knowing their causes and consequences, can allow for the development of organizational models that provide safety for patients and staff. Furthermore, it allows the reduction of the financial impact that AEs generate for health services.[7] A study performed in the city of São Paulo that sought to identify the causes and direct cost of phlebitis in medical hospitalization units pointed to the importance of this topic in contributing to decision-making to tackle this problem.[8] In this study, it was found that grade 2 phlebitis was more prevalent and presented a higher average direct cost compared to grade 1 phlebitis, and the management of phlebitis could involve the application of compresses and application of chamomile gel until the establishment of a new PIVC.[8]

According to the Infusion Nurses Society (INS), phlebitis is classified into four grades: grade 1: the presence of erythema at the intravenous (IV) site with or without pain; grade 2: pain at the IV site with erythema, edema, or both; grade 3: pain at the IV site with erythema, induration, and formation of a palpable venous cord; and grade 4: pain at the IV site with erythema, induration, and formation of a palpable venous cord with purulent drainage.[1]

The causes of phlebitis are diverse, and the systematic orientation of patients and family members on the subject of peripheral access is an important source of prevention of phlebitis, together with the establishment of protocols and educational interventions with health care professionals.[5] Several factors have been associated with the development of phlebitis, such as female sex, quality of peripheral vascular access, lower extremity PIVC insertion, patients with cancer, immunodeficiency, diabetes mellitus, infections, catheter material used, device gauge, drug-related characteristics (extremes of pH, high osmolality, presence of microparticles), the inexperience of the professional who performed the procedure, a catheter inserted in the emergency room, and age above 60 years.[9] Assessment of the venous network and identification of patients with difficult intravenous access are important for the safety and success of intravenous therapy.[10] In addition, it is necessary to improve the notes in patient medical records regarding PIVCs.[11]

Accordingly, the following research question was presented: what are the variables that are associated with the occurrence of phlebitis AEs in the medical-surgical inpatient units of a general, large private hospital?

METHODS

Study Design

This was an observational, retrospective, case-control study in medical and surgical inpatient units of a private general hospital in the city of São Paulo.

Study Location

The study was carried out in a large private hospital located in the city of São Paulo. The hospital was accredited by the Joint Commission International in 2007, having several well-established protocols based on best practices with intravenous catheters, including the recommendation of the Aseptic Non-Touch Technique, vascular access team for difficult intravenous access (DIVA), standardized medication guide based on pharmacological characteristics, periodic training, and standardized materials. At the study site, nurses were responsible for evaluating the PIVC and identifying phlebitis, classifying phlebitis, notifying adverse events, and applying measures to treat complications according to institutional protocols. The INS Phlebitis Scale[1] was translated into Portuguese and used in this institution; during data collection, there was no validated and officially translated study of this scale.

Sample Size

A total of 239 notifications of adverse events related to PIVCs were recorded from January to December 2021. There were 104 forms referring to phlebitis notifications in the medical and surgical hospitalization units; therefore, 104 PIVCs were included in the case group.

For the second stage of data collection, a report was issued with all PIVC cannulations in 2021 and their respective insertion and removal information. For the control group, inclusion and exclusion criteria were applied, and the data were distributed according to age and sex variables in the case group. Stratified randomization was carried out until reaching the same number of patients as in the case group (1:1; Figure 1).

Inclusion and Exclusion Criteria

All electronic forms related to the notification of the occurrence of phlebitis in patients in the medical and surgical hospitalization units from January to December 2021 were included in the case group. Repeated forms, those related to AEs other than phlebitis, incomplete forms, pediatric patients, and patients treated in emergency care, oncological, and critical units were excluded from the study.

The control group included medical records, through systematic sampling, of adult patients admitted to medical and surgical inpatient units from January to December 2021, who had a healthy PIVC (removed upon completion of therapy). The exclusion criteria were pediatric patients, patients treated in emergency care, oncological, and critical units. Also, PIVCs that were removed before the end of

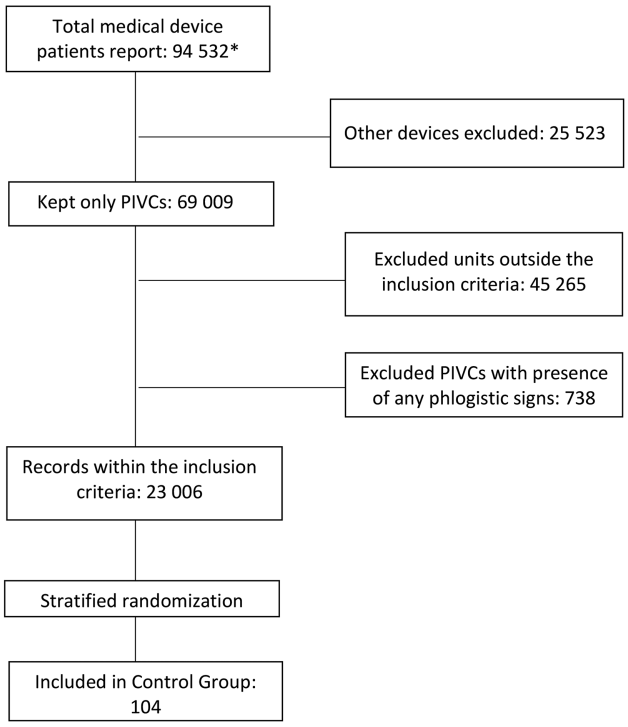

Figure 1 Control group selection flowchart. *Report referring to the total number of devices; each patient could have multiple devices during a hospitalization. *Abbreviations: PIVC, peripheral intravenous catheter.*

therapy due to phlogistic signs, such as pain, edema, and erythema, among other complications, were excluded.

Study Variables

The dependent variable was the presence of phlebitis and, therefore, taking into account the outcome, the independent variables were related to the patient. The demographic and clinical data collected included type of admission (medical or surgical), sex, age, length of stay, diagnostic hypothesis, presence of comorbidities, the risk for venous thromboembolism (VTE), and reduced mobility. Comorbidity was defined as a health condition present regardless of the main diagnosis.[12] The Charlson Comorbidity Index (ICC) is a widely used score that can calculate patient morbidity by assigning a weight according to the number and severity of comorbidity (Table 1).[13] The data collected regarding the insertion and the device included the type of peripheral device (closed or open peripheral IV catheter system), gauge, dwell time of the PIVC, number of PIVCs inserted, and characteristics. Regarding medications, the use of IV medication was evaluated, including infused IV medications, the use of subcutaneous anticoagulants, and the use of oral anticoagulants.

Data Collection

Data collection was carried out in August 2022 using a standardized data collection instrument developed by the researchers from electronic medical records and stored in a Microsoft Excel (Microsoft Inc, Redmond, WA) database for analysis.

TABLE 1

Charlson Comorbidity Index

Weight 1	myocardial infarction, mild liver disease, congestive heart failure, diabetes, peripheral vascular disease, chronic pulmonary disease, cerebrovascular disease, connective tissue disease, dementia, and ulcerative disease
Weight 2	diabetes with complication, moderate-to-severe kidney disease, hemiplegia, solid tumor, lymphoma, and leukemia
Weight 3	moderate-to-severe liver disease
Weight 6	metastatic cancer and acquired immunodeficiency syndrome

Statistical Analysis

Categorical data were represented by the absolute number and percentage of responses. For the descriptive analysis of the data, simple and crossed tables were used for the qualitative or categorized variables. Quantitative variables were represented by measures such as mean and standard deviation (SD).

The normality of the quantitative variables was verified by the Shapiro-Wilk test, observing a sample of nonparametric data. For categorical or qualitative data, the relationships were analyzed by Pearson χ^2 test or Fisher exact test when necessary. The Mann-Whitney *U* test was used to compare groups in a nonparametric sample.

Multivariate analysis included the application of the binary logistic regression model, and the Wald test was used to interpret the significance of individual coefficients in the model and the odds ratio (OR), along with the 95% confidence interval (CI). Significance was set at $P < .05$. The IBM SPSS Statistics software, version 29 (Armonk, NY), was used.

Ethics

This research was approved by the Research Ethics Committee (CAAE: 58941622.6.0000.5461), following the guidelines and regulatory standards for research involving human beings, according to resolution No. 466 of December 12, 2012. Data collection began after approval by the REC, with the signing of a waiver of the free and informed consent form.

RESULTS

The sample consisted of 208 patients; 64% were medical admissions and 36% were surgical admissions. The mean age was 66.3 years (SD = 17.4 y), with a mean length of stay of up to 1 week in 56.7% of the patients and up to 2 weeks in 27.9%. About 62.0% had some comorbidities, 60.0% were on antibiotics, and 32.7% were on analgesics. The comparison between the demographic and medical variables of the case and control groups is presented in

Table 2. During the selection of medical records for the control group, 738 devices were identified that were removed for phlogistic signs; however, they were not noted.

The comparison between the groups in the device and IVT categories is presented in Table 3. The most common devices in the case group were the closed peripheral catheter system with 2 ports with a removable needleless connector (47%), the most commonly used gauge was 22 (43%), and 30% of the sample received guidance on warning signs and care of peripheral catheters. Regarding the number of PIVCs, patients with phlebitis had mainly 2 catheters during hospitalization (31%), and most were receiving antibiotics (63%) and analgesics (37%).

The χ^2 test revealed an association between grade 1 phlebitis and patients who had 5 or more cannulations ($P = .016$) and between grade 3 and the use of the 20-gauge devices ($P = .033$) and patients who received IV analgesics ($P = .045$). The dwell time of the PIVC in the patients who presented with phlebitis was 24 hours (45%); 16.3% of the patients presented with phlogistic signs in the insertion of the PIVC 24 hours before the AE, and 4.8% had soiled or detached dressing.

TABLE 2

Demographic and Clinical Characteristics of the Case and Control Groups (São Paulo, Brazil, 2021)

Demographic and Clinical Characteristics	Control Group n = 104 (%)	Case Group n = 104 (%)	*P*	OR	CI
Sex and age					
Male	51 (49%)	53 (51%)	.890		
Age (media)	66.1	66.3	.552[a]		
Type of admission					
Surgical unit	45 (43%)	30 (28%)			
Medical unit	59 (56%)	74 (71%)	.043	1.8	1.05-3.34
Comorbidities					
Any comorbidity	44 (42%)	85 (81%)	<.001	6.1	3.24-11.47
CCI 1	30 (28%)	46 (44%)	.030	1.9	1.10-3.47
CCI 2	13 (12%)	27 (26%)	.021	2.4	1.18-5.08
CCI 3	0 (0%)	2 (2%)	.498		
CCI 4	1 (1%)	10 (9%)	.010	10.9	1.37-87.23
Reduced mobility	30 (28%)	49 (47%)	.010	2.1	1.23-3.89
VTE Risk	58 (55%)	77 (74%)	.014	2.1	1.20-3.84
Subcutaneous anticoagulant	43 (41%)	50 (48%)	.403		
Oral anticoagulant	3 (2%)	8 (7%)	.214		
Previous phlebitis in the hospitalization	0	10 (9%)	.002	1.1	1.03-1.17
Diagnostic hypothesis					
COVID-19	17 (16%)	13 (12%)	.554		
Pneumonia	3 (2%)	8 (7%)	.134		
Urinary tract infection	5 (4%)	4 (3%)	1.000		
Pyelonephritis	1 (1%)	5 (4%)	.119		
Fracture	3 (2%)	1 (1%)	.621		
Length of stay, wk					
<1	66 (63%)	52 (50%)	.069		
1-2	26 (25%)	32 (30%)	.440		
2-3	5 (4%)	6 (5%)	1.000		
3-4	7 (6%)	14 (13%)	.166		

χ^2 test.
[a]Mann-Whitney test.
Abbreviations: CCI, Charlson Comorbidity Index; CI, confidence interval; OR, odds ratio; VTE, venous thromboembolism; wk, weeks.

TABLE 3

Characteristics Related to the Peripheral Intravenous Catheter and Intravenous Therapy in the Case and Control Groups (São Paulo, Brazil, 2021)

Device Features/Intravenous Therapy	Control Group n = 104 (%)	Case Group n = 104 (%)	*P*	OR	CI
Type, caliber, and PIVC education					
Closed peripheral catheter system with 2 ports with a removable PRN adapter	57 (54%)	49 (47%)	.332		
Open peripheral catheter system	45 (43%)	46 (44%)	1.000		
Closed peripheral catheter system with 2 ports and needleless connector	2 (1%)	5 (4%)	.445		
18 gauge	9 (8%)	4 (3%)	.251		
20 gauge	44 (42%)	30 (28%)	.059		
22 gauge	45 (43%)	45 (43%)	1.000		
24 gauge	2 (1%)	3 (2%)	1.000		
PIVC education	54 (51%)	32 (30%)	.003	0.4	0.23-0.72
Number of attempts					
1 attempt	76 (73%)	41(39%)	<.001	0.2	0.12-0.50
2 attempts	11(10%)	25 (24%)	.001	3.5	1.62-7.89
3 attempts	6 (5%)	7 (6%)	.519		
4 attempts	0	3 (2%)	.091		
5 attempts	0	1 (1%)	.453		
Missing	11(10%)	27 (25%)			
Number of PIVCs during hospitalization					
1 PIVC	47 (45%)	14 (13%)	<.001	0.1	0.09-0.37
2 PIVCs	31 (29%)	33 (31%)	.881		
3 PIVCs	16 (15%)	22 (21%)	.370		
4 PIVCs	7 (6%)	16 (15%)	.075		
5 PIVCs	2 (1%)	7 (6%)	.170		
>5 PIVCs	1 (1%)	12 (11%)	.003	13.4	1.71-105.3
Intravenous therapy					
PIVC without IV therapy	6 (5%)	7 (6%)	.783		
Antibiotic	59 (56%)	66 (63%)	.396		
Analgesic	27 (26%)	39 (37%)	.101		
Antiemetic	10 (9%)	21 (20%)	.050		
Corticosteroid	22 (21%)	20 (19%)	.863		
Electrolytes	14 (13%)	19 (18%)	.448		
Contrast	4 (3%)	16 (15%)	.008	4.5	1.46-14.10
Antineoplastic	12 (11%)	16 (15%)	.543		
Antibiotic and analgesic	14 (13%)	31 (29%)	.007	2.7	1.35-5.12
PIVC dwell time					
Up to 24 h	46 (44%)	47 (45%)	1.000		
Up to 48 h	24 (23%)	23 (22%)	1.000		
Up to 72 h	14 (13%)	11 (10%)	.670		
Up to 96 h	9 (8%)	9 (8%)	1.000		
Up to 120 h	3 (2%)	8 (7%)	.214		
Up to 144 h	3 (2%)	2 (1%)	1.000		
Up to 168 h	5 (4%)	2 (1%)	.445		

χ^2 test.

Abbreviations: CI, confidence Interval; h, hours; IV, intravenous; OR, odds ratio; PIVC, peripheral intravenous catheter.

Table 4 presents the risk variables for the development of phlebitis using logistic regression: medical admission (OR = 4.3; $P = .002$), patient having any comorbidity (OR = 10.7; $P \leq .001$), and patient with 5 or more PIVCs during hospitalization (OR = 53.7; $P = .001$). Regarding IVT, the risk variable was the administration of medications such as antiemetics (OR = 4.5; $P = .008$) and analgesics (OR = 3.9; $P = .002$). On the other hand, patient education (receiving guidance on care and alarm signals from the PIVC) was protective against the development of phlebitis. Figure 2 presents the proposal for practices where the reassessment of the risk factors for phlebitis at different times is recommended.

DISCUSSION

The notification of AEs of phlebitis remains a challenge in health services. A study showed that 40% of the conduct related to notifications was not recorded in the medical records.[7] The National Health Surveillance Agency encourages reporting of AEs due to the importance of assessments and data analysis for decision-making.[3]

Regarding the characteristics of this sample (Table 2), another São Paulo study showed that patients who had phlebitis were mostly males (53.1%).[5] However, data on sex-dependent prevalence worldwide is still contradictory. A meta-analysis described that female sex was a risk factor for phlebitis.[9] This finding is similar to a study conducted in India.[14] Published data indicate a higher prevalence in patients aged 60 to 69 years (23%) and a length of stay of fewer than 4 days (30.2%), in agreement with the results of this study.[5] A Serbian study found a higher prevalence of phlebitis in patients over 70 years of age.[15] Regarding the type of admission, a Brazilian study conducted in a public hospital observed no significant difference between surgical and medical patients in the development of phlebitis,[6] nor did a French study.[14] In China, patients from surgical units were 1.4 times more likely to have a failure in the PIVC compared to medical units. In this study, surgical patients often experienced sudden changes in their clinical status and often received large infusions to replace fluids and to provide nutritional elements and medications that could cause vascular damage.[16] However, in the present study, medical patients were up to 4 times more likely to develop phlebitis, even with no significant difference in length of stay between the groups. The surgical patients, in most cases, underwent elective procedures and had controlled and stable clinical conditions. Patients with medical admission needed to compensate for and stabilize previous conditions.

One Brazilian study reported that most patients who had phlebitis AEs did not have any comorbidities (47.4%).[11]

TABLE 4

Risk Variables for Phlebitis (São Paulo, Brazil, 2021)

Risk variables	B	Exp(B)	CI (Min-Max)	*P*
Demographic and clinical				
Age	-0.22	0.978	0.95-1.00	.083
Female	0.142	1.152	0.55-2.39	.705
Medical admission	1.473	4.361	1.73-10.93	.002
Any comorbidity	2.373	10.733	4.32-26.63	<.001
Reduced mobility	0.333	1.394	0.60-3.23	.438
Number of PIVCs during hospitalization				
1 PIVC	1.938	2.556	0.99-6.57	.051
2 PIVCs	1.602	4.963	1.60-15.35	.005
3 PIVCs	1.991	7.322	1.94-27.55	.003
4 PIVCs	1.819	6.168	0.85-44.32	.071
5 PIVCs or more	3.985	53.793	4.89-590.85	.001
Intravenous therapy				
Analgesic	1.371	3.940	1.66-9.32	.002
Antiemetic	1.521	4.578	1.48-14.15	.008
Contrast	0.803	2.232	0.93-5.36	.072
Education				
PIVC education	−1.027	0.358	0.16-0.76	.008

Logistic regression.
Abbreviations: CI, confidence interval; min-max, minimum-maximum; PIVC, peripheral intravenous catheter.

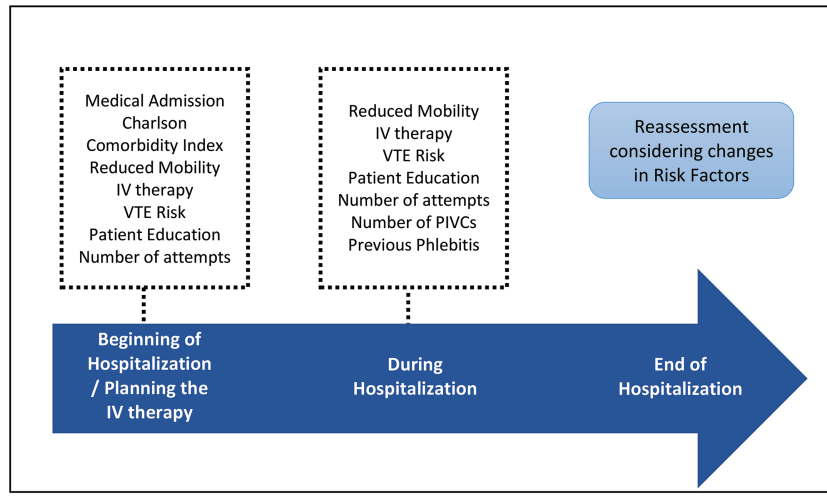

Figure 2 Proposal of reassessment considering risk factors for phlebitis. *Abbreviations: IV therapy, intravenous therapy; PIVC, peripheral intravenous catheter; VTE, venous thromboembolism.*

On the other hand, another Brazilian study reported that 19.8% of the sample had 2 pre-existing comorbidities, highlighting systemic arterial hypertension and diabetes mellitus,[5] and another study was reported in which most patients had chronic diseases.[6] A prospective study evaluated the incidence, severity and risk factors for complications related to PIVCs, with the presence of comorbidities in 52% of the sample and a significant difference in comorbidities for predicting phlebitis ($P = .001$) and an OR of 1.4 (95% CI, 1.17-1.85),[15] substantiating the findings of the present study. In addition to having a majority cohort sample with comorbidities, this factor indicated a risk of developing phlebitis. There was a significant relationship, that is, the higher the ICC score, the greater the association with phlebitis, contrary to the results of the French study.[14] These data are important, given that 54.7% of deaths recorded in Brazil in 2019 were caused by chronic noncommunicable diseases, being the number one cause of death among people aged 30 to 69 years, representing a hospitalization cost of more than 1.5 billion dollars.[17]

Reduced mobility was associated with phlebitis, considering that immobility during hospitalization increases the risk for VTE; a significant difference was also found between VTE and phlebitis, in agreement with findings from studies reporting a risk ratio of phlebitis and reduced mobility ($P = .012$). Patients with a family history of VTE were 22.7 times more likely to develop phlebitis.[6]

The early identification of DIVA patients and the success of insertion in the first PIVC attempt require the adoption of assessment tools, which can improve clinical results.[18] There are few reports on the number of PIVCs before the phlebitis event. However, it is known that previous cannulation attempts in the same area were also risk factors for the development of phlebitis.[15] In the present study, due to the well-established DIVA protocol at the institution (where the professional does not need to perform cannulation attempts before activating the DIVA flow, and if the patient reports that he or she had to activate the DIVA flow in the previous hospitalization, ultrasound-guided cannulation is directed), the total number of cannulation attempts was minimized. However, PIVCs established in a single attempt were a protective factor for the development of phlebitis, and 2 attempts were associated with phlebitis. In China, patients who had a history of cannulations in the previous week were 1.3 times more likely to develop PIVC failure due to complications (phlebitis, infiltration, occlusion, among others).[16]

Regarding the most frequent diagnostic hypothesis in the study, COVID-19 was prevalent in both groups without a significant difference. A study conducted in Curitiba revealed a significant increase in phlebitis in 2021 and reported that this data may be due to the increase in the number of COVID-19 cases, which has, as a possible consequence, peripheral venous involvement, causing thrombotic events, or that it may be related to a decrease in the number of notifications amid the pandemic in 2020.[19]

The duration of the placement of the device, according to the INS, with exchange when clinically indicated, is based on the evaluation of the cannulation site or signs and symptoms of complications, and it should be removed if it is not indicated or is not used for more than 24 hours.[1] The results of a Brazilian study on the removal of PIVCs when clinically indicated, or routine removal, had no difference in the impact of phlebitis.[6] The results of the present study showed that the length of hospital stay and cannulation time were not associated with phlebitis. However, 1 study reported that the device time had a negative impact on the risk of phlebitis,[15] and PIVCs retained for >48 hours were a protective factor for failures in general.[16] Due to the multifactorial conditions that can lead to phlebitis, it is important that institutions create their institutional protocols according to the materials that are available for cannulation and fixation of the catheters since nonsterile dressings or dressings that do not allow the evaluation of the insertion would impair the clinical decision-making process.

In Brazilian studies, the open peripheral catheter system was the most related to phlebitis,[5,20] in contrast with the present study, where the closed peripheral catheter system with 2 ports with a removable needleless connector was related to a majority of the sample that developed phlebitis. In the present study, there was no significant difference between the devices and the development of phlebitis, regardless of the presence of a stabilization platform, corroborating previous findings in a Brazilian study.[6] The standardization of materials and the use of transparent dressings may have reinforced this finding, as the use of adhesive tape to stabilize the catheter reduced the evaluation of the PIVC.[15] The use of transparent dressings was a protective factor in 1 study,[14] since the identification of any alteration in the cannulation site is only possible when the dressing allows this assessment. On the other hand, a soiled dressing, observed during the hospitalization period, can provide an ideal opportunity for the growth of infection-producing microorganisms.[14] In accordance, 4.8% of the case sample had soiled or detached dressings recorded in their medical records 24 hours before the event.

In the current study, the 22-gauge device was the majority in both groups, as well as in another study.[5] Published data point out that the appropriate choice of gauge is a decisive factor for the successful establishment of the PIVC in the first cannulation attempt.[21] In the present study, there was no significant difference between the gauge and the development of phlebitis, unlike the study by Simin et al,[15] who reported that the 22-gauge catheter was 5.8 times more likely to develop phlebitis, the 20-gauge 11.3 times, and the 18-gauge 12.1 times.

INS recommends guiding the patient/caregiver about the planning and objective of intravenous therapy to promote safety and reduce complications.[1] Regarding phlebitis, the nursing team should instruct the patient, when conscious, to report pain and the patient/caregiver to perform self-monitoring of other symptoms.[1] In the current study, it was observed that the education of the patient was essential, being associated with the nondevelopment of phlebitis (Table 3). The orientation was verbal before the procedure, covering indications, risks, and benefits of the PIVC, and after its installation, the professional verified the presence of pain and advised on the sensation of the saline solution as a reference for future infusions. Thus, with this knowledge, the patient could distinguish signs and symptoms of pain, providing an additional tool for the nursing team and the patients.

Patients who report pain at the cannulation site are 8.3 times more likely to develop phlebitis,[6] which indicates the importance of involving the patient in the care of venous access. The evaluation of pain on a phlebitis scale translated and adapted to the Portuguese of Brazil already uses pain as an isolated sign to define grade 1 phlebitis,[22] given the importance of this sign. In Australia, the IV-WISE tool provides important discussion points for the health care professional and patient; this way, it is possible to involve the patient in care and prevent PIVC-related complications.[23] Accordingly, the professional must involve the patient and use different approaches other than verbal guidance, such as visual materials and even demonstrations, so that patients can identify pain to prevent the progression of this AE.

This discussion highlights the importance of guidance of the patient on the reporting of pain, in addition to the evaluation of the catheter by the nursing team and appreciation of the patient report, since pain is an alarm signal for the team, avoiding complications. Both the current study and another study that used the Visual Infusion Phlebitis Score, considering pain as grade 1 showed a prevalence of phlebitis with grades >1.[15] This demonstrates that there is still a failure to identify phlebitis in its early stages, which may be related to nursing competencies when assessing the PIVC or to the patient's lack of knowledge in reporting signs and symptoms related to complications.

Studies have assessed the association between phlebitis and drugs such as antibiotics and irritant solutions.[20,24] Sometimes, antibiotics in general have no impact on adverse events, as found in this study, where the use of antibiotics was not significant in predicting phlebitis. Still, in the literature, the use of specific solutions, such as the antibiotic amoxicillin and proton-pump inhibitors like omeprazole, may contribute to the development of phlebitis (increasing the chances by OR = 1.5 and 1.8, respectively).[6] A higher number of infusions was a predictor of phlebitis in a Serbian study[15]; a result was also observed in patients who received multiple infusions of antibiotics and analgesics.

IV therapy planning should take into account the risks and benefits of choosing the catheter, which is the best therapy, vascular characteristics, age, and comorbidities, among other factors. This is a process involving the participation of the patient, caregiver/family member, and health care professional.[1] The present study assessed variables that occur during hospitalization, and it is not possible to use them in the initial planning, such as the number of PIVCs and the presence of previous phlebitis. In addition, some variables may change after admission, such as VTE risks and reduced mobility, type of therapy, and the number of attempts to cannulate new PIVCs. It is important to analyze the risk factors that occur throughout the patient's journey, taking into account IV therapy planning at different times, such as patient admission, hospitalization, and discharge (Figure 2).

In this study, some PIVCs were found to be idle and unused in both groups. Another study found 36% of PIVCs without IV therapy with the possibility of being used for blood transfusions or fluid administration.[25] The most reported reason for the removal of the devices in the literature was the termination of IV therapy or unnecessary PIVCs.[14] A structured tool can help in the decision-making for catheter removal, especially by assessing the need for IV therapy in the last 24 hours and the prospect of the next 24 hours.[26] The need to maintain or remove a venous

device, whether peripheral or central, should be evaluated daily in health services by the nurse in order to reduce risks and maintain good practices.

LIMITATIONS AND RECOMMENDATIONS

This study has some limitations, such as the absence of a phlebitis scale translated and validated for Brazilian Portuguese during the data collection. Furthermore, this scale does not consider isolated pain as a sign and symptom of phlebitis. In addition, there is a lack of information in the medical records, such as the location of the PIVC, the frequency with which the medications were infused, the type of dilutions, the form of infusions (equipment type, pump use), professionals who cannulated the catheter (vascular access team, technician, or nurse), and absence of phlebitis classification (mechanical, infectious, chemical, postinfusion).

Considering that the data collection period was during the COVID-19 pandemic, underreporting may have occurred more significantly than usual. For the study design, data relating to assessment and classification of the degree of phlebitis and degree of damage were essential for the case group and only available in the notification form. Therefore, catheters that were removed before the end of therapy due to the presence of some complication (some isolated symptom such as pain), which could be phlebitis, infiltration, or extravasation that were not reported in the notification, were excluded from the control group.

The role of the pH of the administered medications was not discussed as an independent variable. Large groups of infused medications were mentioned, but there was no measured correlation between phlebitis and the medication itself or pH. This needs further investigation and should also be listed as a limitation.

Based on the results of this study, the authors suggest the implementation of standardized material/media for guidance on PIVC care for patients/caregivers and guidance to health care professionals regarding vascular health in the context of patients who require multiple cannulations. The authors also suggest the importance of future studies that consider such risk factors in flowcharts related to planning and the reassessment of the choice of catheters during hospitalization to take into account the number of device failures and the number of cannulations, as well as previous phlebitis, for new planning of IV therapy.

CONCLUSIONS

This study analyzed the variables associated with phlebitis AEs in medical-surgical hospitalization units and found the following risk factors for phlebitis: medical-type hospitalization profile, comorbidities, multiple cannulations, and receiving analgesics and IV contrast. These results reinforce the importance of IV therapy planning; the nursing team has an essential role in the care of patients with a peripheral intravenous catheter. However, the authors recommend, in addition to the initial planning, the evaluation of risk factors that are developed during hospitalization and must be considered to change the initial planning to preserve vascular health, reduce damage, and promote safe care. In addition, patient engagement and education during IV therapy are important, and this guidance can be given verbally or with materials such as folders or media, which meet the cultural needs and accessibility guidelines of the individual.

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