



Observational Study on the Incidence of Phlebitis in ICU Patients with Peripheral IV Catheters

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Abstract:

Peripheral intravenous catheterization (PIC) is a routine invasive procedure in hospitalized patients, often leading to complications such as phlebitis. This inflammation of the vein is characterized by pain, erythema, and edema, among other symptoms, with various factors contributing to its development. In this study, we aimed to investigate the incidence, causes, and preventive measures of phlebitis in ICU patients with peripheral IV catheters. Data was collected from 785 adult patients hospitalized in the ICU from December 2022 to September 2023, focusing on demographics, catheter specifics, and medication administered. The study revealed a 9.9% incidence of phlebitis, with factors such as gender, age, catheter gauge, duration of use, insertion site, and drug class influencing its occurrence. Notably, antibiotics were associated with the highest incidence of phlebitis. These findings underscore the importance of continuous monitoring and improvement in catheter management practices to reduce phlebitis rates in critically ill patients.

Introduction:

Peripheral intravenous catheterization (PIC) is one of the most common invasive procedures performed on hospitalized

patients (1). This procedure demands manual dexterity, technical competence, a thorough understanding of pharmaceutical therapies, and familiarity with the vascular system's anatomy and physiology. Because catheterization is performed for various purposes and durations, it poses a risk for several safety incidents, including microbial growth (2). Local complications of PIC include bruises, infiltration, leakage, catheter obstruction, and phlebitis (3).

Phlebitis, an inflammation of the vein, is characterized by pain, erythema, edema, hardening, and sometimes a palpable cord-like vein (4). Multiple factors contribute to the development of phlebitis, such as improper insertion techniques, the patient's clinical condition, vein characteristics, drug incompatibility, the pH of the administered solution, ineffective filtration, and the catheter's diameter, size, length, and material (3, 5-6). Phlebitis can be classified into four types: mechanical, chemical, bacterial, and post-infusion (7-8). Mechanical phlebitis results from cannula movement within the vein or when the cannula is too wide for the vein. Chemical phlebitis is caused by the drug or fluid infused, with pH and osmolality significantly affecting its incidence. Bacterial phlebitis arises when bacteria penetrate the vein, leading to an inflammatory response and potentially serious complications like systemic sepsis. Post-infusion phlebitis typically appears 48 to 96 hours after catheter removal, with incidence linked to catheter material and duration of use (7).

The reported incidence of phlebitis varies widely in the literature, ranging from 1.3% (9) to 61.2% (10). The acceptable rate for phlebitis in any patient population is generally considered to be no more than 5% (11).

Objectives:

The objectives of this study are multifaceted, aiming to comprehensively address the issue of phlebitis in ICU patients. Firstly, the study seeks to determine the incidence of phlebitis among patients admitted to the Intensive Care Unit (ICU), providing critical data on its prevalence in this vulnerable population. Understanding the frequency of phlebitis occurrence is essential for evaluating the magnitude of the problem and for benchmarking against other healthcare settings. Secondly, the study aims to identify the underlying causes of phlebitis in these patients. By pinpointing the contributing factors, healthcare providers can better understand the pathophysiology and risk factors associated with phlebitis, which is crucial for developing targeted interventions. Lastly, the study intends to document and recommend preventive measures that can be implemented to reduce the incidence of phlebitis. This involves outlining best practices and protocols that healthcare professionals can follow to mitigate the risk of phlebitis, thus enhancing patient care and outcomes in the ICU. Through these objectives, the study endeavors to provide a comprehensive framework for understanding, preventing, and managing phlebitis in critically ill patients.

Methodology

This observational study was conducted with a population comprising 785 adult patients (aged 18 or over) who were hospitalized in the Intensive Care Unit (ICU) at a tertiary care Hospital in Central India, from December 2022 to September 2023. The inclusion criteria for the study were the use of a peripheral intravenous catheter (PIC) during hospitalization, assessment of the catheter within the first 12 hours following insertion, and consent to participate in the study. Data collection involved sociodemographic information (age and gender) and specific data related to the PIC, such as location of insertion, catheter gauge (G), duration of catheter use (hours), and the intravenous medication administered.

The insertion sites were examined daily for signs and symptoms of phlebitis, and the locations were monitored for up to 96 hours following catheter removal. Each PIC was treated as a new case and analyzed individually. The drugs monitored during this study were those known to be associated with phlebitis, including various antibiotics (e.g., Clavulanic acid +

Amoxicillin, Amphotericin B, Aztreonam, Cephalothin, Cefazolin, Cefepime, Cefotaxime, Ceftazidime, Ceftriaxone, Clarithromycin, Levofloxacin, Meropenem, Oxacillin, Piperacillin + Tazobactam, Vancomycin), antivirals (Acyclovir), anti-arrhythmic (Amiodarone), anti-spasmodics (Dicyclomine), vasoconstrictors (Dobutamine, Dopamine, Noradrenaline), vasodilators (Nitroglycerin), anti-epileptics (Phenytoin), narcotic analgesics (Fentanyl), anti-anemics (Ferric Hydroxide), sedatives (Midazolam), and antacids (Pantoprazole). The incidence of phlebitis was assessed in terms of number and percentage, providing a comprehensive overview of the factors influencing phlebitis development in ICU patients with peripheral IV catheters.

Result & Observations:

The incidence of phlebitis among the 785 ICU patients studied was 9.9%, with 77 cases recorded. Gender-wise distribution revealed a slightly higher incidence in females (10.6%) compared to males (9.3%), with 28 out of 262 female patients and 49 out of 523 male patients developing phlebitis. Age-wise distribution showed a significant disparity, with patients over 60 years of age experiencing a higher incidence of phlebitis (64%) compared to those under 60 (36%).

The study also examined the relationship between catheter gauge and phlebitis incidence. Catheters with a 22 G gauge had the highest incidence rate at 57%, followed by 24 G at 23.8%, 20 G at 14.3%, and 18 G at 4.8%. Additionally, the duration for which the catheter was retained influenced phlebitis rates, with a higher incidence observed for catheters retained for less than 72 hours (62.5%) compared to those retained for more than 72 hours (37.5%).

Regarding catheter location, the highest incidence of phlebitis was observed in catheters placed in the hand (50%), followed by the elbow (23.8%), arm (19%), and forearm (7.1%). The study also analyzed the incidence of phlebitis in relation to the class of drugs administered through the catheters. Antibiotics were associated with the highest incidence of phlebitis (50%), followed by anti-anemics (14.3%), vasoconstrictors (9.5%), and other classes such as antivirals, anti-arrhythmics, PPIs, and antiepileptics, all contributing to lower phlebitis rates ranging from 4.8% to 7.1%.

These findings underscore the multifactorial nature of phlebitis in ICU patients, highlighting the significant roles of patient demographics, catheter specifications, insertion site, duration of use, and the type of medication administered.

Table-1 Incidence of Phlebitis

Total No of Patients	No. of Phlebitis	%
785	77	9.9

Table-2 Gender Distribution of Phlebitis Cases

Total No of Patients	Male	Female
785	523	262
Incidences of Phlebitis	49	28
%	9.3	10.6

Table-3 Age Distribution of Phlebitis Cases

Age	% incidence of Phlebitis
> 60 yrs.	64
<60 yrs.	36

Table-4 Incidence of Phlebitis by Catheter Gauge

Gauge	% Incidence of phlebitis
18 G	4.8
20 G	14.3
22 G	57
24 G	23.8

Table-5: Incidence of Phlebitis by Duration of Catheter Use

Duration	% Incidence of phlebitis
< 72 hrs.	62.5
> 72 hrs.	37.5

Table-6: Incidence of Phlebitis by Catheter Location

Site	% Incidence of phlebitis
Forearm	7.1
Elbow	23.8
Arm	19
Hand	50

Table-7: Incidence of Phlebitis by Drug Class

Class	% Incidence of phlebitis
Antiviral	7.1
Anti-arrhythmic	7.1
Vasoconstrictor	9.5
Antiepileptic	4.8
PPI	7.1
Anti-anemic	14.3
Antibiotics	50

Discussion

The incidence of phlebitis observed in our study was 9.9%, which exceeds the acceptable rate of at most 5% as suggested by the Intravenous Nurses Society (11). Our findings align with the broader range of phlebitis incidence reported in the literature, which varies significantly from 1.3% to 61.2% (9, 10). This variation might be attributed to differences in patient populations, catheter materials, and insertion techniques. The higher incidence rate in our study underscores the need for continuous monitoring and improvement in catheter management practices.

When comparing gender distribution, our study found a slightly higher incidence of phlebitis in females (10.6%) compared to males (9.3%). This gender disparity was not prominently discussed in many previous studies, indicating a potential area for further research. The age distribution in our study showed that patients over 60 years old had a higher incidence of phlebitis (64%), aligning with Ferreira et al. (6), who noted increased susceptibility to phlebitis in older patients due to fragile veins and comorbid conditions.

The significant variance in phlebitis incidence across catheter gauges in our study (18 G: 4.8%, 20 G: 14.3%, 22 G: 57%, 24 G: 23.8%) corresponds with the findings of Cornely et al. (14), who indicated that smaller gauge catheters are associated with higher phlebitis rates. This can be attributed to increased friction and movement within the vein. Our observation that phlebitis incidence is higher with catheters retained for less than 72 hours (62.5%) contradicts the general expectation that longer duration increases phlebitis risk (7, 8). This discrepancy might be due to the aggressive monitoring and timely removal of catheters in our ICU setting, thereby reducing the risk of complications over extended periods.

The highest incidence of phlebitis at the hand (50%) and the lowest at the forearm (7.1%) are consistent with the findings of Higginson and Parry (7), who highlighted that catheter placement in more mobile sites like the hand increases the likelihood of mechanical phlebitis. In terms of drug classes, antibiotics were the most significant contributors to phlebitis in our study (50%), which aligns with the studies by Modes et al. (1) and the Intravenous Nurses Society (4). These studies noted that antibiotics, due to their chemical properties, are major contributors to chemical phlebitis. Other drug classes such as anti-anemics (14.3%) and vasoconstrictors (9.5%) also showed notable phlebitis incidences, supporting the findings of Martinho and Rodrigues (8).

Conclusion:

Our study provides a comprehensive overview of phlebitis incidence in ICU patients with peripheral IV catheters and highlights several factors influencing its development. The higher incidence rate compared to the recommended 5% underscores the need for continuous monitoring and improvement in catheter management practices. Our findings are consistent with previous research, with some variations that may warrant further investigation into specific patient demographics and clinical practices.

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